Too much of nothing: measuring, understanding and explaining the overprovision of healthcare in the Tanzanian private sector

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Declaration

I, Jessica Julia Carne King, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Quality of care is an issue for health systems worldwide. Overprovision, or healthcare for which the harms outweigh the benefits, is an aspect of quality often overlooked in low- and middle-income countries. As well as harming individual patients, overprovision represents a waste of resources and opportunity cost as countries work towards universal health coverage. Additionally, overprovision of antibiotics and antimalarials contributes to the development of antimicrobial resistance. There is particular concern that in the private sector, which is growing in many low- and middle-income countries, financial incentives may encourage providers to induce demand.

I led the development of standardised patient cases of asthma, non-malarial febrile illness, tuberculosis and upper respiratory tract infection, that would allow overprovision to be studied. I used 909 standardised patient visits to measure overprovision in 227 private for-profit and not-for-profit health facilities in Tanzania. I classified overprovision into three domains of harm: economic, public health and clinical.

There was overprovision in 81.4% of visits, but no association between a facility being for-profit and overprovision (OR= 1.15, 95% CI: 0.66 – 2.03). In a randomised experiment, 86.0% of standardised patients who expressed knowledge that antibiotics were unnecessary received them, compared to 94.8% of those who did not (p=0.074). Providers who exerted more effort in the consultation, measured by history questions and physical exams, were more likely to provide correct care (RR=1.87, 95% CI: 1.47 – 2.38) and less likely to overprovide (RR=0.93, 95% CI: 0.88 – 0.98).

My results suggest there is widespread overprovision in the Tanzanian private sector. In contrast with pre-study hypotheses, overprovision was not less common in not-for-profit facilities, and patients signalling knowledge of appropriate antibiotic use had no more than a modest effect on receiving them. In light of these findings, I discuss future avenues for research, policy implications and the range of reforms that could curb overprovision.

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Lists of Tables and Figures

These lists do not include the tables and figures within the papers in Chapters 3, 5 and 6, which are presented in their published format, or those in the appendices.

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List of Abbreviations

APHFTA: Association of Private Health Facilities of Tanzania

CSSC: Christian Social Services Commission

DDH: Designated district hospital

DHS: Demographic and Health Survey

DRGs: Diagnostic related groups

FBO: Faith-based organisation

HICs: High-income countries

iCHF: Improved Community Health Fund

IHI: Ifakara Health Institute

LMICs: Low- and middle-income countries

LSHTM: London School of Hygiene and Tropical Medicine

MICS: Multiple Indicator Cluster Survey

MoH: Ministry of Health

NGO: Non-governmental organisation

NHIF: National Health Insurance Fund

NIMR: National Institute of Medical Research

NMFI: Non-malarial febrile illness

OECD: Organisation for Economic Co-operation and Development

OOP: Out-of-pocket payment

PHC: Primary Healthcare

QoC: Quality of care

SP: Standardised Patient

TB: Tuberculosis

UHC: Universal health coverage

URTI: Upper respiratory tract infection

WHO: World Health Organisation

1 Chapter 1: Introduction

1.1 Overprovision in the universal health coverage era

The aim of universal health coverage (UHC) is to ensure that the whole population can access the health services they need without financial hardship [1]. Measurement of progress towards UHC typically focuses on three dimensions of coverage: the services available, the proportion of the population included and the extent of financial protection (that is, reduction of cost-sharing and user fees) [2]. The focus on these dimensions has further been reinforced by the selection of two indicators for UHC as part of the Sustainable Development Goals: the average coverage of essential health services among the population, and the proportion of households with catastrophic spending on health [1].

The UHC framework has not historically included measurement of quality of care (QoC), but there is increasing recognition that, as coverage and financial protection are expanded as part of the UHC agenda, care must be of a high enough quality that patients and populations reap the benefits of improved access [3-5]. QoC is a major global health concern, and there is extensive evidence of poor QoC in low- and middle-income countries (LMICs), with outpatients receiving less than half of recommended clinical actions [5, 6] and frequent incorrect diagnoses for serious conditions [7, 8]. Two studies have attempted to quantify the mortality attributable to poor quality of care in LMICs. Their estimates found that poor quality of care was responsible for 5 million deaths per year [9], and between 5.7 and 8.4 million deaths per year [10].

UHC cannot be achieved without addressing inefficiency, so that governments can free up scarce resources which are needed for investment in the health system [11]. Inefficiency can be framed as having large opportunity costs for publicly funded and insurance-based health systems, reducing the capacity to provide effective care [12]. Inefficiency is a concern worldwide [13] but in LMICs with tight fiscal constraints, improving efficiency is especially important [14]. This is particularly the case now that national budgets are strained by the economic shock of Covid-19 pandemic [15]. Tackling waste is a key part of improving efficiency, with an estimated 20-40% of spending on health being wasted [2]. The OECD proposes a framework categorising wasteful healthcare expenditure as either governance-related waste (administration waste, and fraud, abuse and corruption), operational waste (overpaying, or paying for inputs which go unused), or wasteful clinical care [16]. Overprovision can be described as a form of wasteful clinical care, and sources of waste within clinical care include inappropriate use of medicines, overuse of investigations or procedures, and unnecessary admissions to hospital [2].

Overprovision has often been highlighted as a problem for high-income countries (HICs): much of the existing literature focuses on the USA, which has the highest per person expenditure on health in the world [17]. In LMICs, narratives around health systems failures have focussed on underuse caused by constrained budgets [18], rather than overprovision. However, as I argue above, overprovision can cause significant harm to LMIC health systems through waste and poor quality. It is important to recognise that LMIC health systems are not immune to the problems which drive overprovision in HICs; there is increasing private sector provision and financing in LMICs, payment structures may create perverse incentives, and insufficient clinical training can cause diagnostic and treatment errors.

1.2 Defining overprovision

Overuse has been defined in one report as the provision of medical services for which the potential for harm exceeds the potential for benefit [19]. It can include unnecessary diagnostic procedures, surgical interventions, drug therapy and hospital admissions [20]. The two high profile commissions cited have used the term overuse, rather than the term overprovision. However, I will use the term 'overprovision' throughout the rest of this thesis because overprovision can be initiated and driven by all aspects of health systems, including funders, facilities and providers, whereas the term overuse arguably implies that patient behaviour is the key driver. Other related terms which are used in the literature are overdiagnosis, the diagnosis of a condition that would not cause a patient symptoms or harm in their lifetime, and overtreatment, the unnecessary treatment of such a condition [21].

Overprovision can co-exist with underprovision, that is, providers may fail to provide the correct treatment at the same time as providing unnecessary care [22]. Overprovision can be said to have occurred whether or not the patient also received correct care. For example, a patient with a fever caused by malaria, experiences overprovision whether prescribed *only* an unnecessary antibiotic, or an unnecessary antibiotic alongside an antimalarial. In the former case, there is both underprovision of an antimalarial and overprovision of an antibiotic, but in the latter case just overprovision of the antibiotic. Overprovision is conceptualised in more detail in the paper given in Chapter 5 of this thesis.

1.2.1 Quality of care and overprovision

Quality of care is a multi-dimensional concept. Donabedian [23] described quality of care as an object of three dimensions: structure, process and outcomes. Structure refers to the resources required, but not sufficient, to deliver good QoC [24]. Process QoC, also known as clinical QoC [25],

is used to describe the actions taken to produce health [26]. Outcomes are the ultimate aim of care, but can be argued to be an unreliable measure of QoC due to the innate randomness of patients' response to treatment [27]. The focus of this thesis is on clinical QoC, which is the key point where provider behaviour influences the management and eventual outcomes for patients. Clinical QoC is extremely difficult to measure well [25], in part due to the complex nature of QoC itself, the huge diversity of conditions of patients who present at health facilities, and the lack of universal indicators of QoC [28].

More recently, the Institute of Medicine, which has produced a number of influential reports on QoC in the American health system, defined QoC as the extent to which healthcare services increased the likelihood of desired outcomes [29]. It further described high quality healthcare as having six key characteristics: safety, effectiveness, patient-centeredness, timeliness, efficiency, and equitability [30]. Kruk and colleagues, taking a systems approach to QoC, have described a high quality health system as one that delivers care which improves or maintains health outcomes, is valued and trusted, and can adapt to different population needs [5]. They further argue that clinical QoC encompasses competence (evidence-based, effective care within capable systems) and a positive user experience (respectful, user-focussed care).

Overprovision can be framed as a quality of care issue, as well as one of efficiency: giving patients the right care involves a combination of both ensuring that effective interventions are used, and avoiding overprovision [31]. Using the Institute of Medicine definition, overprovision is clearly a threat to QoC, because unnecessary care does not increase the likelihood of desired outcomes, and in some cases may decrease it. Overprovision makes care less safe, effective and efficient. Overprovision can be viewed as poor QoC using the definition of Kruk and colleagues too, as it also contravenes their requirement of effectiveness and being evidence based. As Brownlee and Korenstein argue, any treatment which offers little or no chance of benefit can be harmful [32].

Overprovision can be conceptualised as a continuum, with universally beneficial interventions at one end of a spectrum and entirely ineffective interventions at the other end [20]. Categorising tests, treatments and other healthcare interventions as either effective or unnecessary is not straightforward, and will vary with the patient and circumstances; much medical care can be said to fall into a grey zone where it may be beneficial for some but not all patients, may have risk of significant harms, and may have weak evidence for both harms and benefits [33, 34]. Uncertainty is an added complication when considering whether an intervention is overprovision: a provider may believe that even very unlikely consequences of non-treatment are serious enough to

outweigh the potential drawbacks of treatment [35]. To that provider, the treatment's benefits are greater than its risks, even if another provider or researcher would classify it as overprovision.

This conceptualisation takes a clinical perspective, and assumes a provider simply tells a patient what tests and treatments they should have. The picture is further complicated when accounting for patient preferences, or an alternative model where a provider gives information to the patient, but the patient makes the ultimate decision on which interventions to undergo. Most medical care is again likely to fall somewhere on a spectrum between these two extremes, with the strength of advice varying with context, condition, patient and provider. There may be some overprovision which could be argued to be entirely patient-initiated, such as a caesarean section at maternal request without medical indication. It is important to note, however, that trying to identify which actor in a patient-provider interaction is responsible for overprovision is not necessarily straightforward, informative or particularly useful. In the above example of requesting a caesarean section without an indication, the request may be made in the context of a health system or culture which overemphasises the risks of vaginal delivery and underemphasises the risks of caesarean sections, even if the individual provider explained them accurately to the patient.

1.3 Different perspectives on overprovision

1.3.1 The medical model

The provision of healthcare has been described as following a standard medical model, based on an interaction between the patient and the provider [36, 37]. A patient reports symptoms of illness to the provider who will, on the basis of these symptoms, construct a differential of possible diagnoses. The provider elicits further information by taking additional history from the patient, and carrying out physical exams and diagnostic tests. The provider uses this information to identify the likeliest diagnosis, and then proposes a course of treatment.

There are a number of points in the process where overprovision can arise. The first is within the diagnostic process itself: the provider may carry out diagnostic tests which provide information that would not change their diagnosis or proposed management of the patient, and so confer minimal or no benefit to that patient. Any risks or costs of the tests outweigh the benefits, and so such tests can be described as overprovision. The second opportunity for overprovision is through making an incorrect diagnosis. This can be due to failing to consider the correct differential diagnoses, or not taking sufficient history, or not carrying out appropriate physical exams and diagnostic tests, or through misinterpretation of information gained from the diagnostic process. Thus, an incorrect diagnosis can easily lead to overprovision because the proposed treatment is unlikely to benefit the

patient. Finally, the provider may come to the correct diagnosis, but still propose treatment which has minimal benefits, or a higher risk of harm than necessary.

1.3.2 Economic theories of healthcare provision

The framework of principal-agent relationships can be used to examine sources of overprovision. It is widely accepted that the provider acts as agent for patient (the principal) in the provision of healthcare, and that there is substantial information asymmetry between the agent and the principal [38]. As such, healthcare has been characterised as a credence good [39], that is, the provider of the service has more knowledge than the consumer, and so the consumer (or patient) is reliant on the provider to tell them which goods and services they should purchase, giving the provider the opportunity to make recommendations which the consumer or patient would not take if they had full information [40]. This has been theorised as a source of both underprovision and overprovision of healthcare: underprovision if a provider does not deliver an intervention due to lack of time, or not having the resources available, and overprovision if a provider uses the opportunity to sell an unnecessary treatment or a more profitable treatment than necessary [39]. The exploitation of credence goods to sell unnecessary care can also be described as supplier-induced demand: the provider generates more patient demand than would have been the case had the patient had the same information as the provider. Supplier-induced demand requires both information asymmetry and financial incentives: the marginal revenue the provider receives for selling the unnecessary care must exceed the marginal cost of providing it.

Supplier-induced demand is difficult to demonstrate empirically, but there are some notable examples of evidence from healthcare markets in HICs, particularly where overprovision is observed to increase as a response to falling incomes [41]. A field experiment among Swiss dentists found that 28% of patients were offered overtreatment, and dentists with lower utilisation were more likely to offer unnecessary care, suggesting deliberate inducement [42]. Studies in the US have found that caesarean section rates increased with declining fertility [43], and the volume of procedures performed by thoracic surgeons increased when Medicare reimbursement values were lowered [44].

Providers may also be considered agents for third-party funders and regulators, including the Ministry of Health, social health insurance networks and private insurance companies [38, 45]. Fee-for-service or volume-based reimbursements from such funders (as opposed to capitation or fixed salaries) may create the opportunity to provide more care than the funder would consider effective or good value if they had full information.

Behavioural economics and psychology also provide insight into how overprovision may be introduced into the medical decision-making process. Heuristics, or mental shortcuts, are often used in decision-making, and these strategies can lead to systematic errors in judgement, known as cognitive biases [46, 47]. There is evidence of cognitive biases in medical decision-making, though this mostly comes from HICs [48]. Cognitive biases may lead to overprovision through the diagnostic process, for example with confirmation bias resulting in an incorrect diagnosis [49, 50], or at the treatment stage, where commission bias may lead a provider to recommend a treatment when it would be more beneficial to do nothing [51].

1.4 Measuring overprovision

Measuring overprovision is challenging in all settings. To measure overprovision in a given clinical scenario, appropriate care must first be defined. However, as discussed above, much medical care falls into a 'grey zone' where it is hard to categorise as absolutely necessary or unnecessary [34]. This means that direct measurement of overprovision is both theoretically and practically difficult: to define whether a prescription of a drug to a given patient is necessary, a researcher must first describe all the scenarios in which a prescription would be warranted (or not), then collect enough data about the patient and their health to come to a conclusion. In practice, this is challenging. Medical records, the most obvious source of information about the patient, their diagnosis and their case management, are dependent on the skills and actions of the provider, and do not always reveal the true condition of the patient [52]. Moreover, availability of records in LMICs can be poor, and the details within them too limited to make a proper assessment of appropriateness of care even when records are available [53]. Therefore, much of the evidence for overprovision comes from indirect measurement, and little research has been undertaken in LMICs; a systematic review on the irrational use of medicines in China and Vietnam found no eligible studies which directly measured unnecessary drug prescriptions [54]. The different methods and approaches which have been used for direct measurement of overprovision in LMICs, as well as their advantages and disadvantages, will be discussed in greater detail in the literature review in Chapter 2.

Studies measuring overprovision in LMICs have typically relied on indirect comparisons of prescription rates or use of healthcare (for example, caesarean sections) across groups or against an established benchmark. This allows the identification of facilities, sectors, regions or patient groups with relatively high rates of specific treatments. For example, a Brazilian study found that 81% of private sector patients underwent a caesarean section, compared to 36% of public sector patients [55]. However, this indirect approach does not allow us to say whether the difference is due to overprovision in the private sector or underprovision in the public sector. Furthermore, even

comparison to a threshold of 19% of deliveries by caesarean section (above which there is no evidence of increasing rates being associated with decreasing mortality) [56] does not allow us to say which caesarean sections were unnecessary, and further complicates the picture by suggesting there is overprovision in both sectors.

1.5 Overprovision of antibiotics in LMICs

Overprovision of antibiotics is a key focus of this thesis, as overuse and inappropriate use of antibiotics are among the drivers of the spread of antimicrobial resistance [57, 58]. As such, it is a major global health concern, and overprovision of antibiotics is one of the best-documented examples of medication overprovision [20]. Modelling has predicted that antimicrobial resistance will be responsible for 10 million deaths annually by 2050 [59], as well as an annual shortfall in global economic output of $6 trillion (USD) [60]. Antibiotics may be particularly susceptible to overprovision, because there is a low risk of them causing harm to individual patients, patients are unlikely to know if they are necessary or not, there are a huge number of cheap generics available, and most can act on a wide range of bacterial infections, so there may be a reasonable possibility of them successfully treating an unidentified condition [61].

Increases in antibiotic consumption in recent years have been especially rapid in LMICs. A modelling study of global per capita antibiotic consumption rates estimates that antibiotic use increased by 76% in LMICs between 2000 and 2018, while remaining stable in HICs [62]. Analysis of global antibiotic sales estimated there was an increase in per capita consumption in LMICS of 77% between 2000 and 2015, compared to a decrease of 4% in HICs [63]. The same study found that overall consumption increased by 114% in LMICs and 6% in HICs when not adjusted for differential population growth. While these studies cannot quantify the proportion of antibiotics that are a result of overprovision, it is widely regarded as a global problem [64], and there is some evidence that it may be more common in LMICs than HICs [65]. A systematic review found that 50% of patients attending primary care for any reason in LMICs were prescribed an antibiotic [66]. Only nine studies identified within the review attempted to quantify the proportion of antibiotic prescriptions which could be classified as overprovision, and a pooled estimate was not calculated, but the proportions ranged from 8% to 100% of antibiotic prescriptions being inappropriate.

1.6 Private healthcare in LMICs

1.6.1 Extent and scope of private health care provision in LMICS

The private sector is a necessarily broad term, and the private health care sector in LMICs encompasses a huge range of size and type of providers: informal drug-sellers, 'one man show' clinicians who practice independently, accredited drugstores and pharmacies, not-for-profit health facilities with a charitable or religious ethos, and internationally accredited hospital chains [67].

Crude attempts to measure the size of the private healthcare sector generally rely on estimates of the proportion of health expenditure that is private, or the share of utilisation, providers or facilities in the private sector. Analysis of the latest WHO global health expenditure data suggests close to half of spending on healthcare across LMICs came from private sources: in low income countries, it made up 49% of primary healthcare (PHC) spending and 54% of non-PHC spending, 49% of both PHC and non-PHC spending in lower-middle income countries, and 46% of PHC spending and 39% of non-PHC spending in upper-middle income countries [68]. However, since this private expenditure can include out-of-pocket expenditure in government facilities, and does not include contributions to social health insurance schemes which may fund private facilities, it is not directly analogous to spending at private health providers.

Analysis of Demographic and Health Surveys (DHS) and Multiple Indicator Cluster Surveys (MICS) conducted between 2014 and 2019 in 65 LMICs estimated that the private sector provided up to 68% and 66% of care for sick children in the Eastern Mediterranean and South-East Asian regions respectively, but as little as 7% in European LMICs. For childbirth care, 53% was privately provided in the Eastern Mediterranean region, but just 1% in European LMICs [69]. Earlier analysis of DHS surveys from 1990 to 2013 averaged across 70 LMICs found that the private sector provided 63-67% of care for sick children, and 38% of childbirth care [70].

Such measurements of the private sector include use of retailers such as pharmacies, and faith-based organisations. Faith based organisations play a small but important role in health delivery in some countries, particularly in sub-Saharan Africa, where they provide 7% of childbirth care but they have been estimated to provide just 0.5% of outpatient care across 47 LMICs [71].

There is increasing recognition of the necessity of engaging private sector providers, whether for-profit or NGOs, in order to achieve the expansion in access to healthcare that is needed to make progress towards UHC [72]. In recent years, this has included the expansion of public funding of private health provision, either through social insurance or contracting [73]. However the role of

the private sector in global health delivery is controversial from a number of perspectives, including that of quality [74].

1.6.2 Concerns around quality

While statutory regulation of private health providers in LMICs is common, implementation and enforcement of such regulations in order to ensure good QoC is very often weak [75, 76]. It is difficult to make direct comparisons of QoC between the public and private sectors, as they tend to differ in the demographics of patients served and their health conditions, the qualifications of providers and the level of resources available [77]. Reviews which have attempted to compare the sectors have generally highlighted the low quality of evidence available, but have reached a variety of conclusions: that privately-provided care is either equivalent to or better than public healthcare in quality [78], that there is generally poor QoC in both sectors but there is better drug availability, responsiveness, and effort in the private sector [79], or that QoC may be better in the private sector from a patient experience perspective (comfort of facilities, waiting times), but worse from a technical perspective (compliance with guidelines, diagnostic accuracy and provider knowledge) [80, 81].

While increasing the involvement of the private sector in healthcare provision in LMICS has often been proposed as a solution for improving efficiency of delivery [82], there are a number of reasons to believe that private sector provision may be less efficient and result in more overprovision than publicly delivered care. Public sector health systems typically pay providers with fixed salaries, and procurement of drugs and equipment is centralised, so there are weak incentives for overprovision. By contrast, private sector providers are more likely to be paid through fee-for-service or volume-based payments from public or private insurers, as well as out-of-pocket payments from patients [83]. Private providers may own the facility in which they operate, or the attached ancillary services such as laboratories or pharmacies, and may have relationships with pharmaceutical companies. All of these combine to create stronger incentives for overprovision in the private sector [40] . Empirical evidence from LMICs also points towards lower efficiency and greater overprovision in the private than public sector, with two reviews highlighting high drugs costs and unnecessary testing and treatment in private facilities as drivers of inefficiency when compared to the public sector [80, 81].

1.7 Aims and Objectives

The aim of this PhD is to develop methods to conceptualise and measure overprovision, and to apply these in the Tanzanian private sector to understand the extent and drivers of overprovision.

This can be broken down into specific objectives:

1. To develop and implement standardised patient cases to measure quality of care in Tanzanian private health facilities
2. To develop a framework for understanding the potential harms of overprovision
3. To measure the prevalence of types of overprovision in the Tanzanian private sector, and compare prevalence by facility characteristics
4. To assess whether patients expressing their knowledge of unnecessary practices reduces their likelihood of receiving overprovision
5. To examine the relationship between provider effort and different components of care, including correct treatment and unnecessary care.

1.8 Thesis outline

This thesis has eight chapters, and is a research paper style thesis structured around four academic papers. Chapter 1 (this chapter) is an introduction to the concept of overprovision and the motivation for the PhD. Chapter 2 is a scoping review of the literature on empirical measurement of overprovision. Chapter 3 includes the first academic paper, a review of standardised patient methodology. Chapter 4 gives the study methods, expanding on the details of standardised patient data collection for the data used in the thesis, and explaining the study setting.

Chapters 5-7 comprise the main results of this PhD, each chapter being based on an empirical paper. Chapter 5 introduces a framework for measuring and conceptualising the harms of overprovision, and applies the framework to outpatient care in the Tanzanian private sector. Chapter 6 details an experiment examining the effect of patient knowledge on whether providers prescribe unnecessary antibiotics. Chapter 7 examines the extent to which, and mechanisms through which, provider effort protects against overprovision. Chapter 8, the discussion, looks at the results presented in this thesis as a whole and examines their implications for further research and policy development.

1.9 Role of the candidate

The research for this PhD was embedded within a wider project, the evaluation of SafeCare in Tanzania, on which I was employed as a research fellow from November 2016 to June 2020. The aim of the project was to evaluate the effect of the SafeCare quality improvement model (developed by international NGO PharmAccess) on improving QoC in Tanzania. More detail on SafeCare and the evaluation are presented in the Study Setting section of chapter 4 on Methods.

The main results of the project are not part of this PhD and are published elsewhere [84], along with other research and policy-orientated outputs from the project [85-89]. Within the project, I led on developing, piloting and finalising data collection tools, and wrote fieldwork protocols and analysis plans. I led the training of fieldworkers in Tanzania, and coordinated data collection, making nine visits and spending six months in the country. I conducted all data cleaning and data analysis, and I led the writing of many of the project outputs, including the main results paper.

The PhD uses data collected as part of the project. For each study presented in the research papers within this thesis, I developed the research questions myself, with input from my supervisors. I was responsible for generating, interpreting and writing up results and submitting all papers for publication as the first author.

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1.11 References for Chapter 1

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2 Chapter 2: Literature review

2.1 Scope of review

In this chapter I present a scoping review on the empirical measurement of overprovision in low- and middle-income countries (LMICs). This review does not include a conceptualisation of the harms of overprovision, which are discussed in detail in the results paper in Chapter 5, or a review of standardised patient (SP) methodology, which is covered systematically by the paper in Chapter 3.

The aims of this review are a) to understand the state of the art of measurement of overprovision in LMICs, and b) to summarise the evidence on the prevalence of overprovision and factors associated with it.

The specific questions I will answer within each aim are:

a) Understanding the state of the art of measurement of overprovision in LMICs:
    1) In what settings has overprovision been measured in LMICs?
    2) What types of overprovision have been measured in LMICs?
    3) What medical conditions or types of patients are associated with the overprovision measured?
    4) What methods are used for measuring overprovision?
b) Summarising the evidence on the prevalence of overprovision and factors associated with it:
    5) What is the prevalence of overprovision?
    6) What factors are associated with overprovision?
    7) What evidence exists on the effectiveness of interventions to reduce overprovision?

2.2 Review methods

2.2.1 Search strategy

The purpose of the search was to identify papers which described the empirical and direct measurement in LMICs of any type of overprovision or unnecessary care, or factors associated with overprovision (including effect of interventions on overprovision). Overprovision was taken to include any care defined as unnecessary, without indication, not clinically justified or harmful, as all of these terms imply that the risks of the care outweighed the benefits. For the purpose of this review, direct measurement of overprovision is defined as an approach where the medicine, procedure or other intervention can be classified as necessary or unnecessary for the individual

patient. Indirect measurement uses aggregates which can point towards overprovision, but which do not measure its actual prevalence. An example of an indirect measure is the WHO/INRUD indicator "% of encounters with an antibiotic prescribed" [1]. While a higher proportion of encounters with an antibiotic prescribed suggests a high prevalence of antibiotic overprovision, it does not tell us the prevalence of overprovision of antibiotics: there is some unknown proportion of those prescriptions which are necessary and therefore not overprovision.

I searched Econlit (1886-29 July 2021), Global Health (1910- Week 31 2021), Embase (1974- 6 August 2021) and Medline (1946- 6 August 2021) databases for literature published in the English language. The search combined three filters: one for ideas related to overprovision, including terms such as unnecessary and irrational, a second for ideas related to healthcare, including terms such as drug and "medical care" and a final filter for LMICs. Full details of search terms are provided in Appendix 1.

Papers were excluded if:

- The study was not in the English language
- The study was based in a high-income country (as defined by World Bank)
- The study measured provider knowledge, attitude or reported practice related to overprovision, rather than actual practice
- Providers were pharmacists or retailers
- Overprovision/unnecessary care was initiated or requested by the patient, not recommended or prescribed by the provider (for example an unnecessary attendance at A&E)
- The study used a proxy for overprovision without identifying directly whether care was unnecessary, for example polypharmacy (the use of multiple medicines [2])
- The study used measure of overprovision which included care which was irrational but not unnecessary, for example prescription of the wrong type, duration or dosage of antibiotic in a patient who required antibiotics

2.2.2 Synthesis

2.2.2.1 Setting, patient and overprovision type

Study setting is summarised with respect to the following factors:

- Country (including World Bank Income classification and WHO region)

- Whether data was collected in a single or multiple facilities and, if multiple facilities, whether drawn from a representative sample of a city, region or country
- Level of healthcare facility (hospital, primary healthcare, both or other) and healthcare sector (public, private, or both)

Types of overprovision were classified into six broad categories: antibiotics, specific non-antibiotic drugs, any/various drugs, other therapeutic interventions, diagnostics, and mixed/various overprovision. The conditions of patients included in studies were classified into seven categories: respiratory tract infections, other infectious diseases, non-communicable conditions, surgery and labour, any/various outpatients, any/various inpatients and various/all.

2.2.2.2 Methods for measurement of overprovision

The method that was used to identify whether overprovision occurred was classified into one of seven approaches. An overview of each approach, as well as its strengths and weaknesses, is given in Table 2.1.

Table 2.1: Strengths and weakness of methods for measuring overprovision

Method	How is overprovision determined?	Strengths	Weaknesses
Medical record extraction	Researcher compares the drugs and procedures that the patient received with the diagnosis and/or history and symptoms recorded to determine whether care was necessary	-Not especially resource-intensive so can be done on large scale in multiple facilities	-Relies on diagnosis and/or history-taking of original provider, which may be a mechanism through which overprovision occurs, leading to underestimate of prevalence - Potential for poor data accuracy and incomplete medicals records
Reassessment of patient	As per medical record extraction, but patient is reassessed to determine whether care was necessary	-Not reliant on the provider's own diagnostic or history taking ability	-Much more resource-intensive, as a qualified clinician must reassess each patient to make a judgement -Variation in case and patient mix across facilities makes comparison difficult
Standardised patients (SPs)	A healthy fieldworker attends a facility acting as a real patient, and portrays a set of symptoms and history that has been designed by the researcher. The SP records the care received.	-The researcher has determined the precise symptoms and history of the patients, so is confident of the correct diagnosis and what care is defined as overprovision	-Very resource intensive -Limited range of types of cases for which SPs can be used -SP cases are portrayed by healthy fieldworkers, and so tend to portray conditions which are less serious and do not require much intervention. This means that most care will, by definition, be

		-The case and patient mix can be controlled, so fair comparisons can be made across facilities	overprovision, biasing estimates of prevalence upwards
Patient exit interviews	Patients are asked about the symptoms and history they presented with, and the care they received	-Not reliant on the provider's own diagnostic or history taking ability -Easier to do at scale than some more resource intensive approaches	-Difficult to determine a diagnosis from an exit interview, likely to be limited to certain conditions -Reliant on patient recall of care received -Variation in case and patient mix across facilities makes comparison difficult
Household survey	As per patient exit interviews, but interviews conducted as part of household surveys	-Not reliant on the provider's own diagnostic or history taking ability - Can include a representative sample of the population rather than those at particular health facilities	-Difficult to determine a diagnosis from a survey, likely to be limited to certain conditions -Reliant on patient recall of care received, particularly difficult if last care-seeking occasion was some time ago
Direct observation	Researcher observes the provider, recording patients' symptoms and history, as well as the care given	- Not reliant on patient recall of care or quality of record taking	-The provider may change their behaviour as a result of being observed (Hawthorne effect) -Still somewhat reliant on the provider's own diagnostic or history taking ability, as if the provider does not ask a question or carry out an exam, the researcher cannot know the result of it -Quite resource-intensive, particularly if observer is qualified clinician

2.2.2.3 Prevalence of overprovision measures

There are three main ways in which the denominator can be defined when attempting to measure the prevalence of overprovision.

The first is to define the denominator as all patients who received the treatment or procedure of interest, and to define the proportion of those for whom the treatment was unnecessary as the prevalence of overprovision. In Table 2.2 the denominator is shown as A+B. I will refer to this as the *treatment prevalence* of overprovision. An example of this would be to calculate out of all patients given an antimalarial, in what proportion was it unnecessary.

Table 2.2 Different measures of overprovision

	Did not need care	Needed care	
Given care	A (numerator)	B	A/ (A+B) = *treatment* prevalence of overprovision
Not given care	C	D	
	A/(A+C) = *healthy* prevalence of overprovision		A/ (A+B+C+D) = *population* prevalence of overprovision

The second is to define the denominator as all patients for whom the specified type of care is unnecessary, and to define the proportion of those who received that unnecessary care as the prevalence of overprovision. In this case, the denominator is A+C. An example of this would be to identify all patients who had a negative malaria test, and calculate the proportion who have been prescribed antimalarials. I will refer to this as the *healthy prevalence* of overprovision.

The third is to define the denominator as all patients with the disease, health state or set of symptoms of interest, and to define the proportion of those who received the unnecessary care of interest (or any unnecessary care) as the prevalence of overprovision. In Table 2.2 the denominator is A+B+C+D. I will refer to this measure of overprovision as the *population prevalence* of overprovision. An example of this would be to assess the records of all patients on a ward, and calculate the proportion who have been prescribed unnecessary antimalarials. This measure of overprovision is less instinctive than the first two, and may be more suited to studies with both a widely defined population and a widely defined type of overprovision, for example, any unnecessary drugs prescribed to all inpatients in a hospital. Because of the wide definitions, the researcher cannot clearly define a group of patients who do or do not need drugs, or who were or were not given them, and so the first two prevalence measures cannot be used.

2.2.2.4 Factors associated with overprovision

I categorised factors into four levels: system, facility, provider and patient. Within each level I discuss factors with reference to the framework below (Figure 2.1) developed from Saini and colleagues' framework on the drivers of poor medical care [3]. The framework groups potential drivers of overprovision into three domains: (1) Money, finance, and organisation (2) Knowledge, beliefs, assumptions, bias, and uncertainty and (3) Power and human relationships.

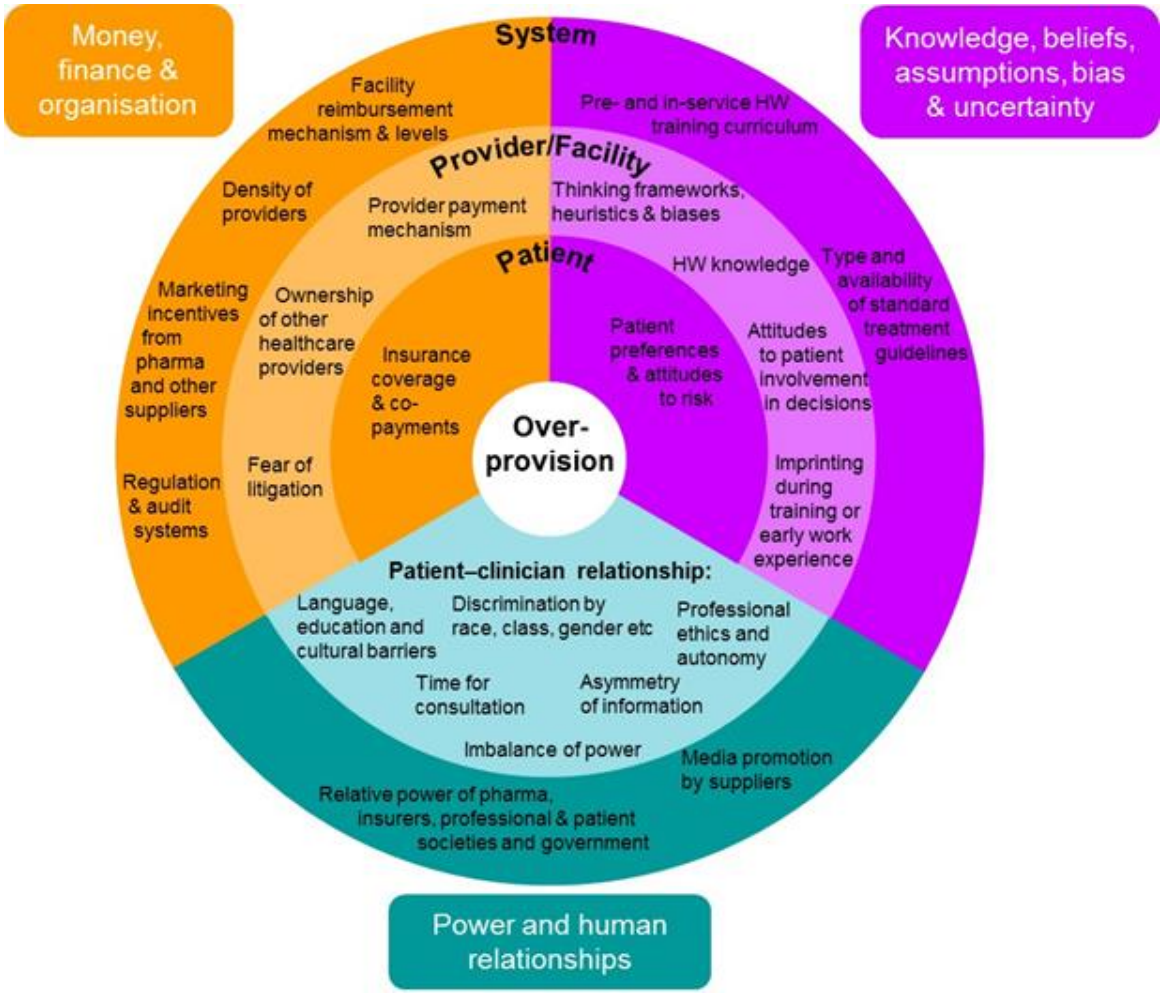

Figure 2.1: Potential drivers of overprovision

2.2.2.5 Interventions on overprovision

Interventions are discussed with reference to the domain (**Figure 2.1**) that they are designed to act upon.

2.3 Results

2.3.1 Literature search results

An initial search identified 1658 papers, which was reduced to 1127 for the abstract review after removal of duplicates. An additional 81 papers were included for abstract review from the bibliographies of three reviews [4-6]. After abstract review, there were 193 retained for full text review. 73 papers fulfilled all criteria and were extracted and included in the final review. A further three papers published in 2022 were identified in the course of the review, to give a total of 76 included studies. The data extraction table with details of all papers is given in Appendix 1.

2.3.2 Geographical and historical distribution of studies

The vast majority of studies (71/76) identified were published since 2010. Four were published in 2005-2009, and one study was published in 1975. Only 12 studies were identified in low-income countries (**Table 2.3**). Half of studies (38) were in lower-middle income countries, driven by the large number in India (12) and Iran (14). Eight of the 14 Iranian studies were identified through a systematic scoping review of medical overprovision in Iran [4]. There were also ten studies in China.

Table 2.3: Studies by country, World Bank income group and WHO region

		World Bank Income Group			
		Low Income	*Lower-middle income*	*Upper-middle income*	*TOTAL*
WHO region	*Africa*	Burkina Faso (3) Burundi (1) Ethiopia (4) Uganda (3)	Ghana (2) Kenya (3) Tanzania (1) Zambia (1)	South Africa (5)	23
	Eastern Mediterranean	Afghanistan (1)	Iran (14)	Jordan (2)	17
	Europe			Bulgaria & Russia (1) Russia (1) Turkey (1)	3
	South-East Asia		Bangladesh (1) India (12) Indonesia (1)	Thailand (1)	15
	The Americas			Brazil (1) Ecuador (1) Mexico (1)	3
	Western Pacific		Vietnam (3)	China (10) Malaysia (1)	15
	TOTAL	12	38	26	

2.3.3 Settings for measuring overprovision

2.3.3.1 Sampling approach and representativeness

29 studies measured overprovision in a single facility, and 47 measured overprovision in multiple facilities. Of those studies including multiple facilities, only 20 reported that facilities were selected randomly from a sampling frame or included all facilities meeting study inclusion criteria. Of these, 16 drew their facilities from a single city or region, while only four were nationally representative: two studies included all 22 public hospitals in Burkina Faso [7, 8], one included a random sample of 545 primary health facilities in Malaysia [9], and one a random sample of 200 private clinics in Kenya [10].

2.3.3.2 *Level and sector of facilities*

49 studies measured overprovision in a single or multiple hospitals, while 21 measured overprovision in a single or multiple primary health facilities (Table 2.4). Four studies included both primary and secondary health facilities. Two measured overprovision at providers of ancillary services: nine blood banks in India [11], and a single academic lab in South Africa [12].

The sector of the facility or facilities could be determined in 60 of the 76 studies. 33 were set solely in the public sector, 13 studies were conducted in a private facility or facilities, and 14 included both public and private sector facilities.

Table 2.4: Studies by sector and level of facilities included

		Sector of facilities				
		Public	Private	Both	Not specified	TOTAL
Level of facilities	Hospitals	25	6	5	13	49
	Primary	5	6	7	3	21
	Both	2	1	1	0	4
	Other	1	0	1	0	2
	TOTAL	33	13	14	16	

2.3.4 Types of overprovision measured

Table 2.5 gives an overview of types of overprovision measure and types of condition or patient in which it was measured. 51 studies measured the overprovision of drugs only, of which 33 assessed the overprovision of antibiotic drugs only. Seven studies measured overprovision of a single type of non-antibiotic drug: antimalarials [13-15], proton-pump inhibitors [16-18] and uterotonics [19]. 11 studies measured overprovision of multiple types or any type of drug, five of which included unnecessary antibiotics as an indicator.

Eleven studies measured overprovision of non-drug therapeutic interventions only. Nine of these examined unnecessary surgery: appendectomies [20, 21], hysterectomies [22] and caesarean sections [7, 8, 23-26]. One measured overprovision of catheters [27], and one unnecessary blood transfusions [11].

Eleven studies measured overprovision related to diagnostics only. Four measured overprovision of multiple types of laboratory tests [12, 28-30], three examined unnecessary magnetic resonance imaging (MRI) [31-33], and two measured unnecessary computed tomography [34, 35]. One examined overprovision of echocardiography and electrocardiography [36], and one measured overprovision of angiography [37].

Table 2.5: Studies by type of overprovision measured and condition/type of patient

		Type of overprovision measured						
		Antibiotics	Specific non-antibiotic drugs	Any/various drugs	Other therapeutic interventions	Diagnostics	Mixed/various	TOTAL
Condition/ type of patient	Respiratory tract infections	Inpatient children with pneumonia [38, 39]. Outpatient children with suspected pneumonia [40]. Outpatient adults, [41-45], children with URTI [46-48] and all ages with URTI [9, 49, 50].		Any unnecessary drug and unnecessary antibiotics for outpatient adults with acute bronchitis [51].			Lab tests, drugs and chest physiotherapy to child inpatients bronchiolitis [52].	16
	Other infectious diseases	Outpatient children [53] and adults with diarrhoea [54]. Inpatient children [55] and outpatients of all ages with malaria [56]. Outpatients of all ages with viral fever [57]. Outpatients of all ages with any infection [58].	Antimalarials to child inpatients [13], outpatients of all ages [15], and inpatients and outpatients of all ages [14] with non-malarial febrile illness.				Unnecessary lab tests, antibiotics, antiparasitics for outpatient children with diarrhoea [10].	10
	Non-communicable conditions			Any unnecessary drugs for outpatients with hypertension [59], any unnecessary drugs for outpatients who had previously been admitted with a cardiovascular disease [60].		MRI for lower back pain [31, 32], CT scan for outpatients with headaches [34]. CT scan for minor head trauma patients [35].		6

	Surgery and labour	Prophylactic antibiotics for surgical patients among children [61], children and adults [62, 63], and with patient age unspecified [64].	Augmentation of labour with uterotonics [19].	Various drugs to patients after cataract surgery [65].	Appendectomy without appendicitis [20, 21], hysterectomy without clinical indications [22]. Caesarean section [7, 8, 23-26].	Unnecessary echocardiography and electrocardiography for elective non-cardiac surgery patients [36]. Unnecessary lab tests for elective surgery patients [30].		17
	Various/any outpatients	Children with any condition [66, 67], adults with any condition [68], all ages any condition [69]. Adults with TB or unstable angina, children with viral gastroenteritis [70].		Any unnecessary or harmful drug for adults with unstable angina and children with dysentery [71]. Any unnecessary or harmful drug [72], and any unnecessary drug and antibiotics for adults with unstable angina and asthma, and children with dysentery [73, 74]. Unnecessary steroids and antibiotics for adults with unstable angina, asthma and TB, and children with diarrhoea [75].		Angiography to outpatients [37]; knee MRI scans [33].		12
	Various/any inpatients	All age groups [76, 77] and children [78, 79].	Unnecessary proton-pump inhibitors to adult inpatients [16-18].	Any unnecessary drugs to adult inpatients [80, 81].	Catheterisation of inpatients [27].	Unnecessary lab tests for inpatients [28, 29].	Unnecessary venous thromboembolism prophylaxis (drug and mechanical) for inpatients [82].	13
	Various/all				Unnecessary blood transfusions [11].	Unnecessary repeat lab tests [12].		2
	TOTAL	33	7	11	11	11	3	

Three studies measured a combination of different types of overprovision: pharmaceutical and mechanical venous thromboembolism prophylaxis [82], unnecessary lab tests, antibiotics and antiparasitics [10] and overprovision of a combination of laboratory tests, drugs and chest physiotherapy [52].

2.3.5 Medical conditions and types of patients

Sixteen studies measured overprovision among patients with respiratory tract infections. These included inpatient children with pneumonia [38, 39] and bronchiolitis [52], and outpatients with uncomplicated or mild upper respiratory tract infections (including only children [46-48], only adults [41-45, 51] and children and adults [9, 49, 50]), as well as outpatient children with suspected pneumonia [40].

Ten studies measured overprovision to patients with other infectious diseases. Three examined overprovision to outpatients with diarrhoea (children [10, 53] and adults [54]), and two overprovision among patients with malaria (inpatient children [55] and outpatients of all ages [56]). Three examined overprovision to patients with non-malarial febrile illness: child inpatients [13], outpatients of all ages [15], and inpatients and outpatients of all ages [14]. One included outpatients of all ages with a viral fever [57], and another outpatients of all ages with any infection [58].

Six studies measured overprovision among patients with non-communicable conditions. These were outpatients with hypertension [59], outpatients who had previously been admitted with a cardiovascular disease [60], patients with lower back pain [31, 32], outpatients with headaches [34], and minor head trauma patients [35].

Ten studies looked at overprovision in patients who had undergone or were undergoing surgery, rather than defining the patient population by their condition or symptoms. Six of these included any surgery or any elective surgery [30, 36, 61-64], while two examined appendectomy patients [20, 21], one covered hysterectomy patients [22], and one covered cataract surgery patients [65]. Seven studies measured overprovision to women in labour [7, 8, 19, 23-26].

The remaining 27 studies measured overprovision in patients with any or multiple conditions, including 12 among outpatients, 13 among inpatients, and two set in ancillary services where patient type was not identified [11, 12].

2.3.6 Methods for measurement of overprovision

The majority of studies (50/76) determined overprovision through extracting data from medical records. A further six studies compared data from medical records with a reassessment of the patient to determine whether overprovision had occurred. Thirteen studies used SP visits to measure overprovision. Four studies measured overprovision through patient exit interviews. Two used direct observation of clinical care, and one used a household survey. The method for determining overprovision is shown by patient condition and type of overprovision in Table 2.6.

Evidence of overprovision to patients in surgery and labour is particularly reliant on record extraction, with 16/17 studies taking this approach. Similarly, 11/13 studies measuring overprovision to various types of inpatients used record extraction. All 11 studies of overprovision of non-drug therapeutic intervention used medical record extraction. SPs were most commonly used for cases of respiratory tract infections or other outpatient conditions, and 12/13 SP studies measured overprovision of drugs only.

Table 2.6: Method for determining overprovision by condition and type of overprovision

		Method for determining overprovision						
		Medical record extraction	Record extraction with reassessment	Standardised patients (SPs)	Exit interviews	Direct observation	Household survey	TOTAL
Condition/ type of patient	Respiratory tract infections	7	0	6	1	1	1	**16**
	Other infectious diseases	9	0	1	0	0	0	**10**
	Non-communicable conditions	3	1	0	2	0	0	**6**
	Surgery and labour	16	0	0	0	1	0	**17**
	Various/any outpatients	2	3	6	1	0	0	**12**
	Various/any inpatients	11	2	0	0	0	0	**13**
	Various/all	2	0	0	0	0	0	**2**
Type of overprovision	Antibiotics	22	2	6	1	1	1	**33**
	Specific non-antibiotic drugs	4	2	0	0	1	0	**7**
	Any/various drugs	5	0	6	0	0	0	**11**
	Other therapeutic interventions	11	0	0	0	0	0	**11**
	Diagnostics	6	2	0	3	0	0	**11**
	Mixed/various	2	0	1	0	0	0	**3**
	TOTAL	**50**	**6**	**13**	**4**	**2**	**1**	

2.3.7 Prevalence of overprovision

Nearly half of studies identified (37/76) reported the treatment prevalence of overprovision which, as discussed in Section 2.2.2.3, was the proportion of all patients who received the treatment or procedure of interest for whom the treatment was unnecessary. 25 studies reported the healthy prevalence of overprovision, i.e., the proportion of all patients for whom the specified type of care is unnecessary who nevertheless received that type of care. Six studies reported the population prevalence of overprovision, i.e., the proportion of all patients with the disease, health state or set of symptoms of interest who received the unnecessary care of interest (or any unnecessary care). Four reported both the treatment prevalence and the healthy prevalence, four the healthy prevalence and the population prevalence, and one the treatment prevalence and the population prevalence.

These differences in denominators, and the huge variety in setting and patient population, mean that care should be taken when comparing overprovision across studies. In Table 2.7 below, I present the number of studies, and highest and lowest prevalence for the three measures across six types of overprovision, along with details of the setting for those studies mentioned. For intervention studies, pre-intervention or control group prevalence is presented. Where a study covers multiple types of overprovision, the highest and lowest within the study are presented.

Table 2.7: Highest and lowest point estimates of overprovision by types of measure and type of overprovision

Type of overprovision	Treatment prevalence	Healthy prevalence	Population prevalence
Antibiotics	15 studies. Antibiotics were inappropriate in **7.7%** of 963 requests for parenteral antibiotics for inpatients in a small public teaching hospital in Brazil [77]. Antibiotics were inappropriate in **90.25%** of 523 outpatients diagnosed with URTI and prescribed an antibiotic in a public health centre in Ecuador [50].	20 studies. **5%** of 324 children with suspected pneumonia assessed by community health workers in Zambia and found to have normal breathing received antibiotics [40]. **97.7%** of 87 surgical patients who did not need antibiotic prophylaxis received it across six hospitals in Iran [63].	3 studies. **25.0%** of 517 outpatients in the emergency department of a tertiary public hospital in India received unnecessary antibiotics [68]. **47.9%** of 800 outpatients with diarrhoea across 20 Chinese hospitals received unnecessary antibiotics [54].
Specific non-antibiotic drugs	3 studies. **28.0%** of 2738 prescriptions for antimalarials did not have a positive malaria test across five private facilities in a county of Kenya [14]. **72.5%** of 193 adult inpatients prescribed proton-pump	4 studies. **48.7%** of 1479 low-risk women in labour received unnecessary uterotonics to augment labour [19]. **84.1%** of 446 children with non-malarial febrile illness prescribed an antimalarial	None

	inhibitors in two tertiary hospitals in Jordan had no clinical indications for them [16].	in a public regional hospital in Ghana [13].	
Any/various drugs	1 study. 64% of prescriptions were unnecessary or harmful for 82 outpatients (adults with unstable angina and children with dysentery) visiting 48 clinics in rural China [71].	5 studies. 2% of 166 outpatients (adults with unstable angina, asthma or TB, and children with diarrhoea) visiting 42 private facilities in a Kenyan city were given steroids [75]. 92.5% of 200 cataract surgery patients in a Chinese tertiary hospital were given systemic steroids [65].	8 studies. 12.0% of 300 inpatients at a public hospital in Ethiopia received an unnecessary drug [80]. 99.1% of 226 outpatients visiting 113 private health facilities in a city in South Africa received at least one unnecessary drug [51].
Other therapeutic interventions	11 studies. 12.0% of 300 caesareans across 10 referral hospitals in Burkina Faso had no medical indication [23]. 67.1% of 6910 blood components requested across nine blood banks in India were inappropriate [11].	None	None
Diagnostics	11 studies. 3.18% of laboratory tests at an academic lab in South Africa were unnecessary repeats [12]. 72.0% of 25 echocardiographs for patients having elective surgery in a private general hospital in Russia were unnecessary [36].	None	None
Mixed/various	None	3 studies. 3.4%. of 88 children admitted to a private hospital in Jordan with bronchiolitis were given inhaled steroids against guidelines, while 100% had chest radiography against guidelines [52].	None

Prevalence of overprovision varied widely, and was highly dependent on setting and patient group, even when comparing studies which examined the same broad type of overprovision and used the same measure of prevalence. For example, only 7.7% of antibiotics were classified as overprovision for inpatients in a Brazilian hospital [77], but 90% of antibiotics for outpatients with URTIs at an Ecuadorean health centre were classified as overprovision [50] (Table 2.7). This also highlights the influence of the choice of population: in the first case, it would be expected that hospital inpatients would have a high chance of needing antibiotics, and so the prevalence of overprovision of

antibiotics is likely to be low, while in the second case the defined population group (outpatients with URTIs) are much less likely to need antibiotics, leading to a high prevalence of overprovision.

There was also variation even within the same patient group: both inhaled steroids and chest radiography were not recommended for inpatient children with bronchiolitis at a hospital in Jordan, and while overprovision of inhaled steroids was rare (3.4%), all patients underwent chest radiography [52]. There were other examples of overprovision being near universal: 99.1% of outpatients visiting private health facilities in South Africa received at least one unnecessary drug [24], and 92.5% of cataract surgery patients in a Chinese hospital were given unnecessary steroids [46].

There was less evidence on the prevalence of overprovision of non-drug interventions, and so it is not surprising that similarly extreme values are not observed. However, there was still notable variation: 12% of caesareans were unnecessary in one Burkina Faso study [23], but this was as high as 55% in a Ugandan study [26].

2.3.8 Factors associated with overprovision

39 studies sought to identify factors associated with overprovision. Of these, 30 carried out statistical testing or provided estimates of the uncertainty of effect sizes, and only these studies are discussed below. The odds ratio (OR), adjusted odds ratio (AOR) or prevalence difference are given where these were presented in the study. If an effect size was not calculated, the prevalence for each group is given, along with a p value from statistical testing.

2.3.8.1 System level factors

None of the studies measured system level or national factors, such as regulatory approaches or pharmaceutical marketing.

2.3.8.2 Facility level factors

2.3.8.2.1 Facility sector

Seven studies compared overprovision in the public and private sectors. There is a clear mechanism by which overprovision might be expected to vary by sector: the function of most private facilities is profit-making, and fee-for-service or volume-based payment structures may incentivise overprovision. It is important to consider that not-for-profit facilities may not have the same incentives, and may behave more like the public sector.

45.9% of antibiotic prophylaxis for surgery was unnecessary in a private hospital compared to 21.1% (p=0.003) in a public teaching hospital in South Africa [61]. MRI for lower back pain was less likely to be unnecessary in public than private hospitals in Iran (AOR=0.48, 95% CI: 0.26- 0.90) [31]. Conversely, MRI was unnecessary in 19.4% of cases from private centres and 29.6% of cases from public centres (p=0.003) in another Iranian study [32]. 49.0% of SPs visiting public facilities received an unnecessary antibiotic compared to 37.4% visiting the same doctor at their private practice (p<0.1) in India, but there was no significant difference when comparing public and private facilities overall, or in the likelihood of receiving any unnecessary drug [73]. Informal private providers were less likely to prescribe unnecessary antibiotics (AOR=0.24, 95% CI: 0.10 - 0.63) or any unnecessary care (AOR= 0.27, 95% CI: 0.10, 0.76) when compared to public providers in another Indian study [74]. There was no difference in the rate of prescription of unnecessary antibiotics or steroids when across public and private facilities in a Kenyan city [75], and no difference in prescription of unnecessary antimalarials comparing public and private not-for-profit facilities in Uganda [15].

2.3.8.2.2 Other facility level characteristics

Three studies compared overprovision in different levels of health facility. When considering the domain of knowledge and uncertainty, higher level facilities may have more capacity for testing and better qualified providers, reducing the chance of overprovision. But organisational structures will also mean such facilities have scope to carry out more types of care, potentially increasing the risk of overprovision.

SPs visiting village clinics in China were more likely than those at township health centres to receive unnecessary antibiotics for unstable angina (25% vs 4%, p=0.0004), with some evidence of a difference for viral gastroenteritis (48% vs 31%, p=0.0659), but no difference for those with TB or when the three conditions were pooled [70]. There was no difference in the proportion of patients receiving unnecessary antimalarials comparing hospitals and health centres in Uganda [15], and no difference in the proportion of caesareans which were unnecessary in regional hospitals, university hospitals and medical centres in Burkina Faso [23].

Two studies examined the role of patient load at facilities in overprovision. Providers at busier facilities may have less time to make a diagnosis, and be more reliant on heuristics, as well as feeling less able to explain to patients why certain treatments are not necessary. However, a Ugandan study found no relationship between staffing ratios and prescription of unnecessary antimalarials [15], and a Chinese study found some suggestive evidence (p<0.1) that increased patient load was associated with a decreased likelihood of prescribing unnecessary drugs [71].

Differences in urban and rural overprovision patterns could be driven by financial considerations, with urban facilities facing more competition, or uncertainty, with providers in rural facilities more concerned that their patients may not be able to return if their condition deteriorates, and therefore more likely to prescribe unnecessary medications as a precaution. A study in China compared overprovision across hospitals in rural and urban locations, and found that SPs visiting hospitals in cities were more likely to be prescribed unnecessary antibiotics than those in rural areas (65% vs 55%, p<0.01) [45].

A study in Uganda examined unnecessary antibiotic prescriptions for patients with malaria by drug availability at the health facility. This study found that antibiotic prescriptions were more likely in facilities with a shortage of antimalarials (AOR=1.44, 95% CI: 1.02-2.01), but there was no association with shortage of antibiotics [56]. This may be explained by the provider's concern to prescribe an alternative drug if the appropriate one is not available, driven by economic incentives. In the same Ugandan facilities, local prevalence of malaria infection was not associated with unnecessary antibiotics [56] or antimalarials [15].

Four studies compared overprovision in individual facilities, rather than facility characteristics. In an Indonesian study, 34% of antibiotic prescriptions were unnecessary in Hospital A compared to 48% in Hospital B (p<0.001), with Hospital A having more patients who had low incomes, were uninsured and lived in urban areas than patients attending Hospital B [76]. A comparison of two Tanzanian hospitals found unnecessary caesareans were more likely in a designated district referral hospital without user fees than in a hospital which charged user fees and accepted few referrals (OR=2.24, 95% CI: 1.00-4.98) [24]. A comparison across seven university and private hospitals in Iran identified significant differences in the proportion of angiography which was unnecessary (p=0.044), though specific characteristics of hospitals were not identified [37], and a study in South Africa identified significantly different proportions of patients being prescribed unnecessary antibiotics across eight clinics (various ORs, not shown), again without giving characteristics of the clinics [58].

2.3.8.3 Provider level factors

11 studies examined the role of provider qualification, cadre, education, experience or specialism in overprovision, of which three also explored provider demographic characteristics.

2.3.8.3.1 Provider qualification, cadre, education, experience and specialism

A study in China found that providers with lower level qualifications were more likely to prescribe unnecessary antibiotics than those with a college degree, with an AOR of 1.30 (95% CI: 1.21-1.39)

for those with a junior college qualification, and AOR=1.60 (95% CI: 1.42-1.80) for those with a technical secondary school qualification [69]. The same study found that associate chief physicians (most senior) were more likely to prescribe unnecessary antibiotics than residents (most junior) (AOR=1.99, 95% CI: 1.62 – 2.42), but there was no difference between attending physicians (middle ranking) and residents. Another Chinese study found that providers with upper secondary education or higher (compared to less education) had a reduced rate of unnecessary antibiotic prescription of 35.4 percentage points ($p<0.05$), but no difference by years of experience or whether the provider had a practising physician certificate (compared to a lower qualification) [71].

A study in India found that doctors with degrees in ayurvedic medicine were more likely than those with degrees in allopathic medicine to prescribe unnecessary antibiotics for a viral fever (81% vs 15%, $p<0.001$) [57]. Providers with the shortest training, such as nursing assistants and students, were more likely than medical officers (those with a medical degree, the longest training) to prescribe unnecessary antibiotics to patients with malaria in Uganda (AOR=1.86, 95% CI: 1.05-3.2), but there was no difference when comparing nurses, midwives or clinical officers (mid-level cadres) to medical officers [56].

There was no difference in the prescription of unnecessary antibiotics in a South African study comparing nurses and doctors [58], or a Chinese study comparing attending physicians and chief physicians [45].

In health facilities in Burkina Faso, clinical officers (a lower cadre of provider) were more likely to perform an unnecessary caesarean than obstetrician-gynaecologists (AOR=4.46, 95% CI: 1.44-13.77), but there was no difference between general practitioners and obstetrician-gynaecologists [23]. Another study in Burkina Faso found that general practitioners were more likely to decide on an unnecessary caesarean than obstetrician-gynaecologists (AOR=1.61, 95% CI: 1.13-2.30), but no difference between nurse-midwives and obstetrician-gynaecologists [7].

A previous consultation with an infectious disease specialist was protective against unnecessary antibiotics in a hospital in Brazil (OR=0.03, 95% CI: 0.00 – 0.21) [77], but consultation with a specialist in rehabilitative medicine was not associated with the likelihood of having an unnecessary MRI for lower back pain in Iran [31]. In the same Iranian study, neurosurgeons were less likely to refer for unnecessary imaging than neurologists (AOR=0.34, 95% CI: 0.16 – 0.72). In a study of computed tomography for minor head trauma in Iran, ear, nose and throat specialists were more likely to refer for unnecessary tomography than emergency physicians (OR=5.34, 95% CI: 1.06 – 26.81), but there was no difference between neurosurgeons and emergency physicians [35].

2.3.8.3.2 Provider demographic characteristics

There may be a relationship between provider demographic characteristics and overprovision. Older providers are likely to be more experienced and so, for the reasons discussed above, less likely to provide unnecessary care. However younger providers are more likely to have received their medical education at a time of heightened awareness of antimicrobial resistance, and could have a better understanding of the importance of avoiding overprovision for this reason. Provider sex may impact the power dynamic in the provider-patient relationship.

Three studies, all based in China and all measuring prescriptions of unnecessary antibiotics, examined overprovision by the age and sex of the provider. All three found male providers were more likely to prescribe unnecessary antibiotics than female providers, with an AOR of 1.65 (95% CI: 1.54 – 1.78) in one [69], a 67.3 percentage point difference in the second [71] and a report of a statistically significant difference in the third [45]. The pattern with respect to age was less clear, with one study finding that compared to providers aged 25-31 years, overprovision was less likely among providers aged 32-38 (AOR 0.58 95% CI: 0.53 – 0.64) and 39-75 (AOR 0.30, 95% CI: 0.27 – 0.35) [69], but no differences were observed in the other studies [45, 71].

2.3.8.4 Patient level factors

20 studies explored the relationship between overprovision and patient level factors.

2.3.8.4.1 Patient sex

Six studies examined overprovision by patient sex. There are varying reasons to believe patient sex could influence overprovision. As mentioned above, the patient-provider relationship and its power dynamics, including sex discrimination, could be a factor. It could also relate to the knowledge and biases of the provider: a failure to understand differential presentations of a condition by sex could lead the provider to overtreating one sex more than the other. Money could also be a factor: women may be perceived as less willing or able to pay for care than men.

Appendectomies were unnecessary in 40.3% of women compared to 26.8% of men ($p<0.001$) in a study in India [20]. There was some evidence of more unnecessary MRI requests for men (29.9%) than women (20.9%) in one study in Iran ($p=0.089$) [32], but no difference in risk of unnecessary MRI between men and women in another study in Iran [31]. Studies in Brazil, China and South Africa both found no relationship between patient sex and unnecessary antibiotic prescriptions [58, 69, 77].

2.3.8.4.2 Patient age

Eight studies examined overprovision by patient age. The role of patient age in overprovision is likely to relate to bias and uncertainty: a provider may be more likely to provide unnecessary care out of precaution to the very young or old who are perceived as most vulnerable. However, money may also play a part: working age people may be perceived as having more disposable income and be more likely to have private insurance.

In a study in Ghana, 46% of 0 –1-year-olds received unnecessary antimalarials compared to 27% of older children (p=0.028) [13]. Children aged under five were more likely than older children and adults (AOR= 1.39 95% CI:1.25-1.55) to receive unnecessary antimalarials in Uganda [15]. In the same Ugandan facilities, children aged 0-4 (AOR= 1.96, 95% CI: 1.75-2.19) and 5-15 (AOR= 1.39, 95% CI: 1.25-1.55) were more likely than adults to receive unnecessary antibiotics [56]. Older children were less likely to receive unnecessary antibiotics than those under five (AOR= 0.67, 95% CI: 0.60-0.83) in a study in China, but adults of all age groups were more likely to receive them than children under 5 (various AORs, not shown) [69]. In a study of community health workers in Zambia, there was no difference by age in the receipt of unnecessary antibiotics for suspected pneumonia when using the community health workers' own measure of breathing rate, but children aged 1-4 were more likely than those aged under one (45% vs 18%, p<0.01) to have received unnecessary antibiotics when breathing rate was reassessed by an expert [40]. Age was not associated with unnecessary antibiotics in a study including children and adults in Brazil [77], or when comparing unnecessary antibiotics in children and adults in South Africa [58], or with unnecessary MRI in Iran [31].

2.3.8.4.3 Patient socioeconomic characteristics

Just three studies examined socioeconomic characteristic, such as occupation, ethnicity and education, when examining overprovision. Variation could arise for a number of reasons: providers may discriminate against certain groups of patients [83], while more educated patients may be better able to advocate for themselves, and patient's own preferences may also vary.

A study in Burkina Faso found that compared to women married to farmers, unnecessary caesarean sections were more likely among women married to traders (AOR= 1.77, 95% CI:1.19 - 2.62), salaried public employees (AOR= 2.15, 95% CI:1.38 – 3.32) and salaried private employees (AOR= 2.11, 95% CI:1.46 – 3.07) [7]. The same study found unnecessary caesarean sections were more likely among women living in urban than rural areas (AOR= 1.55, 95% CI:1.12 - 2.12), but no difference between those living in semi-urban and rural areas. A study of unnecessary antibiotics prescribed to children in South Africa found unnecessary antibiotics were more common among

children whose parents had completed secondary school compared to both those who had lower qualifications (OR=1.9, 95% CI: 1.1-3.6) and higher qualifications (OR=3.1, 95% CI: 1.5-6.6) [47]. The same study found no relationship between unnecessary antibiotics and residence (urban, rural or township) or ethnicity. A study of unnecessary MRI for lower back pain in Iran found no relationship with the patient's level of education [31].

2.3.8.4.4 Patient clinical characteristics

The role of clinical characteristics in overprovision, similar to patient age, likely relates to cognitive bias and uncertainty. If a provider is more certain in a diagnosis, they may be less likely to prescribe unnecessary drugs as a precaution, and patients who are perceived as higher risk may be more likely to receive unnecessary care.

In Burkina Faso, there was some evidence that women who had one previous birth were more likely to have an unnecessary caesarean section than those who had never given birth (AOR=2.52, 95% CI: 0.97 – 6.56), but there was no difference between those who had two or more births compared to those who had never given birth [23]. In Iran, an MRI for lower back pain was more likely to be unnecessary among patients who had no treatment before the MRI (AOR=26.68, 95% CI: 11.69 – 72.86), and no previous MRI (AOR=2.91, 95% CI: 1.21 – 6.97) [31]. Inpatients with peritoneum infections (OR=2.58, 95% CI: 1.22 – 5.44) and urinary tract infections (OR=2.74, 95% CI: 1.255–4.83) were more likely to be given unnecessary antibiotics than other inpatients in a Brazilian hospital [77]. In an Indian hospital, 64.7% of paediatric surgical outpatients received unnecessary antibiotics compare to 22.7% of paediatric medical outpatients [67]. Antibiotic prescriptions were less likely to be unnecessary for HIV positive patients (AOR=0.31, 95% CI: 0.20-0.45) and patients with emergency triage status (AOR=0.75, 95% CI: 0.59-0.96), but there was no relationship with visit number (first or return visit).

2.3.8.4.5 Patient requests and knowledge

A patient request for a particular drug can clearly encourage a provider towards overprovision. If a patient shows that they are aware certain drugs are unnecessary for their condition, this removes some of the information asymmetry in the patient-clinician relationship, and can be argued to reduce the financial incentive for overprovision.

85% of patients who requested unnecessary antibiotics in China received them compared to 15% of those who did not make a request [44]. In Kenya, patients who requested amoxicillin were no more likely to receive unnecessary antibiotics, but those who requested albendazole were more likely to receive unnecessary antiparasitics (25% vs 13%, $p<0.001$) [10]. Children whose parents

requested antibiotics were more likely to receive unnecessary antibiotics (OR=5.9, 95% CI: 2.5 – 14.9) in South Africa [47]. In a Chinese study, patients who revealed their knowledge that antibiotics were unnecessary had a 22 percentage point reduction ($p<0.05$) in unnecessary antibiotic prescription compared to those who did not [45].

2.3.8.4.6 Financial incentives at the patient level

The patient's insurance status and the reimbursement mechanism for the provider or facility may impact financial incentives for overprovision. Fee-for-service insurance and out-of-pocket payments may incentivise the provision of more care than necessary, while capitation may do the opposite.

Patients who were covered by a rural insurance cooperative were more likely to receive unnecessary antibiotics than those who paid out-of-pocket (AOR= 1.18, 95% CI:1.08 - 1.30) in Chinese hospitals [69]. Two studies in Iran found no relationship between insurance (whether private, public or none) and unnecessary MRI [31, 32]. In a South African study of dispensing doctors (who typically include drugs costs within a flat consultation fee), patient insurance status (insured vs paying out-of-pocket) had no impact on the likelihood of receiving any unnecessary drugs. However, asking the provider to write a separate prescription (in order to buy the drugs elsewhere) and charge a lower consultation fee reduced the proportion receiving non-antibiotic unnecessary drugs by 9 percentage points ($p=0.055$), but there was no relationship with unnecessary antibiotics or unnecessary drugs overall [51]. In Chinese hospitals, where fees for drugs were charged on top of the consultation fee, 10% of patients who requested a separate prescription to buy the drugs elsewhere received unnecessary antibiotics, compared to 55% of those who made no particular request ($p<0.05$) [44]. The patient offering a small gift to the physician at the beginning of the consultation was associated with a 15 percentage point reduction ($p<0.05$) in receiving antibiotics in another study in China [43].

2.3.9 Evidence of interventions on overprovision

Ten studies reported on the effect of interventions on overprovision. Eight addressed the knowledge domain of drivers of poor medical care, with interventions based around provider training and the implementation of guidelines, while two could be said to address the finance domain, by changing the payment mechanism through which providers were reimbursed.

2.3.9.1 Knowledge interventions

Five studies reported on the effect of interventions on overprovision of drugs. The joint evaluation in 36 Ugandan facilities of two interventions, a cluster randomized control trial of on-site training

and quality improvement, and a before-after study of off-site training courses for providers, found that the on-site support reduced unnecessary antimalarial prescriptions (ARR=0.70, p=0.011), but the off-site training did not (ARR= 0.96, p=0.4) [15]. A randomised control trial of a training programme to improve quality of care among 273 informal providers in India found no effect on prescriptions of antibiotics or unnecessary drugs overall [74]. In a before-after study in an Indian neonatal intensive care unit, the rate of unnecessary antibiotic use dropped from 451 to 361 per 1000 patient-days (p=0.015) after a quality improvement initiative including training of staff and introduction of protocols [79]. The other two studies did not carry out formal statistical testing: a clinical audit including training and monitoring in a health centre in Afghanistan reduced the unnecessary use of antibiotics in children with diarrhoea from 90% to 23% [53], and an intervention including the development of guidelines and staff retraining in two hospitals in Burundi reduced the unnecessary use of antibiotics in children with malaria from 14.2% to 11.6% [55].

Two studies reported on interventions to reduce unnecessary caesarean sections. A cluster randomised control trial in 22 hospitals in Burkina Faso of an intervention including training, SMS reminders and monthly audits observed a reduction of 17.0% (95% CI: 13.2 – 19.2) in the proportion of caesareans which were unnecessary [8]. A quality improvement programme including communication of audit results, staff training and development of guidelines did not significantly reduce the percentage of caesarean sections which were unnecessary in a hospital in Uganda (57% before vs 52% after, p=0.57) [26].

A before-after study in a hospital in Jordan reported on the effect of the introduction of guidelines for the management of children with bronchiolitis on various types of overprovision, including drugs, lab tests, and chest radiography and physiotherapy. It resulted in reductions in four types of overprovision, but no change in another nine types [52].

2.3.9.2 Finance interventions

The two studies reporting on the effect of changing payment mechanisms were both based in China. A cluster randomized control trial introducing capitation with pay-for-performance elements (compared to fee-for-service payment in the control) was conducted in two counties containing 28 towns and 266 villages. There was a 9.3 percentage point reduction (p=0.02) in antibiotics prescribed for colds in township health centres, and a 16.0 percentage point reduction in village health posts (p<0.001) [49]. A before-after study found that switching from fee-for-service to case-based payments in a single hospital reduced the percentage of cataract surgery patients receiving unnecessary systemic antibiotics from 25.0% to 3.0% (p<0.0001), systemic steroids from 92.5% to

10.5% (p<0.0001), adjuvant drugs from 85.0% to 0.0% (p<0.0001), and multiple antibiotic eye drops from 86.0% to 37.0% (p<0.0001) [65].

2.4 Summary of findings and gaps in knowledge

This review of studies which measure overprovision has identified several areas where evidence is very limited.

The literature does not represent a wide range of LMICs: while there are 137 countries classified as an LMIC, studies from only 25 individual countries were identified. More specifically, there are 17 lower-middle income countries in the WHO African region, including Tanzania, but just seven studies were identified from four of those countries: three from Kenya, two from Ghana, one from Zambia, and one from Tanzania.

The selection of facilities in these studies means that it is hard to generalise their findings. Over a third of studies measured overprovision in a single facility, and only four could be said to be nationally representative, while another 16 were representative of an individual region or city. This means that the vast majority of evidence on overprovision in LMICs cannot be assumed to be in typical facilities. Just 17 studies, less than a quarter of those identified, included primary healthcare facilities, while hospitals appear to be overrepresented. Since over half of expenditure on healthcare is spent on primary healthcare [84], this is a huge potential source of overprovision which is understudied. About a quarter of studies included private sector health facilities, but only 11 included private primary health facilities.

In terms of types of overprovision, unnecessary antibiotics are a major focus of the literature, and were the only outcome or one of the outcomes of over half the studies identified. Evidence on other types of drugs was much more limited: the only other specific drug types mentioned were antimalarials, proton-pump inhibitors and uterotonics, as well as 11 studies which measured overprovision of any drug or a variety of drug types. Looking at non-drug treatments, caesarean sections were the subject of six studies, but there was very limited evidence on overprovision of other types of surgery. Just one study was on hysterectomy and one on appendectomy, and the only other types of therapeutic intervention measured were catheterisation and blood transfusion.

Evidence on overprovision of diagnostic tests and procedures was limited, and concentrated in Iran: four of seven studies on diagnostic imaging and two of four studies on laboratory testing were from Iran. That the majority of studies were identified through another review rather than the literature search is suggestive of the difficulty of finding literature on overprovision, and raises concerns that

there may be relevant studies not identified through the search approach. In general, there was little evidence on the extent of overprovision of diagnostic services.

The methods used to measure overprovision are subject to limitations. About a quarter of studies made some attempt to independently ascertain what medical care the patient required, either by reassessing the patient, by direct observation of care or by using SPs. The rest relied on medical records, patient exit interviews or a household survey, which means that investigators relied on the reports of others to decide on whether care was necessary or not. This could bias estimates of overprovision in either direction: upwards if the provider has failed to record the information which, in fact, justifies the provision of care (and so it is classified as overprovision by the researcher), or downwards if the provider incorrectly records a diagnosis which justifies care when it is, in fact, not necessary.

Evidence on factors associated with overprovision was too limited to observe many consistent patterns, and the lack of generalisability discussed above means that any factors identified may well be specific to an individual facility. While 14 studies included both private and public health facilities, only seven compared overprovision in the public and private sectors. Three of these studies suggested overprovision was more prevalent in the public sector, two in the private sector, and two showed no difference. Only three studies examined overprovision by facility level, and no clear pattern emerged. Among the six studies which looked at the role of provider qualification or specialism in overprovision, there appeared to be a trend of more specialised or qualified providers being less likely to overprovide care. Three studies examined the role of provider age and sex in overprovision, all of which found that male providers were more likely to overprovide, but there was no relationship with the age of the provider.

Four studies examined overprovision by patient sex, but there was no clear trend. Five studies investigated patient age: it appeared from three studies that younger children were more likely than older children to receive unnecessary antibiotics or antimalarials, but the studies which included adults showed no clear relationship between age and overprovision. Only three studies examined the role of socioeconomic factors such as occupation or education, and there was no clear pattern to their findings. There was some evidence that a patient request for antibiotics increased the chance of their overprovision, with two of three studies investigating this factor finding a significant increase. Just four studies compared overprovision by insurance status; while one found insured patients were more likely to receive overprovision, the other three found no difference with respect to insurance.

Evidence on interventions to reduce overprovision is sparse and of low quality. Only ten studies were identified, and two did not carry out any formal statistical testing of the effect of the intervention. Four studies had a robust cluster randomised control trial design; the rest were before-after studies in one or two individual facilities. The types of overprovision covered by the studies are limited in range: unnecessary antibiotics and antimalarials, unnecessary caesarean sections, and unnecessary care in specific types of patients (cataract surgery patients and children with bronchiolitis). Only one examined the effect of an intervention on diagnostic procedures. Only two studies included adult outpatients. Eight of the ten interventions were traditional quality improvement programmes which took a clinical approach to reducing overprovision, and involved a combination of audit, guideline implementation and staff training. Just two took a more system-level approach by changing the mechanism through which providers were paid from fee-for-service to case-based payments or capitation.

2.5 Conclusions

This review has identified evidence of overprovision of medical services in LMICs, some of which is clearly widespread in certain settings. However, the scope of evidence for overprovision is limited in a number of dimensions: the countries studied, the types of facilities included, and the types of overprovision measured. The methods for selecting facilities and for measuring overprovision itself mean that findings are rarely generalisable, and estimates of the prevalence will be impacted by quality of record keeping. In addition, the different denominators used, and the range of patient populations, make it difficult to compare across studies. Very few studies attempted to identify factors associated with overprovision (including interventions) and their study designs were rarely robust.

The work within this PhD should address some of these gaps: facilities were selected from a national sampling frame, and include private primary health facilities as well as hospitals. Measures of overprovision will cover a wide variety of drugs and laboratory tests. The large sample size will allow work to identify facility and provider level factors associated with overprovision, and the use of SPs removes concerns around patient and case mix, as well as allowing for reliable identification of necessary and unnecessary care.

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3 Chapter 3: Standardised patients

3.1 Overview

Chapter 3 introduces the standardised patient (SP) methodology, explains its advantages and disadvantages compared to alternatives for measuring quality of care, highlights some key results from a literature review of the use of SPs, and presents a step-by-guide on developing and implementing SPs.

The purpose of the literature review was to identify examples of the use of SPs for the measurement of quality of care in low- and middle-income countries. The focus was on the use of SPs in health facilities, as opposed to pharmacies or drugstores. This is because it is in facilities, where providers have the opportunity to carry out physical exams and laboratory tests, that SPs are particularly difficult to implement. For this reason, papers were excluded from the review if the provider was a pharmacist or retailer, or if there was no face-to-face contact with the SP, for example in telephone appointments. Studies were also excluded if SPs were not undercover, or not using health facilities under real conditions, for example, if they were being used to train or test medical students. The full list of papers included is given in the supplementary material for the paper, which is attached in Appendix 2.

I wrote the step-by-step guide to SPs, with additions and revisions from my co-authors, on the basis of my experience of developing and implementing SPs for the evaluation of SafeCare in Tanzania. It is presented as a generic set of steps to be applicable to a wide range of studies; in Chapter 4 (Methods), I give further details which are specific to the SPs used in this thesis, including the criteria which we used to choose SP cases, and on the recruitment and training of SPs. Together, Chapters 3 and 4 address Objective 1 of the PhD, the development and implementation of SP cases.

The paper was published in Health Policy and Planning in August 2019, and is reproduced with permission of Oxford University Press. A cover sheet with further details follows, and the license agreement is attached in Appendix 3.

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Surname/Family Name	King		
Thesis Title	Too much of nothing: measuring, understanding and explaining the overprovision of healthcare in the Tanzanian private sector		
Primary Supervisor	Timothy Powell-Jackson		

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SECTION E

Student Signature	Jessica King
Date	15/08/2022

Supervisor Signature	Timothy Powell-Jackson
Date	25/08/2022

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How to do (or not to do)

How to do (or not to do) . . . using the standardized patient method to measure clinical quality of care in LMIC health facilities

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Abstract

Standardized patients (SPs), i.e. mystery shoppers for healthcare providers, are increasingly used as a tool to measure quality of clinical care, particularly in low- and middle-income countries where medical record abstraction is unlikely to be feasible. The SP method allows care to be observed without the provider's knowledge, removing concerns about the Hawthorne effect, and means that providers can be directly compared against each other. However, their undercover nature means that there are methodological and ethical challenges beyond those found in normal fieldwork. We draw on a systematic review and our own experience of implementing such studies to discuss six key steps in designing and executing SP studies in healthcare facilities, which are more complex than those in retail settings. Researchers must carefully choose the symptoms or conditions the SPs will present in order to minimize potential harm to fieldworkers, reduce the risk of detection and ensure that there is a meaningful measure of clinical care. They must carefully define the types of outcomes to be documented, develop the study scripts and questionnaires, and adopt an appropriate sampling strategy. Particular attention is required to ethical considerations and to assessing detection by providers. Such studies require thorough planning, piloting and training, and a dedicated and engaged field team. With sufficient effort, SP studies can provide uniquely rich data, giving insights into how care is provided which is of great value to both researchers and policymakers.

Keywords: Standardized patients, quality of care

Introduction

Clinical quality of care, the process through which inputs from the health system are transformed into health outcomes (Donabedian, 1988), is arguably the most informative dimension of quality, as it is the key point where provider behaviour influences case management. However, it is also highly challenging to measure (Hanefeld *et al.*, 2017), and many commonly used methods for measuring clinical quality have significant disadvantages. Direct observation cannot control the types of patients and cases observed (Peabody *et al.*, 2000), clinical vignettes measure knowledge rather than practice (Leonard *et al.*, 2007; Mohanan *et al.*, 2015), and both suffer from Hawthorne effects (Leonard and Masatu, 2010). Medical record abstraction is usually unfeasible in LMICs especially in the private sector where record-keeping is often poor or non-existent (Aung *et al.*, 2012). Patient exit interviews suffer from recall bias and poor response rates, and may require the patient to understand clinical procedures (Onishi *et al.*, 2010).

Key Messages

- Standardized patients are a uniquely valuable tool for measuring quality of care.
- Multiple recent studies have successfully addressed scientific, ethical and practical challenges when implementing large-N standardized patient studies in health facilities.
- Future studies can not only build on the increasing expertise and experience of others but also innovate and develop the tool.

A key advance in the measurement of clinical quality is the use of standardized patients (SPs) in primary care settings. Healthy people, employed by a research study, pose as real patients, responding to the clinician's actions as a real patient would. Alternative terms include mystery client, simulated patient, covert patient and undercover careseeker. SPs have a long history in medical education (Peabody *et al.*, 2000), where the clinician knows that she is being tested outside a real-world milieu. The method is increasingly being used as a research tool in large field studies to assess deficits in care (Das *et al.*, 2012; Kohler *et al.*, 2017; Christian *et al.*, 2018), evaluate quality improvement strategies (Harrison *et al.*, 2000; Mathews *et al.*, 2009; Das *et al.*, 2016a), and identify how financial incentives influence quality (Currie *et al.*, 2014; Das *et al.*, 2016b).

The SP method has a number of advantages. In a high-quality SP study, clinicians believe they are treating a real patient and, therefore, measures are not influenced by the Hawthorne effect (Leonard and Masatu, 2010). Because each case is completely standardized, care can be benchmarked against pre-determined standards for a specific condition. We can say that an antibiotic was incorrectly used because we know the SP presented with symptoms of a viral pharyngitis rather than pneumonia. The ability to control patient-mix avoids confounding and allows for the investigation of rarer conditions, such as tuberculosis (TB), which might otherwise require long observation periods to gather a sufficient sample (Peabody *et al.*, 2000). Where the objective is to compare across different types of patients, the SP presentation can be altered (or different types of SPs such as men and women can present the same condition) to assess how provider behaviour responds to patient characteristics (Currie *et al.*, 2011; Planas *et al.*, 2015). Finally, in evaluations of interventions, SPs provide scope for double-blinding, whereby providers cannot tell which patients are SPs, and the SPs themselves are blinded to the treatment arm of providers they visit (Das *et al.*, 2016a).

The main downsides are that the disease cases suitable for SPs are limited, thereby restricting their applicability, and developing SPs for use in the field is complex, which may limit their scalability. There is ongoing debate on the ethics of SP research, though the 'deception' of clinicians can be ethically justified where (1) other options cannot answer the research questions (Alderman *et al.*, 2014); (2) risks to SPs and providers are minimal; and (3) the knowledge generated is of value to society (Rhodes and Miller, 2012).

In this article, we provide a step-by-step guide on using SPs to measure the quality of care in health facilities (dispensaries, health centres or clinics). The guide is based on a review of SP studies in low- and middle-income countries (LMICs) (full details in Supplementary Appendix), as well as our experiences implementing this approach in public and private health facilities in China, India, Kenya, South Africa and Tanzania. The SP method is also frequently used in the retail sector, e.g. in pharmacies or informal drug sellers (Fitzpatrick and Tumlinson, 2017), but our focus on health facilities reflects the particular challenges faced in documenting clinician–patient interactions and handling requests for exams and diagnostic tests.

Step 1: choosing a suitable SP case

The first choice made when designing an SP study is case selection, i.e. the condition or symptoms SPs present to providers. The major considerations are whether the case is technically feasible, whether it is ethically acceptable to ask SPs to present the case, and whether the case will be suitable both to the local context and the purpose of the study. We list 10 questions which researchers should ask when assessing cases for inclusion in Table 1. Some cases will never be feasible and are likely to be excluded by all studies, e.g. any case requiring inpatient care would be deemed too high a risk to a fieldworker, and an SP with a wound would be practically impossible to falsify. Perceptions of feasibility may change over time; e.g. TB was once perceived as a condition which could not be measured using the SP method, but has now been validated as an assessment of quality (Das *et al.*, 2015).

It is useful to refer to—and sometimes replicate—SP cases developed by previous studies. We conducted a scoping review of all SP studies in LMIC health facilities up to December 2016, and identified 17 conditions across 63 articles, covering 45 studies (Table 2). One advantage of replicating such cases is the opportunities to share SP scripts and tools and learn from the experience of others. Colleagues can advise on the feasibility of implementing certain SP cases, and how effectively they measured the quality of care. Secondly, if multiple studies share SP cases, direct comparisons are possible across settings. Examples of such comparisons to date include: (1) dispensing practices for suspected TB patients in multiple settings in urban India (Miller *et al.*, 2018) and (2) treatment of asthma, chest pain, diarrhoea and TB across China, India and Kenya (Daniels *et al.*, 2017; Das *et al.*, 2018). However, as Table 2 shows, the range of SP cases used is currently limited. This may reflect not only the need and scope for the development of more cases but also the challenges of identifying cases meeting the requirements discussed in Table 1.

If resources allow, choosing more than one case so that each provider receives multiple visits allows more quality dimensions to be assessed and increases statistical power. One might consider using a range of different SP cases, mixing:

- Infectious diseases with non-communicable diseases (NCDs)
- Uncommon but severe conditions with common, non-critical, but high-burden diseases
- Conditions requiring laboratory diagnostics with those requiring only history taking to diagnose
- Conditions for which there is typically overprovision with conditions where there is underprovision
- Different stages of disease progression or experimental variants, such as some patients already having a laboratory report whereas others do not, for the same disease

Step 2: defining correct management

Once conditions are chosen, an indicator of correct management should be pre-defined for each SP case. Correct management should

Table 1 Ten questions to consider when assessing suitability as an SP case

Key question	Explanation and examples
Technical feasibility	
Can a trained SP portray the case?	Conditions which have visible symptoms are unlikely to be suitable SP cases, as are conditions where patients would be expected to be acutely unwell. For example, an asthma SP could describe a previous attack but would not be expected to mimic one during the visit.
Do national or international guidelines exist for correct management or treatment?	If the aim is to assess quality of care against specific standards there will be a need for agreed-upon guidelines to provide a clear definition of the correct treatment outcome.
Can expected management be performed within one visit?	There is unlikely to be scope within the study design for the SP to return to the facility for follow-up visits.
Ethical acceptability	
Does the case choice minimize potential harm to fieldworkers?	Conditions should be chosen to avoid the need for invasive tests. Although cases requiring finger-prick blood tests have been used (Mathews *et al.*, 2009), it would be inappropriate to use a suspected sexually transmitted infection (STI) case which is likely to require a genital exam, or suspected typhoid which may require a venous blood draw for a Widal test. It should be noted that unexpected invasive tests may be requested: in one study in Senegal, almost all SPs requesting family planning were told they needed a vaginal exam. Researchers should consider whether the SP can avoid such unexpected tests or exams without raising undue suspicion.
Does the case require the involvement of children?	Some studies may choose not to use child SPs due to concerns over potential harm to and exploitation of children.
Appropriateness to context and research question	
Is the case appropriate to the study objective?	For example, in a study to measure the effect of a quality improvement intervention, the treatment of the case chosen should be sensitive to the intervention. In addition, one might select a 'control' condition which should not show improvement as a result of the intervention.
Do stakeholders agree the case is a 'fair test'?	Ensuring buy-in from funders, partners, implementers and government before implementation improves confidence in the validity of results and can enhance the study's potential to inform practice and policy.
Is the case applicable to all health facilities and regions in the study?	Certain small or specialist facilities may offer a limited range of services. Religious faith may preclude some facilities from offering certain care (e.g. Roman Catholic run facilities might not provide family planning services). A word of caution though—we often come across facilities who say they do not provide care for certain categories of patients, but in practice do provide care when visited by the SP. Service availability should, therefore, be investigated empirically by an SP visit or a scoping exercise rather than relying on researcher assumptions or stated practices.
Does the case represent a public health concern?	Cases should be a public health concern at the individual or population level. This could reflect high prevalence (e.g. malaria); potentially severe consequences such as a high case fatality rate (e.g. heart attack); or the likelihood of unsafe or inappropriate treatment (e.g. overuse of antibiotics for common cold).
Does the case match local epidemiology?	Rare conditions may raise provider suspicion or have very low rates of recognition or correct management.

Table 2 Conditions used in SP studies in health facilities in LMICs

Category	Condition	Number of studies
Sexual and reproductive health	Family planning client	20
	STI symptoms	7
	HIV testing	2
	Suspected pregnancy, seeking abortion	1
	STI screening after partner notification	1
Other infectious diseases	Common cold, respiratory tract infection or influenza-like illness	5
	Malaria	3
	Tuberculosis	1
	Diarrhoea	1
NCDs	Angina	3
	Asthma	2
	Back pain	1
Psychological	Anxiety	2
	Depression	1
Childhood infectious diseases	Diarrhoea (child absent)	4
	Pneumonia (child absent)	1
	Diarrhoea (child present)	1

Source: Review of SP studies in LMIC health facilities, up to December 2016. For further details see Supplementary Appendix.

Table 3 Outcomes to consider in definition of correct management

Outcome	Example
Prescription or dispensing of appropriate drugs	Salbutamol inhaler for asthma
Carrying out or ordering necessary diagnostic tests	mRDT or blood slide for suspected malaria
Referral for further testing (to another facility if necessary)	Suspected TB
No inappropriate testing	No urinalysis for cases without symptoms of urinary tract infection
No harmful treatments	No beta-blockers for asthma
No provision of unnecessary drugs	No antibiotics for upper respiratory tract infection

be based upon national standard treatment guidelines to ensure appropriateness to the study setting, but may need to incorporate international recommendations (such as WHO guidelines) where national guidelines are unavailable. A technical advisory group including clinicians and public health professionals, with knowledge of best practice and experience of local health systems, can also be convened to advise on correct management. Suggested types of outcomes are given in Table 3 covering both actions required, such as the provision of certain drugs or referral, and actions that are not only not required but also may be considered harmful to the patient, or unnecessary care which is not dangerous but nonetheless has an opportunity cost. An alternative to a binary correct management definition is to construct a continuous index by assigning points for different elements of management. However, any such measure will be critically sensitive to the weighting of the different possible correct, incorrect and neutral components of care. Our experience has shown that the types of unnecessary and harmful care provided can be highly unpredictable, so collecting outcomes based solely on a preconceived checklist of what *should* happen may miss much of the care that is actually provided. Researchers should therefore ensure that data collection tools are sufficiently open and flexible to collect data on all laboratory tests, medicines and recommendations provided.

If the sample includes a wide range of providers or facilities, the definition of correct management may need to accommodate a range of potentially correct outcomes, depending on provider qualifications or facility level. For example, in facilities with on-site TB testing, correct management for suspected TB should be defined as the ordering of appropriate diagnostic tests. In smaller facilities without such capacity, correct management may be defined as referral to a higher-level facility.

Regardless of the provider type, researchers will need to make judgements on how lenient or strict/comprehensive the definition of correct management should be, and this can have a dramatic impact on results (Sylvia *et al.*, 2017). Box 1 uses data from Kwan *et al.* (2018) to construct the flowchart of provider actions for 765 SP interactions with providers without a medical degree. If we define correct management as 'asking for a TB-related test', 17.0% are classified as correctly managed. But, of these, 21.5% also gave a contraindicated drug, 42.3% did not mention TB to the patient and 30.8% gave unnecessary (but not contraindicated) drugs, including antibiotics. A stringent definition of correct management as 'asked for a TB-related test without giving contraindicated or unnecessary drugs and discussed the prognosis with the patient' reduces the fraction correctly managed to 0.9%.

Further, the classification of correct management may be conditional on the results of diagnostic tests. For example, correct management of suspected malaria has two steps, the second of which is conditional on the first: a malaria test must be carried out, then an appropriate antimalarial prescribed if the test is positive, or no antimalarial prescribed if the test is negative. Researchers may also wish to consider the true status of the patient in the definition of correct management. For example, if an SP is known not to have malaria, any antimalarial provision could be considered inappropriate even if the provider reports a positive test, though as such tests are not 100% accurate even under ideal conditions, this may identify both faults with the provider and with the test itself.

This complexity of defining correct management is not a flaw of the SP method per se; instead, it highlights the importance of paying close attention to the definitions selected, and the utility of presenting a range of definitions. Finally, while correct management is typically the primary study outcome, it is relatively easy to also collect other outcomes related to the consultation (e.g. history taking) or the patient experience (e.g. waiting time), which provide important context for understanding correct management outcomes. Some suggestions are given in Box 2.

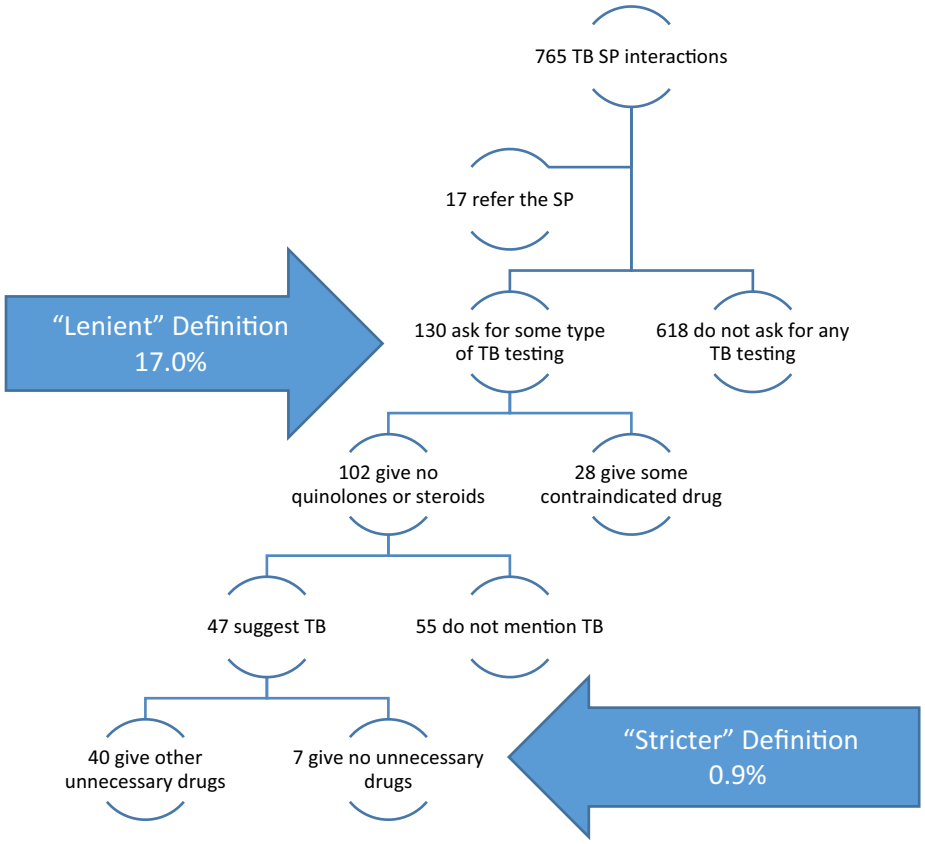
Step 3: designing tools and planning the study

The SP scripts define each case in detail and are the primary means for standardizing the case to ensure comparability across providers. A script begins with a short opening statement which the SP delivers to each provider describing the symptoms (such as 'Doctor, I have a cough and some fever' for suspected TB), which is followed by scripted responses to history questions, which the provider may or may not ask. The SP must not give additional information to the provider outside this script, nor give information from the history question section unprompted. The script should also include a short biography describing the social background, age, occupation, family details and the circumstances of the illness presented.

The corresponding structured questionnaire, which the SP completes after each interaction, captures all information needed to define correct management (physical exams, diagnostic tests, drugs and other treatments), as well as other outcomes of interest and general comments on the visit. It should be completed soon after the visit, either as a self-completed questionnaire by the SP or through an interview of the SP by a supervisor. Developing these tools is an iterative process, and numerous changes will likely be made during piloting and training, with SP trainees themselves playing integral roles throughout this process. Steps to take when developing tools are described in Box 3.

Once the design of cases and tools are underway, the researcher must define a sampling frame and decide on the unit of analysis. Analysis of SP studies can be done at the level of the clinician or the facility. Facility-level analysis is likely to be appropriate when the research questions do not relate to the performance of specific providers, e.g. when evaluating an intervention randomized at the facility level. Provider-level analysis has the advantage of allowing investigators to address additional questions such as the know-do gap of individual providers (Mohanan *et al.*, 2015), or the effect of provider cadre or training on quality. However, provider-level data are more challenging to collect because SPs must visit specific

Box 1. Using a lenient versus stricter definition of correct management for TB has a substantial effect on the proportion defined as correctly managed (data from Kwan *et al.*, 2018)



Box 2. Other possible outcomes

- Waiting time and consultation time
- History taking
- Correct diagnosis
- Total fees paid and fees by type (consultation, laboratory tests, drugs)
- Subjective outcomes such as provider manner and patient-centeredness
- Intervention specific elements (e.g. voucher received)

clinicians identified a priori, which presents two practical challenges: first, the production of a sampling frame of all eligible providers (facility staff lists may be incomplete and providers may work at multiple facilities) and second, the identification of providers by SPs in contexts where name badges are rare and asking for a name may be considered unusual or rude.

Step 4: addressing ethical concerns

Ethical norms in medical research require informed, freely given consent of participants. However, the SP method, by its very nature, requires that providers do not have full information on when or how data collection occurs (Madden *et al.*, 1997). Furthermore, because providers are likely to have substantial knowledge about the quality of their own practice, selective refusal may hamper a study's ability to produce representative data on care real patients receive (Rhodes and Miller, 2012).

Several approaches to provider consent have been used (Table 4), though it should be noted that many studies identified in the literature review (21/45) did not report their consent process.

Where consent is obtained, researchers still need to withhold certain information from participants. The participant should be given a broad window of time during which an SP will visit, not a date or appointment. For example, if SP visits are planned six weeks after consent, the provider can be informed that the visit will occur 'at some point in the next three months'. If the provider asks for a specific date, they should be told that to give one would compromise the nature of the research. A similar explanation should be given if they ask about the type of patient who will visit, or the condition they suffer from. To avoid providers unintentionally being given such sensitive details, ideally the team members conducting the consent process should be blinded to the SP conditions, or the consent process carried out by a senior researcher who will be able to resist pressure from providers to disclose such details. The consent process may be combined with other, non-SP aspects of a study, such as a survey of the health facility or provider knowledge.

Box 3. Key stages in developing scripts and questionnaires

Preliminary observation in health facilities to inform tool design

- How do patients with the condition(s) of interest behave? What vernacular is used to describe symptoms and treatments?
- What questions are asked of patients and what information is collected on them?
- What is the route of a patient through a health facility (e.g. through reception, triage, consultation, laboratory, etc.)? Where and when do they pay (if applicable)?

Writing SP script

- Decide on symptoms, history and biographical details of SP
- Begin with an opening statement giving key information, which should be delivered in a natural manner
- Specify answers to questions which providers typically ask
- Give appropriate amount of information to enable diagnosis, but only in response to appropriate prompting
- Check that language used is appropriate for a typical patient (i.e. not overly medicalized)

Developing questionnaire

- Draft questionnaire content, ensuring that all required outcomes are covered
- Consider using a standardized questionnaire which can be adapted to the case, allowing comparison across cases and studies
- Decide how the questionnaire will be administered:
  - Self-administered questionnaires minimize the time lag between the end of the interaction and debrief, reducing recall bias. Supervisor-administered may allow for probing and checking responses but is more resource-intensive.
  - Smartphone or tablet questionnaire removes need for later data entry. In some settings, smartphones can be carried in the facility without attracting attention

Piloting

- Start with observed role-plays, where a member of the study team or trusted fieldworker performs the script with a provider outside the study who has agreed to assist
- Next, approach other providers outside of the study for consent to do undercover piloting
- Record experiences from each visit, including history questions asked and diagnostic tests ordered, amending the script and questionnaire as necessary
- Piloting visits can also be used to forecast SP fee costs for the study
- Conduct repeated pilots during training

Table 4 Approaches to provider consent in SP studies

Approach	Rationale	Resource-intensiveness of consent process	Number of studies[a]
Waiver of consent	Services are freely accessible by the public and collecting data has minimal risk to providers. Obtaining consent would increase risk of detection, thereby reducing quality of data and harming study aims.	Low: • Submit justification for waiver of consent to ethics committees • Possibly contact providers after completion to inform them that study has been carried out	4
Consent from over-arching entity	If providers or facilities in the study come under the control of an entity (such as a Ministry of Health, a diocese or a chain), a representative of the organization can consent on their behalf.	Low: • Contact representative(s) of organization(s) to inform of study and ask for consent	0
Consent from facility in-charge prior to SP visit	If the data collection and analysis are carried out at the facility (rather than provider) level, the owner and/or manager of the facility can give consent.	Middle: • Contact in-charge of each facility to inform of study and ask for consent	8
Consent from individual providers prior to SP visit	Providers are the participants whose behaviour is observed in the course of the research, and so consent should be obtained from them. This may be considered particularly important if the data collection and analysis are carried out at the provider level.	High: • Identify all individual providers in study • Inform and obtain consent from individual providers • Ensure that SPs only seek care from providers who have consented	12

[a]Studies in review of SP studies in LMIC health facilities for which the consent process was described.

If the waiver of consent approach is chosen, this must be justified to ethics committees, who may not be familiar with the SP method and may be wary of such waivers. Committees may only be prepared to approve such an approach if there are government approvals for the study, and/or a commitment to inform providers that they received an SP by letter or public meeting after data collection is completed. Further risks associated with using a waiver of consent are loss of the trust of a provider if an SP is discovered and risk of aggression towards that SP.

Working as an SP exposes fieldworkers to risks they would not experience during ordinary survey data collection, and it is the responsibility of the study team to minimize and mitigate these risks to the greatest possible extent. This can be achieved through two main pathways. Firstly, the study should be designed to minimize such risks. This must be considered throughout the design process, and has been discussed under other Steps, such as choosing SP conditions that minimize the risk of fieldworkers undergoing invasive tests. Secondly, fieldworkers should be trained intensively to avoid risks which cannot be removed by design (Table 5). One risk-minimizing strategy SPs will frequently need to use is the refusal of invasive tests; a particular challenge is ensuring that the reasons given for refusals come across as normal behaviour and do not raise suspicions. Despite these challenges, experience has shown that the SP method has minimal risk to fieldworkers equipped with proper training (Daniels *et al.*, 2017) and need not inconvenience real patients (Das *et al.*, 2015).

Step 5: training fieldworkers and organizing fieldwork

Playing the role of an SP is more complex and demanding than standard fieldwork, so we recommend recruiting experienced and proven fieldworkers. Although some studies have recruited trained actors, experience indicates that while actors may perform well in improvisation and staying in character, adherence to protocol and precise recall of information are equally important. Many studies have, therefore, drawn from the same population they would use for any survey enumerator position and dedicated several weeks to selecting and training on SP skills.

The mix of SPs may also matter if quality is expected to vary by age, social group or other characteristics. For example, male and female SPs may receive different treatment (Borkhoff *et al.*, 2009), so for cases relevant to both genders, hiring an even mix of men and women and randomly assigning them to facilities should be considered. Alternatively, cases may be portrayed by one gender only; this may be appropriate for cases such as family planning clients, but for other conditions may make the study less generalizable. Researchers should consider whether SPs will need a certain physical appearance to portray the case (e.g. a 60-year-old woman could not portray a family planning client), and the languages spoken by typical patients in the geographical areas of interest.

Administering a background health questionnaire at the start of training is a crucial first step for protecting fieldworkers, maintaining consistency of SP case presentation, and ensuring that real health conditions do not confound the interpretation of results. For example, the physical symptoms of poorly controlled asthma or hypertension may lead a provider to dismiss a possible diagnosis of TB in an SP with a cough and chest pain. This may require consultation with your institution's Human Resources department to check that equal opportunity requirements are balanced with study needs.

Training should begin with an introduction to the concept of SPs, followed by fieldworkers reading and role-playing scripts. They should work in small groups to discuss the patient narrative and identify difficulties with phrasing or context-specific inconsistencies. For example, in a Tanzanian training session run by some of the authors, an initial draft of a script instructed the SP to say that they had never had an HIV test, but trainees noted that this would be implausible for female SPs with children, since HIV testing is ubiquitous in antenatal care there.

Emphasis should be placed on playing the role consistently, never giving more initial information than the opening statement,

Table 5 Strategies for minimizing harm to fieldworkers

Risk	Design choices to minimize harm	Training strategies to minimize harm
Exposure to surface pathogens		• Not touching surfaces unnecessarily • Refusing oral thermometers and reusable tongue depressors • Using alcohol hand rub after each visit
Exposure to blood-borne infections	Avoiding SP cases which will require a venous blood draw	• Refusing injections and venous blood draws on the grounds of not being able to pay, disliking needles or not having time for the procedure
Exposure to airborne infections	Condition should not require extended period of time in areas of higher risk (e.g. TB clinics)	• Not remaining in high-risk areas for long
Harassment/abuse by providers		• Develop strategies during training to avoid or remove self from the situation • Carry letter from study in case the SP needs to reveal self in order to avoid any harm
Invasive physical examinations	Avoiding SP cases which are likely to require intimate exams, e.g. STIs	• Role-play assertively refusing providers who insist on invasive physical exams
Anxiety over health based on diagnoses received	Fieldworker pre-screening health form to establish no pre-existing conditions	• Reassure SPs that diagnoses given by doctor are not real, but given on the basis of fictional symptoms
Treatment or admission	Avoiding SP cases which are serious enough to require immediate treatment or admission	• Train to refuse treatment with excuses such as not being able to pay, to leave the facility if necessary and to reveal role as SP as a last resort

and then providing answers to only the questions the provider asks, which is essential for ensuring measurement reliability. As they learn about the study condition it can be tempting for SPs to help or guide the provider to a correct diagnosis, so training must explain why it is important to avoid this. Comparison across SP studies has confirmed that the amount of information provided heavily influences treatment choices by providers (Miller *et al.*, 2018).

In most studies, each fieldworker performs only one SP case throughout the study. However, training fieldworkers in two roles gives the team more flexibility, though SPs should be randomly allocated to a role at each facility to avoid bias. In studies covering large geographies, it may not be possible for SPs to be randomly allocated to facilities, and an SP-specific variable should be controlled for as a fixed effect in the analysis (Das *et al.*, 2016a). There should be no systematic differences in time of day or week of the visit by condition or SP – e.g. avoid the male SPs always visiting in the morning and female in the afternoon.

In studies in rural or remote locations, particular attention should be paid to 'cover stories', or how SPs explain their presence as an outsider if questioned. One resource-intensive approach is to research in advance the names of villages and people who SPs can say they are visiting, specific to every location. Alternatively, a number of stories can be developed for use in different contexts: e.g. that they are buying cash crops or livestock or researching places to sell second-hand clothing. Experience in the field has taught us that SPs should not improvise: some members of a team were detected after telling one provider they were agents for the government.

Once SPs understand their script and role, introduce them to the questionnaire. A useful training exercise is to have fieldworkers observe the same role-play, then complete the questionnaire separately. Comparing answers highlights difficult parts of the consultation to remember. The final stage of training is SPs practising their roles and questionnaires by making undercover visits to providers who have agreed to take part. It may be helpful for this to initially be done in pairs (e.g. posing as husband and wife) so that peer feedback can be provided.

If SPs are permitted to undergo certain diagnostic tests (e.g. fingerprick blood tests or urinalysis), we recommend that supervisors retest any fieldworker who receives a positive result for malaria or urinary tract infection. This will give peace of mind to the fieldworker (or allow for treatment if a true positive) and validate the facility's test for the purpose of analysis. Supervisors can be trained to conduct malaria rapid diagnostic tests (mRDTs) and urine dipstick tests and be provided with a supply for the field.

SPs should purchase all drugs prescribed, if the budget allows, as this will reduce recall bias when recording drugs prescribed, improve the comprehensiveness of data on medicines, allow for the collection of drug costs and reduce the risk of raising provider suspicion. In addition, it may be possible to incorporate drug quality testing into the study (Wafula *et al.*, 2017). To test the reliability of recall, SPs can carry covert audio recorders, although this may introduce additional ethical issues (Das *et al.*, 2015).

Step 6: assessing detection

A follow-up study to assess the detection rate of SPs (i.e. the proportion of SPs identified by providers as being SPs and not genuine patients) is seen as an important step in ensuring the validity of results. Detection rates from recent health facility LMIC studies have typically varied from 0% to 5% (Das *et al.*, 2015; Daniels *et al.*, 2017; Sylvia *et al.*, 2017), but there is no consensus on a maximum acceptable rate. Higher detection rates can be expected in rural settings compared with urban ones, where outsiders are likely to raise more suspicion. False-positive rates (providers report suspecting real patients to be SPs) varied from 1% to 6% in the same studies.

It may be advantageous to inform providers when obtaining consent that there will be a follow-up study and ask them to make a note of the name, description, symptoms and date if they receive any patients they suspect are SPs. This will allow for easy distinction between true and false detections at follow-up. However, priming providers in this way may increase the risk of detection, so the study team must decide whether they are willing to take this risk for the benefit of ease of classification. In addition, priming is not possible where a waiver of consent or institutional consent is used.

Dependent on setting and resources, the detection survey can be conducted as a face-to-face interview, or remotely by telephone or email. If face-to-face, the survey can be combined with other elements of the study, such as vignettes to measure provider knowledge and compare with SP performance to measure the know-do gap (Das *et al.*, 2015; Mohanan *et al.*, 2015; Sylvia *et al.*, 2017). Carrying out such knowledge assessments after completion of SP visits has the advantage of being less likely to influence provider behaviour than if done before SP visits. In addition, if a waiver of consent has been used, the detection survey is an opportunity to inform providers that SP visits have taken place and allow them to ask questions and provide feedback.

The detection survey should start by briefly reminding (or in the case of a waiver of consent, informing) providers of the SP study's aims and methods, then asking if the provider recalls receiving patients they suspected were SPs. For every suspected SP, the following information should be collected:

- Date and time of visit (approximate if necessary)
- Name, age (approximate) and gender of SP
- Symptoms of SP
- Diagnosis and treatment given by provider
- The reason the provider suspected the patient was an SP
- Whether the provider became suspicious during the visit or after it was complete
- Whether the provider changed their treatment or confronted the SP due to their suspicions

These data should then be used to classify suspected SPs as true or false positives at the analysis stage. The stringency of a true positive definition will depend on setting, conditions and whether providers are primed. Some studies may require that the name of the SP is reported, but others may only require that the provider correctly identifies the gender and symptoms of the SP and gives a date of visit correct to within 1 week.

Conclusion

SPs are a valuable research tool, with enormous potential to improve the measurement of clinical quality in primary care settings. However, their undercover nature means that there are methodological and ethical challenges beyond those found in normal fieldwork. Moreover, SPs in health facilities are much more complex to implement than those in retail outlets. There is growing experience of developing and implementing a range of SP cases in diverse settings, and we hope that this article can help make such learning accessible to those planning similar studies.

The choices made when undertaking an SP study are highly dependent on the setting, purpose and resources. A well-designed

Box 4. Avenues for methodological developments

- Can SPs be trained to make follow-up visits and, therefore, be used to investigate continuity of care in more complex conditions? The principal difficulty here is that in the first round, each SP will likely receive different recommendations, so a single SP condition can morph into multiple pathways when visits are repeated.
- Should correct treatment vary by context? For instance, under what circumstances should referral to a higher-level facility be defined as correct management? Is referral a useful action in remote settings where patients are unlikely to access other facilities?
- How should false positive diagnostic test results be managed? Are these accepted as part of random testing error or are they indicative of poor quality care?
- How representative can SPs be of real patients and their interactions with doctors?
- How can variability caused by SP characteristics be addressed in power calculations? Simulations have suggested that the number of individual SPs may be a critical factor for power calculations (Daniels *et al.*, 2019).

study will draw on a thorough understanding of the health system in question. It will also capitalize on the contribution of fieldworkers during tool development, training and piloting to ensure cases are credible, rarely detected and minimize risk. The task of developing the script, backstory, symptoms and behaviour of an SP should not be underestimated. The process of implementing SPs must therefore be collaborative, incorporating both local knowledge and technical expertise on the SP method.

The absence of Hawthorne effects and the ability to observe healthcare as it is delivered, when controlling the condition and characteristics of that patient, make SPs a valuable tool, which can answer research questions no other method can. We also recognize that the SP method, as currently implemented, has its limitations. With this in mind, we conclude by offering a number of avenues for future methodological development (Box 4). These relate to challenges in investigating the continuity of care, defining correct treatment in different contexts, dealing with false-positive diagnostic tests, conducting power calculations and representativeness of the population of patients.

Ethical approval. No ethical approval was required for this study.

Supplementary data

Supplementary data are available at *Health Policy and Planning* online.

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Conflict of interest statement. None declared.

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4 Chapter 4: Methods

4.1 Study setting and context

4.1.1 Tanzania

The modern state of the United Republic of Tanzania was created in 1964 on the union of Tanganyika, which had become independent of British colonial rule in 1961, with the Zanzibar Archipelago. Tanzania had a population of 45 million at its last census in 2012 [1], and an estimated population of 58 million by 2019 [2]. Population growth is fast, at an annual increase of 3.0%, compared to an average of 1.3% in lower-middle income countries and 2.6% in low-income countries [2], and the total fertility rate remains high at 5.2 children per woman [1]. The country is divided into 31 administrative regions, 26 on the mainland and five on Zanzibar. The administrative regions are further subdivided into 184 districts [1].

The Tanzanian economy has seen strong growth in recent decades, with an average annual real growth rate of 6.8% in GDP between 2013 and 2019 [3], and was reclassified from a low-income to a lower-middle income country by the World Bank in July 2020 [4]. Despite this, 27% of the population live below the national poverty line (equivalent to US$1.35 in purchasing-power-parity terms), and 50% below the international poverty line of US$1.90 [5]. Along with rapid population and economic growth, Tanzania has been urbanising, with 32% of the population living in urban areas in 2015, compared to 21% in 1995 [6]. Dar Es Salaam, the largest city, is projected to reach a population of 10 million by 2029 [6]. Female literacy is 77% (89% among urban residents), and male literacy 83% (94% among urban residents) [1].

4.1.2 Tanzania health profile

Tanzania's life expectancy at birth has improved rapidly in recent decades, from 49.5 years in the period 1995-2000 (having decreased as a result of the HIV/AIDS epidemic) to 64.8 years in 2015-20 [2]. The three leading causes of death in 2019 were neonatal disorders, lower respiratory infection and HIV/AIDS; together these were responsible for 28% of deaths [7]. Adult HIV prevalence is 4.7%, but there has been a 35% reduction in new HIV infections and 49% reduction in AIDS-related deaths since 2010 with the successful rollout of antiretrovirals [8]. There were 32,000 deaths from tuberculosis (TB) and 137,000 incident TB cases in 2019; while these have fallen by 43% and 15% respectively since 2015, Tanzania still has the 15th highest TB burden in the world [9]. Malaria is endemic in Tanzania, and there were 7.1 million cases and 21,000 deaths in 2020 [10], accounting for 3.0% of malaria cases (10th in the world) and 4.1% of malaria deaths (3rd in the world) globally

[11]. Under-five mortality has decreased dramatically, from 130 deaths per 1000 live births in 2000 to 49 per 1000 live births in 2020, below the average of 74 for sub-Saharan African countries [12]. Progress on maternal mortality has been slower, with a decrease from 854 per 100 000 live births in 2010 to 524 per 100 000 live births in 2017, slightly above the average of 542 for sub-Saharan Africa [13].

4.1.3 Health system

The organisation of health services is overseen by the Ministry of Health (MoH) in mainland Tanzania, and the Ministry of Health in Zanzibar (MoHZ) [14]. The ministries have an overall policy setting and stewardship role, but public healthcare delivery is the responsibility of local governments at the district level, who are sent funds directly from treasury and are the employers of healthcare staff [15].

Primary healthcare is delivered in dispensaries, health centres and clinics. Dispensaries are the lowest level of facility and normally only provide preventative and curative outpatient services; health centres are a higher level which can admit patients for inpatient care and sometimes provide surgical services; and clinics are typically private facilities with a similar function to dispensaries [16]. Secondary healthcare is provided by hospitals at the district level, with specialist referral hospitals at the regional, zonal and national levels [14]. All these facilities charge user fees, which for public facilities make up 40-50% of revenue at the facility level [15]. However, there are fee exemptions in public facilities for under-five year olds, pregnant women, family planning services and treatment of a number of specific conditions, including diabetes, cancer, meningitis, TB, leprosy and HIV/AIDS [17].

Tanzania's total health expenditure in 2019 was US$40 per capita [18]. 41% of this was spending by government (made up of 34% government transfers and 7% social health insurance contributions), while 36% came from external donors [18]. The remaining 23% of spending was from private sources: 22% on out-of-pocket payments (OOPs), and just 1% on voluntary health insurance contributions [18]. Total health spending represented 3.8% of the country's GDP. Of this, government health expenditure was equivalent to 1.6% of GDP, and 9.6% of the government's total budget [18]. While OOPs are much lower than the lower-middle income country average of 40%, is more reliant on external aid, which averages just 12% of health expenditure in other lower-middle income countries, and 29% in low income countries [19]. Overall expenditure is well below the international benchmarks of total expenditure of US$86 per capita, or government health spending equal to 5% of GDP, which are suggested in order to achieve Universal Health Coverage [20].

As well as government-funded user fee exemptions, there are a number of social health insurance schemes in the country designed to provide financial risk protection. The largest is the improved Community Health Fund (iCHF), a voluntary scheme with an annual premium of $US15 [21], which generally only covers care at government primary health facilities [16], and pays providers through capitation [22]. It has a population coverage of 23% [23], meaning its depth is shallow in terms of both services and people covered. The National Health Insurance Fund (NHIF) offers more comprehensive cover, including inpatient and outpatient care at any enrolled facility (which can include private facilities), but has an even more limited population coverage of 9% [23]. NHIF was originally established to provide compulsory health insurance for civil servants (who make salary contributions of 3%), and in recent years has also been open to employees of private companies and individuals [23], so would be expected to cover only wealthier parts of the population. NHIF reimburses providers on a fee-for-service basis [22].

4.1.4 Private healthcare provision

4.1.4.1 Typology

The private provision of healthcare in Tanzania can be broadly classified into two sectors: for-profit and not-for-profit facilities. For-profit practice was officially banned in 1977 [24], but after the ban was lifted in 1991 there was a rapid proliferation of for-profit facilities in the country, particularly dispensaries [25]. The Association of Private Health Facilities of Tanzania (APHFTA) is the main body which represents private-for-profit providers [16].

Not-for-profit facilities have a longer established role in the provision of healthcare in the country [25]. The not-for-profit sector encompasses faith-based organisations (FBOs), non-governmental organisations (NGOs) and community-based organisations. Many FBOs fall under the Christian Social Services Commission (CSSC), an umbrella organisation which represents facilities run by its member churches. In 34 districts of mainland Tanzania, there is no government district hospital, so an FBO member CSSC runs a Designated-District Hospital (DDH) [16]. These facilities tend to be closely linked to government, are often government funded and staffed with health workers on the local government payroll, and may be more similar to public than private-for-profit hospitals in management and administration practices. Number of private facilities

To examine the size and growth of the private sector in recent years, in Table 4.1 I compare data extracted from the MoH Health Facility Registry in 2022 [27] to data supplied by the MoH to the World Bank in 2012 [16]. In 2022, 2976 (32%) of Tanzania's 9283 hospitals, health centres, dispensaries and clinics were privately owned, 62% of which were for-profit facilities. For-profit facilities had the largest relative growth between 2012 and 2022, with an 111% increase in the

number of private-for-profit facilities, compared to a 46% increase in the number of facilities overall. The share of facilities operated on a for-profit basis increased from 14% in 2012 to 20% in 2022. Not-for-profit facilities played an important role at the higher level, making up 60% of private hospitals and 31% of all hospitals.

Table 4.1 Tanzanian health facilities by level and sector, 2012-2022

		Public		For-profit		Not-for-profit		**Total**	
		2012	2022	2012	2022	2012	2022	**2012**	**2022**
Hospitals	Number of facilities	103	197	36	83	101	127	**240**	**407**
	% growth 2012-22		*91%*		*131%*		*26%*		***70%***
	% share of facilities	43%	48%	15%	20%	42%	31%		
	Percentage point increase in share 2012-22		*5%*		*5%*		*-11%*		
Health centres	Number of facilities	444	670	55	124	134	172	**633**	**966**
	% growth 2012-22		*51%*		*125%*		*28%*		***53%***
	% share of facilities	70%	69%	9%	13%	21%	18%		
	Percentage point increase in share 2012-22		*-1%*		*4%*		*-3%*		
Dispensaries and clinics	Number of facilities	4057	5440	787	1643	625	827	**5469**	**7910**
	% growth 2012-22		*34%*		*109%*		*32%*		***45%***
	% share of facilities	74%	69%	14%	21%	11%	10%		
	Percentage point increase in share 2012-22		*-5%*		*6%*		*-1%*		
Total	**Number of facilities**	**4604**	**6307**	**878**	**1850**	**860**	**1126**	6342	9283
	% growth 2012-22		***37%***		***111%***		***31%***		***46%***
	% share of facilities	**73%**	**68%**	**14%**	**20%**	**14%**	**12%**		
	Percentage point increase in share 2012-22		**-5%**		**6%**		**-1%**		

Tanzanian private health facilities are concentrated in large cities, with 27% of institutions based in Dar es Salaam, and 9% in Arusha, by a 2016 estimate [26].

4.1.4.2 Utilisation of private facilities

The DHS (Demographic and Health Survey) 2015-16 provides national data on health care utilisation by sector. However, the picture is partial because the DHS only covers a small number of specific health services. It suggests that jointly, private not-for-profit and for-profit medical facilities (that is, not retailers such as pharmacies and drugstores), account for 19% of childbirth care, 12% of the provision of modern contraceptives, and 12% of care for children with fever (Table 4.2) [1]. If only

measuring care at medical facilities (not retailers), the latter two figures rise to 17% and 26% respectively. Comparing between for-profit and not-for profit facilities, the not-for-profit sector dominates in the provision of contraceptives and childbirth care, responsible for 87% of modern contraceptives and 80% of births in private medical facilities. For the treatment of children with fever, for-profit facilities provided 78% of the care in private medical facilities.

Table 4.2: Utilisation by sector from DHS 2015-16

	Public/ Government	Private not-for-profit	Private-for-profit (medical)	Other (including private retail)
Source of modern contraceptive methods (among users aged 15-49)	60.8	10.5	1.6	26.9
Place of delivery (among births in health facilities)	80.8	15.3	3.8	-
Source of advice or treatment for children aged under five with fever (among those for whom advice/treatment sought)	34.0	2.7	9.4	53.0

4.1.4.3 Expenditure in private facilities

Tanzania National Health Accounts do not usually report spending by public or private sector providers, only whether the source of funding was public or private [18]. The most recent estimates of expenditure by sector are from World Bank calculations based on data from 2012, which was provided directly to the World Bank authors by the MoH [16]. It estimated that 67.7% of total health expenditure in Tanzania was spent at health facilities (excluding retailers) [16]. Of this facility expenditure, 69.9% was in public facilities and 30.1% was in the private sector (19.9% in non-for-profit facilities, 11.2% in for-profit facilities).

4.1.5 Quality of care

Many in Tanzanian health facilities lack the basic infrastructure and human resources to offer safe care: in the most recent Service Provision Assessment of 2014-15 [14], one third of facilities did not have regular electricity, an improved water source or handwashing facilities in the outpatient department. The typical dispensary employs one non-doctor clinician (such as a clinical officer or assistant medical officer), three nurses and no pharmacist or laboratory staff. Process quality of care measured in the Service Provision Assessment was also poor [14]. In observations of consultations with sick children, 46% were evaluated for three key symptoms, and just 8% were assessed for three danger signs, as per IMCI management guidelines. Only 20% of providers took an appropriate reproductive history from women seeking family planning for the first time, and only 8% a sufficient history during first antenatal care visits.

In a drive to improve quality of care in health facilities, the MoH introduced a star rating assessment programme in 2014 [14]. In 2015, every facility in the country was assessed and awarded a score between zero and five stars, then given a quality improvement plan [28]. Results were generally poor, with 34% of facilities scoring zero stars and 52% scoring one star, but 72% of all facilities improved their score by the second round of assessment in 2017-18 [28]. Private facilities, both for-profit and not-for-profit, were less likely to improve than public ones, controlling for facility level and baseline score [28].

There are other policy efforts to enforce and improve quality of care nationally. A pay-for-performance programme (known as Results-Based Financing) was piloted from 2011 [29] to incentivise the meeting of targets through bonuses for staff and increased funds for facilities, and has since been scaled up more widely [30]. Evidence on its effects has been mixed, with improvement in certain indicators such as the provision of antimalarials in pregnancy [31], but questions over whether it is cost effective [32] or improves efficiency [33]. Other national policies include implementation of standard treatment guidelines and a national essential medicine list [34], and legislative regulation of drugs and healthcare professionals [24].

4.1.6 SafeCare evaluation

This PhD research was embedded within a Health Systems Research Initiative funded project (supported by the Wellcome Trust, Medical Research Council, Economic and Social Research Council, and the Department for International Development). The research project sought to evaluate the effect of the SafeCare model on quality of care provided in private health facilities in Tanzania. The research partners on the project were the London School of Hygiene and Tropical Medicine (LSHTM), Ifakara Health Institute (IHI), and PharmAccess.

4.1.6.1 SafeCare model

SafeCare is a quality improvement model established by PharmAccess, Joint Commission International, and the Council for Health Service Accreditation of Southern Africa in 2011 [35]. It is aimed at healthcare providers in low resource settings. It follows a stepwise improvement model, where facilities are assessed against a series of quality standards and awarded a level from one to five. The standards and grading process are accredited by the International Society for Quality in Health Care, and are designed to be appropriate even to small facilities with severe shortages or infrastructure issues [36].

After the assessment, facilities are given a tailored quality improvement plan, which prioritises steps to take in order to progress to the next level. Facilities are supported with mentoring and

training on quality of care and good business practices, and are able to apply for loans through the Medical Credit Fund, another PharmAccess initiative, which underwrites local bank loans for health facilities [37]. Facilities receive a repeat SafeCare assessment after 1–2 years, with the intention that they gradually progress through the quality levels. SafeCare has been implemented in over 2500 facilities across 14 countries in sub-Saharan Africa [38].

4.1.6.2 Evaluation design

The evaluation of the impact of SafeCare on quality of care was designed as a cluster-randomised controlled trial with two arms. 237 facilities were recruited (see Section 4.1.6.3 below) to the study in March-November 2016, and randomised to the control or intervention arm after an initial SafeCare assessment. Assessments were carried out by quality assessors, who were typically clinicians (nurses or clinical officers), and had completed a 70-hour training programme with PharmAccess. Facilities in the intervention arm were given the full SafeCare quality improvement package, while facilities in the control arm were given a report of the initial assessment and no further contact until follow-up, which included an endline SafeCare assessment.

Randomisation was stratified by recruitment cohort, partner organisation membership (APHFTA or CSSC), geographical zone and facility level (hospital or non-hospital). Correct management of standardised patients (SPs) was one of the two primary quality of care outcomes, and it is data from these SPs that are used in this thesis, and will be discussed in more detail in Section 4.2. The other primary outcome was compliance of health workers with infection prevention and control practices, which was measured through direct observation. Secondary outcomes were the endline SafeCare assessment score, patient experience-of-care score (measured through exit interviews), patient out-of-pocket spending (measured by standardised patients), and monthly facility caseload and revenue (calculated from facility records for the three preceding months).

4.1.6.3 Sampling of study facilities

Facilities were recruited through partner organisations APHFTA and CSSC. Dispensaries, health centres and district-level (i.e., not referral) hospitals in CSSC, and dispensaries and health centres (hospitals were excluded due to low numbers) in APHFTA were eligible to participate. Facilities were ineligible if they provided specific services only (e.g., mental health or maternity). Facilities were recruited from the Northern, Eastern, Central, Southern and Southern Highlands zones of Tanzania (Lake Zone was excluded because SafeCare had been rolled out there prior to study commencement).

The sampling of study facilities was based on an initial long list of 975 private health facilities provided by the implementing partners (462 APHFTA member facilities and 513 CSSC member facilities). We then worked with the implementing partners to select a sampling frame of 280 facilities that potentially met study eligibility criteria. For the CSSC facilities, we selected a random sample of 124 health facilities, stratified by facility type (dispensary, health centre, hospital). For the APHFTA facilities, we were given a list of 156 health facilities that included dispensaries and health centres.

The partner organisations approached the 280 potentially eligible facilities to confirm eligibility, carry out sensitisation and obtain written informed consent to participate. Of these, 43 declined to participate in the study or were found to be ineligible, such that 237 facilities were recruited at baseline. A map showing the distribution of study facilities across Tanzania is given in Figure 4.1. SP visits were carried out in 227 facilities at endline: nine facilities had closed, and one was owned by a private company and served only their employees, so SPs could not visit undercover. A full trial profile of the SafeCare evaluation is given in Appendix 4.

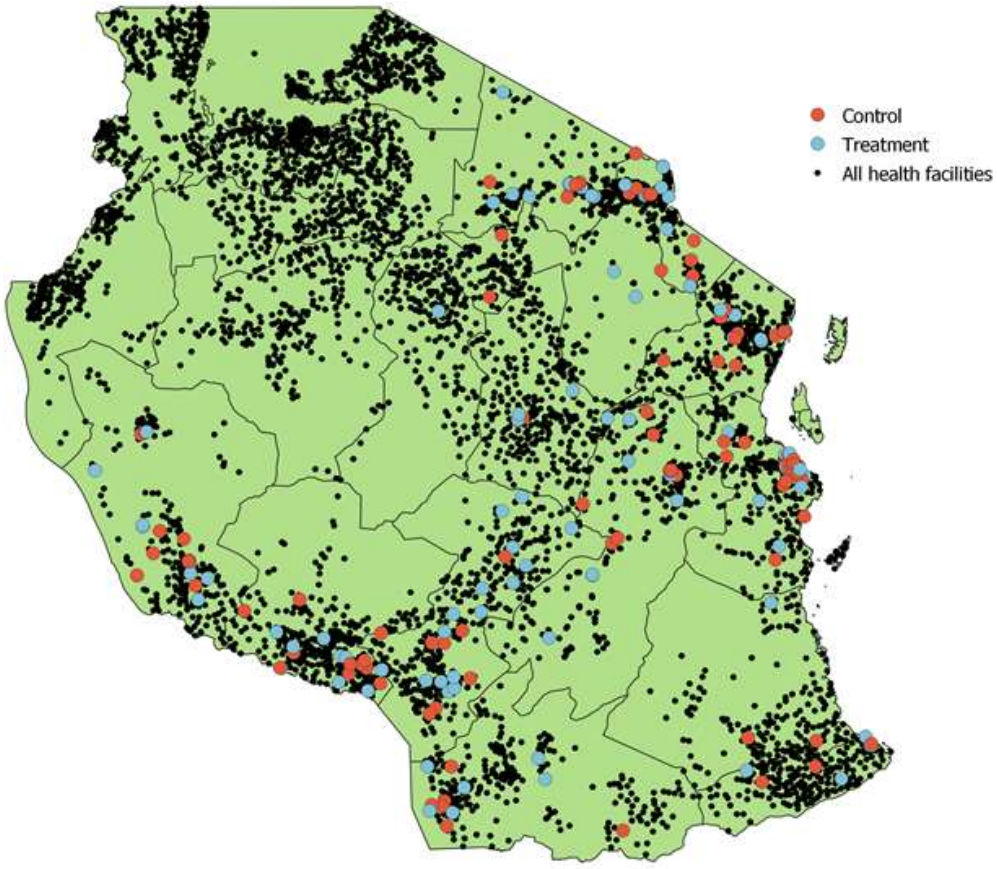


Figure 4.1: Map of Tanzania showing control facilities in red, intervention facilities in blue and other health facilities (public and private) in black

4.1.6.4 Implementation of SafeCare in the evaluation

After the initial SafeCare assessment, intervention arm facilities received a quality improvement plan that highlighted specific areas for improvement, actions to be taken, and the facility staff member responsible. Facilities then received mentoring visits from the quality assessors who carried out the initial assessments, to monitor progress and provide onsite training sessions on topics such as infection control, waste management, customer care, business management, record keeping, and patient rights. Managers and clinicians from the facilities were also invited to off-site classroom training days. Mentoring visits were intended to be quarterly (at least five visits were expected to take place in the 18–24-month study period), and staff from each facility were expected to attend at least two training sessions (either onsite or in the classroom).

Facilities had the opportunity to apply to the Medical Credit Fund (part of the PharmAccess Group) for underwritten loans to fund specific quality improvement activities. A full-time business analyst, employed by the Medical Credit fund, supported the writing of business cases and loan applications for SafeCare facilities.

In practice, intensity of intervention implementation was lower than expected. While all 118 intervention facilities received a quality improvement plan, they received a mean of 3.1 mentoring visits (compared to five expected) and 0.6 training sessions (compared to two expected) [38]. Only two of the 18 facilities successfully received a Medical Credit Fund loan in the intervention period.

4.1.6.5 Evaluation findings

The results of the SafeCare evaluation itself do not form part of this PhD, and are published in full elsewhere [38], but are summarised here to provide context. Looking at the two primary quality of care outcomes, at endline, there was no difference in management of standardised patients, which was correct in 27.0% of visits in intervention facilities and 29.2% in control facilities (adjusted absolute difference -2.8 percentage points, p=0.36). There was some evidence of increased compliance with infection prevention and control practices in the intervention arm, with 56.9% compliance compared to 54.7% in the intervention arm (adjusted absolute difference 2.2 percentage points, p=0.071).

The mean endline SafeCare assessment score was higher in intervention facilities (55.2% compared to 50.8%, p=0.015). There was no evidence of a difference in mean patient experience of care score (90.8% of maximum score in intervention, 90.7% in control, p=0.72) or out-of-pocket spending (US$5.17 in intervention, US$4.91 in control, p=0.87). While intervention facilities had a numerically larger mean monthly revenue (US$8833 vs US$6840), estimates were very imprecise

and there was no evidence this was a true difference (p=0.38). The same phenomenon was observed in monthly caseload (1024 visits in the intervention, 822 in control, p=0.27).

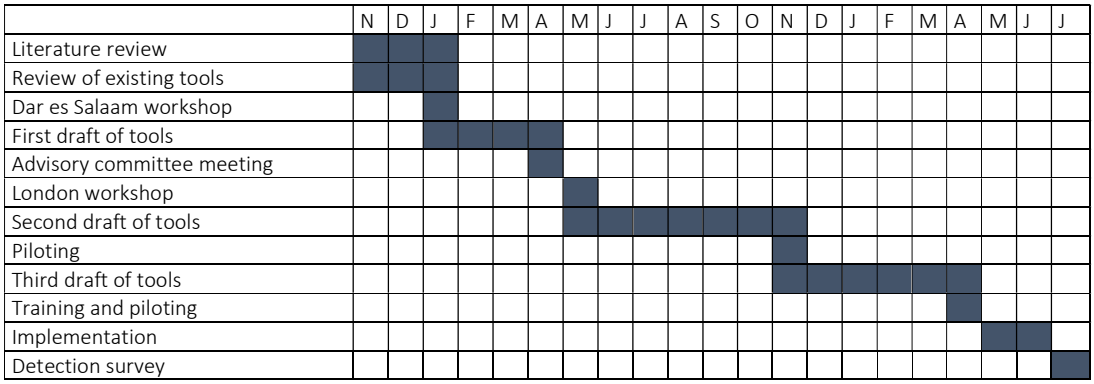
4.2 Standardised patient data collection

4.2.1 Standardised patient cases

4.2.1.1 Development process

SP cases, protocols and tools were developed in a rigorous stepwise process in the period November 2016 - April 2018, illustrated in **Figure 4.2**.

Figure 4.2: Development of SP cases and tools



Key steps included:

1) I conducted a literature review in November 2016 - January 2017. The review identified published examples of the use of covert SPs to evaluate all aspects of clinical care. These were drawn upon as guidance for what was feasible and ethical in SP studies. The review formed the basis of the paper presented in Chapter 3.
2) I reviewed protocols from other SP studies in 2017. SP scripts, debrief questionnaires and protocols were shared by teams from the World Bank and Duke University for two SP studies carried out in India, one examining TB [39], the other asthma, angina and childhood diarrhoea [40]. These were reviewed to identify the key elements required in SP tools and used as a basis to structure drafts of tools.
3) I planned and co-facilitated a one-day workshop in Dar es Salaam in January 2017. The workshop was attended by the LSHTM and IHI study team, representatives of PharmAccess, APHFTA and CSSC, and clinical specialists from IHI. The role and utility of SPs in measuring quality of care in the Tanzanian private sector, and the ability of SP measurement to detect the impact on the SafeCare intervention, were discussed.

4) I attended and presented at study advisory committee meeting in May 2017. Attendees were members of the study advisory committee and other experts in quality of care. the draft SP protocol and specific questions on implementation and analysis of SP data were discussed.
5) I planned and co-facilitated a two-day workshop in London in May 2017. The workshop was attended by the study team, representatives of PharmAccess, and academics with experience of using SPs. The workshop reviewed the proposed SP cases and discussed practical and ethical issues related to fieldwork and training.
6) I oversaw piloting of the SP cases in Tanzania in November 2017. Two fieldworkers were hired to pilot SP cases for one week in and around Dar Es Salaam. Initial visits were overt and pre-arranged with providers, with study team attendance. Cases were further refined, and fieldworkers carried out covert visits at facilities which had consented in advance.
7) I ran final piloting in Dar Es Salaam in April 2018. Final changes were made to the SP cases during training of SPs (further details of training are given in Section 4.2.2).
   The final scripts and debrief questionnaire are given in Appendix 5.

4.2.1.2 SP case choice rationale

I drew up a shortlist of conditions based on (i) the literature review reported in Chapter 3 and (ii) conditions reported to be frequently treated in participating facilities in Tanzania. I assessed each condition on the shortlist for inclusion on the basis of six criteria:

1. Evidence for treatment: is there clinical evidence (preferably national standard treatment guidelines) by which to define correct treatment or management? This was a prerequisite for consideration.
2. Clinical or public health significance: does recognition and correct treatment of the condition have an important public health role, or is it a serious clinical emergency?
3. Frequency in study facilities: is the condition seen commonly enough in study facilities that correct recognition and treatment is feasible, and it will not arouse suspicion?
4. Risk to fieldworker and ethical considerations: will the case necessitate practices which expose the fieldworker to hospital-acquired infection, invasive examinations, or a life-changing diagnosis?
5. Falsifiability of symptoms and ease of diagnoses: can the symptoms be easily falsified by fieldworkers, and will the provider be able to make a diagnosis on the basis of those symptoms during a single consultation with limited laboratory testing?
6. Universal applicability: can the condition be diagnosed or treated, or can an appropriate referral be made, at all facilities in the SafeCare study?

The assessment is summarised in Table 4.3 below. As a result, four conditions were selected as most appropriate for SPs in our study: upper respiratory tract infection (URTI), non-malarial febrile illness (NMFI), TB and asthma.

Table 4.3: Standardised patient cases considered for the SafeCare evaluation

Case/condition	Clinical and public health significance	Frequency in study facilities[1]	Risk to fieldworker and ethical considerations	Falsifiability of symptoms and ease of diagnosis	Universal applicability
Included:					
Asthma	Some (not infectious, can be life-threatening)	Low (40/234)	Low- blood tests only to exclude other conditions	Good- can report distinctive breathing difficulties	Yes
Non-malarial febrile illness	High (life-threatening, infectious, resistance)	High (221/234)	Some- reduced risk with fingerprick testing with single-use lancets	Good- cyclic pattern of fever means no fever required at consultation	Yes
TB	High (underdiagnosed, infectious)	Low (assumed)	Low- X-ray required but not in facility	Good- history of cough and weight-loss, cough need not produce blood	Yes
Upper respiratory tract infection	High (antimicrobial stewardship)	High (178/234)	Low- blood tests only to exclude other conditions	Good- generic symptoms of headache, coughing and running nose	Yes
Excluded:					
Angina	Limited (life-threatening, not infectious)	Low (assumed)	Low- blood tests only to exclude other conditions	Limited- angina patients typically appear seriously unwell	Yes
Child (any condition, absent)	High (often infectious, significant morbidity)	High (assumed)	Low- child is absent	Poor- attending health facility without child not a cultural norm in Tanzania	Yes
Child (any condition, present)			High- child SPs cannot give consent to study participation	Limited- would need to train children	Yes
Depression	High (significant morbidity, underdiagnosed)	Low (assumed)	Low- blood tests unlikely	Limited- unlikely to be recognised non-specialist facilities	Yes
Diabetes	High (significant morbidity, underdiagnosed)	Low (65/234)	Some- blood glucose test requires fingerprick	Limited- symptoms can be falsified but not blood glucose levels	Yes
Diarrhoea	High (significant morbidity, infectious)	High (188/234)	Low- blood tests only to exclude other conditions	Poor- can't provide stool sample	Yes
Family planning client	High	Variable (up to 480 visits per month)[2]	Some- pelvic exam can be refused	Good- no symptoms needed	No[2]
HIV testing	High (infectious)	Medium (85/234)	High- could be mitigated by testing fieldworkers before study	Good- no symptoms needed	Yes
Hypertension	High	Medium (100/234)	Low- blood tests only to exclude other conditions	Poor- will not be hypertensive	Yes
Injuries and accidents	High	Medium (81/234)	Low- blood tests unlikely	Poor- difficult to falsify injuries	Yes
Pregnancy testing	Limited (interest in antenatal care, not pregnancy testing)	High (191/234)	Low- blood tests unlikely	Limited- symptoms easily falsifiable but urinalysis will be negative	Yes
Skin diseases	Limited	High (123/234)	Low- blood tests unlikely	Poor- difficult to falsify skin complaints	Yes

STI	High (significant burden, infectious)	High (147/234)	Some- pelvic/genital exam, difficult to refuse	Limited- can report pain and discharge but can't falsify visible symptoms	Yes
UTI	Limited	High (227/234)	Low- blood tests unlikely	Good- painful and frequent urination	Yes
Worms	High (significant burden)	High (147/234)	Low- blood tests unlikely	Poor- can't provide stool sample	Yes

[1]Study facilities complete a situational analysis (SA+) form when joining the study. Facilities can choose up to ten conditions from a predefined list as the ones most commonly diagnosed or treated. Frequencies listed are the number of facilities which list a given condition as one of their 'top ten'. Data is available for 234 of 237 study facilities.
[2]92 facilities reported having a non-zero number of family planning clients per month (averaged over the last six months) on the SA+. 60 reported zero clients, and 83 reported that the question was not applicable. Data is available for 235 of 237 study facilities.

4.2.1.3 *Standardised patient case details*

The initial presentation and further details of each SP case are given in Table 4.4. If asked about any symptoms not listed, the SP said they did not have them. For the experiment on patient knowledge presented in Chapter 6, half of the URTI SPs were randomised to add the statement "but I don't know what to do because my friend told me he read on the internet that you don't need antibiotics for a simple cough" after their initial presentation. The specific details of methods for that experiment are given in Chapter 6.

Table 4.4: Standardised patient case presentation

SP case	Initial presentation	Further details given if asked	Previous careseeking if asked	Own and family history if asked
Asthma	"I have had a problem with breathing, and last night it became terrible"	Attacks of shortness of breath and wheezing, triggered by exertion, normally at night, lasting 15 minutes to two hours and becoming more frequent over the last year.	None	Used to cough a lot as a child, brother has similar difficulties
Non-malarial febrile illness	"I have a fever and I think I have malaria"	Fever and headache lasting three days, joint and muscle pain.	Has taken paracetamol for two days, has not done a malaria test.	Recent travel to place with higher malaria incidence. Last had malaria one year ago.
Tuberculosis	"I have had a cough and it is not getting better"	Three-week cough with yellow sputum, no blood, low grade fever, chest pain, night sweats, loss of appetite and weight.	Saw a doctor elsewhere one week ago, tested negative for malaria. Took seven-day course of amoxicillin with no improvement.	No TB in the family or contact with TB patients. Never tested for TB.
Upper respiratory tract infection (uninformed)	"I have a cough and my head and throat hurt"	Symptoms for three days, blocked nose and sneezing, no fever.	None	None
Upper respiratory tract infection (informed)	"I have a cough and my head and throat hurt, but I don't know what to do because my friend told me he read on the internet that you don't need antibiotics for a simple cough"			

4.2.2 Recruitment and training

22 fieldworkers (11 men and 11 women) were recruited to train as SPs. At the beginning of the training process, SPs were asked if they had any underlying conditions such diabetes, TB or asthma which would affect a clinician's assessment of their health. One SP had asthma as a child so was

assigned to non-asthma cases only. SPs were trained to portray two of the four cases, either asthma and NMFI, or TB and URTI. Training lasted for two weeks, and content included:

- Introduction to SP methods and important principles (following script, consistency, refusing unsafe care)
- Script content
- Developing cover stories (explaining refusal of care and presence in a remote place)
- Debrief questionnaire on smartphone
- Fieldwork logistics (payment, drug storage)
- Tests on recall of script content and accuracy of form completion
- Undercover practice visits to facilities (first with a partner posing as relative, then alone)

At the end of the training period, 16 SPs were selected to take part in fieldwork on the basis of performance in tests and observations during training. Eight were given the asthma and NMFI role, and eight the TB and URTI role, with four men and four women playing each role. The other six trainees were not selected for fieldwork, though one was re-recruited later during fieldwork to replace an SP who found alternative employment and left the study.

4.2.3 Fieldwork

Consent for SP visits was sought from the manager or in-charge of each facility during an earlier round of fieldwork done for the facility survey, described below in Section 4.3 in February-April 2018, and described below in Section 4.3. They were told that SPs would visit at an unspecified date in the next three months, and were given no details of the types of patients to expect. All 228 facilities at the time of the earlier fieldwork gave their consent. However, one was owned by a private company and served only its employees so SPs could not visit undercover, resulting in a sample size of 227 facilities. The information sheet and consent form are given in Appendix 6.

SP visits were carried out in May and June 2018. SPs were organised into four teams of four people, each with one man and one woman who could play each of the two roles (asthma/NMFI and TB/URTI). Each team was assigned to a region for fieldwork for ease of logistics, rather than randomly. All four SPs in the team visited each facility, and within the team whether the man or woman played each role was randomly assigned for each facility.

SPs approached facilities on foot rather than using study vehicles to avoid attracting attention. When making their visit, SPs refused venous blood draws, sputum tests, X-rays and HIV tests but accepted other laboratory tests including fingerprick tests for malaria and provided urine samples if requested by the clinician. They bought any drugs prescribed but did not buy treatments which

would be administered at the facility (such as injections) or agree to any other type of treatment, such as receiving a saline drip. They paid consultation, testing and drug fees out-of-pocket with cash, as is typical of many patients getting treatment in the private sector.

After the encounter, SPs left the facility and recorded the visit in a structured survey questionnaire through ODK Collect on smartphones. The questionnaire recorded history taking by the doctor, laboratory tests ordered and their results, diagnosis given by the doctor, treatments prescribed and dispensed, and any fees paid. The debrief tool is given in Appendix 5. Responses to the questionnaire were carefully reviewed with the supervisor at the end of each day, or the next day if more practical. Drugs dispensed as a result of the consultation were labelled and stored by the supervisor, then returned to the study team at the end of fieldwork.

4.2.4 Follow up survey

A potential concern with SPs is that they may be identified by the doctor as being a fake patient, with obvious implications for the validity of the data. It is therefore considered best practice to measure the extent to which SPs may be uncovered. In July 2018, after all the SP visits were completed, each facility was contacted by phone to ask if they had suspected a visit from an SP. If they had, the details of the suspected SP were recorded, and were used to confirm whether this was a correct detection. SPs were classified as confirmed detected if the facility gave the SP's name or the correct date of visit. A possible detection was defined if the facility gave some correct details of the SP's presentation, but no name or date which allowed us to confirm whether it was the SP or a real patient. If the facility said they suspected an SP visit, but could not give sufficient detail (or the details contradicted the SP's name, date of visit or presentation), this was not classified as a detection. The tool used for the detection survey is given in Appendix 5. The follow-up calls were completed for 225 facilities (901 SP visits), and 39 visits were classified as detected (4.3%), with a further 9 classified as possible detections (1.0%), giving a total of 48 (5.3%) confirmed or possible detections.

4.2.5 Data management

I downloaded data from the server on a daily basis throughout fieldwork to make quality control checks. After the completion of fieldwork, all data was downloaded and imported into Stata. For every visit in which drugs were dispensed (765 visits, 84.2% of visits), I checked the drugs recorded in the form against the drugs bought and handed into the study team.

4.3 Facility survey data collection

The work in this thesis uses data on facility characteristics collected through the SafeCare evaluation endline health facility survey, as well as standardised patient data. The health facility survey was conducted February-April 2018 in 228 facilities. It comprised an interview with the facility manager on background information (ownership type, staffing, participation in quality improvement programmes and receipt of loans), a management questionnaire, and a review of records to ascertain utilisation and revenue over the most recent three months. Data were collected using ODK Collect on tablets, and the survey tool is given in Appendix 5. Written consent was obtained from the facility manager at the start of the interview, at the same time as consent for future SP visits was sought. All facilities consented to participate. The combined information sheet and consent form for the facility survey and SP visits is given in Appendix 6.

4.4 Analysis approach

The statistical analyses are specific to each research paper and are therefore described in detail in each of the results chapters. Broadly speaking, the approaches to analysis I used were from epidemiology. This includes the language and terminology around the statistical methods. The papers presented in Chapters 5 and 7 are observational studies using cross-sectional data, and the paper presented in Chapter 6 uses an experimental study design. In general, I estimated the prevalence of binary outcomes of interest, and the main effect estimates I used were odds ratios from logistic regression, and relative risks from modified Poisson regression. I estimated differences in continuous outcomes with linear regression (ordinary least squares). The main measures of uncertainty I used were confidence intervals and p-values from statistical tests.

4.5 Ethical considerations

4.5.1 Ethical approvals

The data collection and analysis for this PhD fall under the aims of the SafeCare evaluation in Tanzania. Ethical approval for the SafeCare evaluation was obtained from the national ethics committee in Tanzania (National Institute for Medical Research, NIMR) and institutional committees at LSHTM and IHI. A summary of approvals and amendments is given in **Table 4.5**, and the approval letters are given in Appendix 7. Permission was obtained from NIMR to publish the papers presented in Chapters 5 and 6, which use data collected as part of the study, and permission letters are given in Appendix 8.

Table 4.5: Approvals from ethics committees

	LSHTM	IHI	NIMR
Initial approval	5 Jan 2016 (without study tools), no time limit, annual reports to be submitted Reference number: 10493	9 Mar 2016, valid to 8 Mar 2017 Reference number: IHI/IRB/No:04-2016	17 Feb 2017 – valid to 16 Feb 2018 Reference number: NIMR/HQ/R.8a/Vol. IX/2415
Extension 1	-	3 July 2017, valid to 8 Mar 2018 Reference number: IHI/IRB/EXT/12-2017	29 Dec 2017 – valid to 16 Feb 2019 Reference number: NIMR/HQ/R.8c/Vol. II/914
Extension 2	-	15 Jan 2018, valid to 8 Mar 2019 Reference number: IHI/IRB/EXT/No:001-2018	-
Amendment	13 Sep 2017 amendment to add study tools and ICFs, and to replace vignettes with observations, change SP scenarios and update investigators Reference number: 10493-1	31 July 2017 – amendment to replace vignettes with observations, change SP scenarios and update investigators Reference number: IHI/IRB/AMM/No:009-2017	22 Nov 2017 – amendment to replace vignettes with observations, change SP scenarios and update investigators Reference number: NIMR/HQ/R.8c/Vol. I/543

4.5.2 Special ethical considerations for standardised patients

The use of SPs creates ethical concerns in addition to those of collecting data at health facilities in an overt fashion, as discussed in the paper in Chapter 3. Avoiding unnecessary risks to fieldworkers was a key part of the rationale for choosing SP cases, as discussed in Section 4.2.1.2. Cases were chosen to avoid the likelihood of SPs being asked to undergo invasive exams or requiring venous blood drawn for testing. We chose not to use SP cases involving children to avoid their exposure to infection inside health facilities.

SPs were intensively trained in ways to avoid harm and risk of exposure to infections. They practised strategies for assertively refusing providers who tried to insist on invasive exams, and they developed a number of ways to explain their reasons for not wanting venous blood tests. They were also trained to refuse the use of reusable tongue depressors and unsterilised oral thermometers to avoid infection. They did not buy treatments which might be administered at the facility, such as injectable drugs, to avoid the risk of being given the treatment. SPs were trained to avoid touching surfaces unnecessarily, and were provided with alcohol hand rub to use after each visit[1]. The harm minimisation protocol developed for fieldwork is given in Appendix 10.

[1]The fieldwork was carried out in 2018, before the emergence of the Covid-19 virus. It is possible that the risk assessment and acceptability of sending healthy people to spend extended periods of time in health facilities would now be viewed differently.

Consent for SP visits was sought from the facility in-charge or manager, rather than from individual clinicians. This was for pragmatic reasons: because of rostering and staff turnover, there was no guarantee that the clinician(s) in the facility on the day of seeking consent would be the same as those providing outpatient care on the day of the SP visit up to three months later. Furthermore, it would have been difficult for SPs to identify the clinician they were visiting in order to check whether they had consented, as it was not always standard practice for clinicians to introduce themselves, or wear name badges. This approach could be thought to threaten individual clinician autonomy, since some individual providers would therefore participate without their knowledge or consent. However, the risk of harm to clinicians was judged to be low, as the performance of individual facilities or clinicians was kept confidential and never reported to the facility themselves, partner organisations or in internal or external publications. This low risk of harm was balanced against a high probability of poor data quality if many SP visits could not be carried out because the individual provider could not be identified or had not consented, which would have undermined the study aims.

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5 Chapter 5: Harms and prevalence of overprovision

5.1 Overview

In Chapter 2, I highlighted the limitations of evidence on the prevalence of, and factors associated with, overprovision in low- and middle-income countries. These limitations included the reliance on methods such as record extraction, which rely on the clinician's own judgement, and quality of record-keeping, to assess overprovision. In Chapters 3 and 4, I have explained how standardised patients (SPs), which do not rely on good record-keeping, were used to measure quality of care in Tanzanian private health facilities. In the paper that follows, the first empirical results paper, I used the SP data to understand overprovision in that setting.

I started by conceptualising the harms of overprovision. I argue that all unnecessary healthcare has an economic harm, and some overprovision may additionally have clinical harms (to the individual patient receiving the overprovision), or public health harms, or both. This addresses Objective 2 of this PhD, developing a framework for understanding the potential harms of overprovision.

I then classified all the drugs prescribed and lab tests ordered into whether they were necessary or unnecessary, and the overprovision into specific types of harms, and calculated the proportion falling into each category. A full list of the categorisation of each drug and test is given in the supplementary material for the paper, which is attached in Appendix 10. I estimated the prevalence of various overprovision outcomes, by case type and overall, and compared the prevalence in for-profit and not-for-profit facilities. I also carried out multivariate analysis, simultaneously examining the association between overprovision and profit status, facility location and facility level. This addresses Objective 3 of the PhD, measuring the prevalence of types of overprovision, and comparing prevalence by facility characteristics.

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First Name(s)	Jessica Julia Carne		
Surname/Family Name	King		
Thesis Title	Too much of nothing: measuring, understanding and explaining the overprovision of healthcare in the Tanzanian private sector		
Primary Supervisor	Timothy Powell-Jackson		

If the Research Paper has previously been published please complete Section B, if not please move to Section C.

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SECTION E

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Date	15/08/2022

Supervisor Signature	Timothy Powell-Jackson
Date	25/08/2022

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How much healthcare is wasted? A cross-sectional study of outpatient overprovision in private-for-profit and faith-based health facilities in Tanzania

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Abstract

Overprovision—healthcare whose harm exceeds its benefit—is of increasing concern in low- and middle-income countries, where the growth of the private-for-profit sector may amplify incentives for providing unnecessary care, and achieving universal health coverage will require efficient resource use. Measurement of overprovision has conceptual and practical challenges. We present a framework to conceptualize and measure overprovision, comparing for-profit and not-for-profit private outpatient facilities across 18 of mainland Tanzania's 22 regions. We developed a novel conceptualization of three harms of overprovision: economic (waste of resources), public health (unnecessary use of antimicrobial agents risking development of resistant organisms) and clinical (high risk of harm to individual patients). Standardized patients (SPs) visited 227 health facilities (99 for-profit and 128 not-for-profit) between May 3 and June 12, 2018, completing 909 visits and presenting 4 cases: asthma, non-malarial febrile illness, tuberculosis and upper respiratory tract infection. Tests and treatments prescribed were categorized as necessary or unnecessary, and unnecessary care was classified by type of harm(s). Fifty-three percent of 1995 drugs prescribed and 43% of 891 tests ordered were unnecessary. At the patient-visit level, 81% of SPs received unnecessary care, 67% received care harmful to public health (prescription of unnecessary antibiotics or antimalarials) and 6% received clinically harmful care. Thirteen percent of SPs were prescribed an antibiotic defined by WHO as 'Watch' (high priority for antimicrobial stewardship). Although overprovision was common in all sectors and geographical regions, clinically harmful care was more likely in for-profit than faith-based facilities and less common in urban than rural areas. Overprovision was widespread in both for-profit and not-for-profit facilities, suggesting considerable waste in the private sector, not solely driven by profit. Unnecessary antibiotic or antimalarial prescriptions are of concern for the development of antimicrobial resistance. Option for policymakers to address overprovision includes the use of strategic purchasing arrangements, provider training and patient education.

Keywords: Overprovision, antimicrobial resistance, quality of care

Introduction

Addressing inefficiency is crucial if governments are to free up scarce resources needed to strengthen comprehensive health service delivery towards the attainment of the sustainable development goals (Stenberg *et al.*, 2017). One way to reduce inefficiency is to tackle waste. WHO estimates that 20–40% of spending on health is wasted and that an important component is overprovision of healthcare (WHO, 2010). Overprovision has been defined as provision of medical services for which the potential for harm exceeds the potential for benefit (Chassin and Galvin, 1998). It includes unnecessary testing, procedures, medication, referral or inpatient admissions (Brownlee *et al.*, 2017) and frequently coexists with underprovision (James *et al.*, 2011).

There are numerous negative consequences of overprovision. First, there are the risks of unnecessary adverse events, without any corresponding health benefits. In addition to physical side effects, overprovision may cause patients anxiety. This may occur when waiting for test results, or if inconclusive or false-positive results lead to unnecessary investigations or diagnosis of a disease they do not have or that is not causing them harm (Kale and Korenstein, 2018; Korenstein *et al.*, 2018). Overprovision is also wasteful. It results in substantial costs for publicly funded and insurance-based health systems, reducing resources available for effective care (Russell, 1992). While such inefficiency is a major concern in all health systems (Evans *et al.*, 2001), it is of particular importance for low- and middle-income countries (LMICs) striving to move towards universal health coverage in a context of tight fiscal constraints, which could become even more strained with the global slowdown of the economy in the light of COVID-19 (Das *et al.*, 2018; Lagomarsino *et al.*, 2012). Overprovision can also result in substantial unnecessary expenditures for households, in the form of out-of-pocket

Key messages

- Limited resources available for universal health coverage must be used efficiently in low- and middle-income countries, and overprovision is not only wasteful but can cause clinical harm to individual patients and wider public health harms.
- By sending standardized patients (SPs) to 227 private-for-profit and faith-based health facilities in Tanzania, we found 81.4% of patients received some unnecessary care, 67.2% received care that could threaten public health (prescription of an unnecessary antibiotic or antimalarial) and 6.2% received care that could be clinically harmful to the individual patient.
- Private-for-profit facilities were more likely to provide potentially clinically harmful care than not-for-profit facilities but no more likely to provide unnecessary care or care harmful to public health.
- Policymakers need to understand factors that lead to overprovision when considering interventions such as changing provider payment mechanism, training and consumer education.

payments for user fees or insurance co-payments (Hume *et al.*, 2008). Patients may also incur the opportunity costs of lost time and wages from receiving unnecessary care or from adverse events (Korenstein *et al.*, 2018). Finally, overprovision can have broader public health consequences; a commonly highlighted type of overprovision is unnecessary use of antibiotics and antimalarials, which contributes to antimicrobial resistance (AMR) (Laxminarayan *et al.*, 2013; Llor and Bjerrum, 2014). It is estimated that drug-resistant infections will account for 10 million deaths annually by 2050 (O'Neill, 2016), with inappropriate antimicrobial use recognized as a primary driver of AMR (Llor and Bjerrum, 2014).

Overprovision is commonly highlighted in high-income countries (Brownlee *et al.*, 2017), with documentation of tests, treatments and procedures for which the risks outweigh the benefits for all patients or certain patient groups (Morgan *et al.*, 2019). In LMICs, however, the focus has typically been on underprovision, driven by poor access to healthcare and lack of resources within the health system (Glasziou *et al.*, 2017), while the question of overprovision has received little attention.

There are substantial methodological challenges in measuring overprovision in all settings. Some empirical work identifies overprovision in an indirect way by comparing prescription rates or use of healthcare (e.g. caesarean sections) across groups or against an established benchmark. Such indirect measures allow identification of facilities, geographical areas or patient groups with relatively high rates of certain practices or which exceed established norms. For example, a Brazilian birth cohort study found that 81% of private sector patients underwent a caesarean section, compared to 36% of public sector patients (Barros *et al.*, 2011). Indirect measures are also frequently used as an indication of antibiotic overprovision. For example, global consumption of antibiotics is estimated to have increased by 39% between 2000 and 2015, driven mainly by LMICs (Klein *et al.*, 2018). However, such aggregate measures do not provide a measure of actual overprovision; they can only suggest that overprovision may exist, as there is no indication of what appropriate rates of provision should be. They also ignore case-mix variation, and may fail to identify overprovision if rates are universally inappropriately high.

Direct measures of overprovision tackle these issues by using individual patient level data, comparing care provided to pre-defined treatment guidelines for a specific clinical scenario. In practice such measures can be challenging to implement, as much medical care falls into a 'grey zone' where there is considerable scope for clinical judgement in reference to the individual case confronting the provider, and an incomplete evidence base means it is not always possible to classify care as definitively necessary or unnecessary (Brownlee *et al.*, 2017). Even where appropriate care is clearly defined, direct measurement is rarely possible from routine medical records, which can only ever reveal the clinician's actions and judgements, not the true condition. Moreover, in LMICs, record availability is very patchy, and where present they generally contain insufficient details on clinical presentation and history for an assessment of appropriateness of diagnosis and care to be made (Aung *et al.*, 2012). As a result, the limited number of LMIC studies using direct measures based on medical records have small sample sizes from middle-income settings (Al-Tehewy *et al.*, 2009; Gontijo *et al.*, 2005; Hou *et al.*, 2013; Osatakul and Puetpaiboon, 2007; Kotwani *et al.*, 2012; Sulis *et al.*, 2020a), with only two from a sub-Saharan African context.

Standardized patients (SPs) are an alternative tool for direct measurement of overprovision. They are increasingly used for measuring clinical quality of care in large studies, in order to assess deficits in care (Christian *et al.*, 2018) and evaluate quality improvement strategies (Mathews *et al.*, 2009). SPs have particular strengths for direct measurement of overprovision as it is possible to define what care is necessary for the case presented, they control for patient-mix, and providers are blinded to measurement (King *et al.*, 2019; Kwan *et al.*, 2019). While SP studies do not typically have a primary objective of measuring overprovision, a small number of studies report on some aspects of overprovision. A study of informal providers in India found that 70% of SPs (with symptoms of asthma, angina or an absent child with diarrhoea) were given some unnecessary or harmful care (Das *et al.*, 2016a), while a similar study of angina and asthma SPs visiting public and private Indian health facilities found 80% were given unnecessary care (Das *et al.*, 2016b). In rural health facilities in China, 64% of SPs (with symptoms of angina or an absent child with diarrhoea) were prescribed an unnecessary or harmful drug (Sylvia *et al.*, 2015), and 42% of SPs (with symptoms of tuberculosis (TB), angina or an absent child with diarrhoea) were prescribed inappropriate antibiotics (Xue *et al.*, 2018). A study of SPs with symptoms of angina, asthma, TB or an absent child with diarrhoea visiting public and private health facilities in Nairobi, Kenya, found that 50% were prescribed an unnecessary antibiotic (Sulis *et al.*, 2020b). Analysis of several studies using SPs with TB symptoms found that between 8% and 97% of SPs were given some kind of unnecessary care, dependent on country, setting and provider type (Daniels *et al.*, 2019).

There is concern that overprovision may be a particular problem in private for-profit facilities (Berendes *et al.*, 2011), because information problems and fee-for service payment or

reimbursement systems combine to incentivize providers to induce demand beyond that which an informed patient would choose (Darby and Karni, 1973). The private healthcare sector is expanding rapidly in LMICs. Analysis of Demographic and Health Surveys in 70 LMICs suggests that the private sector provides around 63–67% of care for sick children and 30–39% of maternal healthcare, when averaged across countries (Grepin, 2016). While the private sector category in such surveys also includes faith-based facilities which are important in some contexts, it is the for-profit facilities that are growing most rapidly (Kagawa *et al.*, 2012). There is therefore increasing interest in ensuring that care delivered by private for-profit facilities is appropriate.

We set out to quantify the prevalence of overprovision to outpatients visiting private health facilities in Tanzania and to investigate whether overprovision varied by profit status. We first provide a novel conceptualization of overprovision, classifying care in terms of whether it causes an economic, clinical and/or public health harm, to define a set of overprovision indicators for both drugs and tests. Using undercover SPs, we measure overprovision for four cases of asthma, non-malarial febrile illness (NMFI), tuberculosis (TB) and upper respiratory tract infection (URTI), in a large sample of for-profit and not-for-profit facilities across Tanzania.

Methods

Conceptualizing overprovision

We conceptualize the harms of overprovision as falling into three overlapping categories: economic, clinical, and public health harm (Figure 1). All overprovision is classified as an economic harm as any unnecessary care involves waste of resources for the patient, provider or the health system funder. In addition, some forms of overprovision are also considered to have a potential clinical harm, a public health harm or both.

Drugs are classified as unnecessary (economic harm) if they are neither 'required' nor 'palliative' for a specific case. Required drugs are those recommended as correct treatment for the condition in the national standard treatment guidelines (The Ministry of Health, 2017). Palliative drugs are those not required but for which there is evidence or recommendation for control of symptoms. Unnecessary drugs can be further divided into clinical harm if there is a potential significant risk to patient health from short-term use (e.g. a non-steroidal anti-inflammatory medicine for asthma patients) or from delivery through a high-risk route (e.g. an IV drip); or as a public health harm if personal use has potential to increase AMR and thus indirectly affect the health of others (e.g. provision of antibiotics or antimalarials for a patient with an uncomplicated viral URTI, or an antimalarial for a patient with a negative malaria blood test). An example of a drug with an economic harm, but no clinical or public health harm, would be paracetamol for a patient with asthma: it will neither treat the condition nor alleviate their symptoms and is therefore wasteful. An example of a drug which may cause all three harms would be fluoroquinolone antibiotics for a patient with TB: this could mask the symptoms, delaying access to correct treatment and therefore causing clinical harm, as well as risking the development of AMR, and being wasteful.

Diagnostic tests are classified as unnecessary/an economic harm if they were neither 'required' nor 'appropriate' for a specific case. Required tests were those recommended as part of correct management of the condition or symptoms in the national standard treatment guidelines (The Ministry of Health, 2017). Appropriate tests were those not required but still considered potentially useful for making a diagnosis given the symptoms and setting. Unnecessary tests were further classified as clinically harmful if there was a potential significant health risk to the patient from the test, such as an unnecessary CT scan exposing a patient to a high dose of radiation. A test with an economic harm but no clinical harm would be urinalysis for a patient without symptoms of a urinary tract infection. A test which could cause public health harm might be a low-specificity antibody test for a highly transmissible virus: a false positive could encourage someone to risk exposure (and thus infection and onward transmission to others) because they believe themselves to be immune (Mallapaty, 2020). We acknowledge that there are grey areas classifying diagnostic tests: some unnecessary tests may be clearly 'inappropriate' (not helpful in making or ruling out a diagnosis), while others could be considered 'rarely appropriate' (unlikely to be appropriate except in rare circumstances, for example, a Widal test for typhoid in a patient with malaria symptoms). As rarely appropriate tests would not be considered typical good practice, we classify rarely appropriate tests as unnecessary.

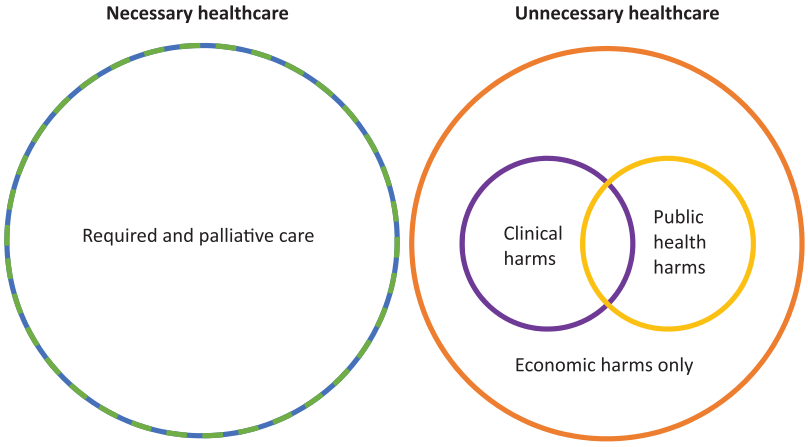

Figure 1. Conceptualizing the harms caused by overprovision.

Study facilities

Data were collected between 3rd May and 12th June 2018 as part of a wider evaluation of a quality improvement programme in 227 Tanzanian for-profit, faith-based and NGO private health facilities. The faith-based sector is closely tied to the public sector, often employing government-salaried health workers (Boulenger *et al.*, 2014). Faith-based facilities normally charge fees (or invoice health insurance) to recuperate the costs of care, but may provide free care for certain conditions or to the poorest patients. More detail on facility selection is provided in the appendix. Potentially eligible facilities in the Northern, Eastern, Central, Southern and Southern Highlands zones of Tanzania were identified by the Association of Private Health Facilities in Tanzania and the Christian Social Services Commission from among their members. Facilities were ineligible if they refused consent, provided specific services only (e.g. mental health or maternity) or were tertiary hospitals. The sample included dispensaries (the lowest level of health facility, often staffed by a single clinical officer with three years of post-secondary clinical training), health centres (a larger facility with more staff and which may admit patients) and hospitals (which all have inpatient wards and usually have a fully qualified doctor on staff). Study facilities were widely dispersed across both urban and rural areas, in 18 of mainland Tanzania's 22 regions.

Data collection

SPs are undercover healthy fieldworkers, trained to present at health facilities reporting specific symptoms and history and to record the care they receive. We describe the methods and the protocol for the safety of SPs in more detail in the appendix. Based on pre-defined selection criteria and a systematic review of the literature (King *et al.*, 2019), we developed four SP cases: asthma, NMFI, TB and URTI. Symptoms and required drugs and tests for each case are described in Table 1. These cases were selected because there were clear clinical guidelines on their management, they were of clinical and/or public health significance, they were reasonably common in all study facilities, healthy SPs could falsify the symptoms and they posed minimal risks to SPs, for example from invasive examinations.

We trained 17 SPs for two weeks, with extensive piloting and testing to ensure faithful presentation of case scripts and accurate recall of events. Facility managers were asked to consent to a visit from an undercover SP that would take place at an unspecified date over the next three months. Each facility received the four SP cases. SPs were organized into teams of four containing two male and two female SPs, each of whom were trained to portray two cases. For each facility, whether the case would be portrayed by the female or male SP was randomly assigned. Teams were allocated to facilities according to geographical region to ease logistics.

SPs completed a debriefing questionnaire on a smartphone using Open Data Kit Collect immediately after the visit, and fieldwork supervisors verified the information with the SP the same day. The questionnaire recorded history taking by the doctor, laboratory tests ordered and their results, diagnosis given by the doctor, treatments prescribed and dispensed, and any fees paid. For safety reasons, SPs refused venous blood draws, sputum tests, X-rays and HIV tests but did record them as ordered. If asked about their HIV status, SPs said they did not know. SPs carried out other laboratory tests including fingerprick tests for malaria and provided urine samples if requested by the clinician. They bought any drugs prescribed but did not buy treatments which would be administered at the facility (such as injections) or agree to any other type of treatment, such as receiving a saline drip. In a follow-up telephone survey with facility managers, 5.3% of SP visits were categorized as detected; 0.5% of visits to for-profit facilities were detected, compared to 9.1% of those to not-for-profit facilities (Supplementary Appendix Table A4).

Analysis

We analysed the data at two levels: first, at the level of item provided (i.e. out of all drugs prescribed or all tests ordered); and second, at the level of the patient visit. At the item level, we calculated the proportion of all drugs prescribed that fell into the categories: required, palliative, economic harm, clinical harm and public health harm. Similarly tests were classified as: required, appropriate, economic harm, clinical harm and public health harm. Classification of care into harms was developed with a clinician experienced in working in low-resource settings and a pharmacist specializing in the rational use of medicines. A full categorization of all drugs and tests is given in Supplementary Appendix Table A2.

We then carried out the analysis of overprovision at the patient-visit level. We defined an overall patient-visit level

Table 1. SP case presentation and correct management

Case	Symptoms	Required drugs and tests	Palliative drugs	Appropriate tests
Asthma	Describes history of attacks of wheezing and difficulty breathing, which are brought on by physical exertion	Prescription of salbutamol or other beta-2 antagonists or steroid inhalers	Other β_2 antagonists and steroids, antihistamines and xanthines	Allergy tests, electrocardiogram, HIV and X-ray
NMFI	Three-day fever and headache, SP says that they think they have malaria	Malaria test with negative result and no prescription of antimalarial	Cold and flu combinations, cough syrups, NSAIDs[a] and paracetamol	Complete blood count and HIV
TB	Three-week cough, weight loss and night sweats	Order or refer for sputum TB testing	Cold and flu combinations, cough syrups, NSAIDs and paracetamol	Complete blood count, HIV, malaria, X-ray and Widal
URTI	Three-day cough, sore throat, blocked nose and headache	No prescription of antibiotic	Cold and flu combinations, cough syrups, NSAIDs and paracetamol	HIV and malaria

[a]Non-steroidal anti-inflammatory drugs.

Table 2. Definitions of patient-visit level overprovision outcomes

Economic harms	
Any unnecessary care	Prescription of unnecessary drug or test
Unnecessary medication	Prescription of unnecessary drug
Unnecessary diagnostic test	Order or recommendation of unnecessary test
Clinical harms	
Any clinical harm	Prescription of drug defined as clinically harmful, or drug administered through a high-risk route (e.g. IV drip), or ordering a clinically harmful test
Public health harms	
Any public health harm	Prescription of unnecessary antibiotic or antimalarial, or test harmful to public health
Any unnecessary antimalarial	Prescription of unnecessary antimalarial
Any unnecessary antibiotic	Prescription of unnecessary antibiotic
Multiple antibiotics	Prescription of two or more antibiotics
Any WHO Watch or Reserve list antibiotic	Prescription of antibiotic listed by WHO as a high priority for antimicrobial stewardship (The Ministry of Health, 2017)

Table 3. Facility characteristics

	Total ($n = 227$)	For-profit ($n = 99$)	Not-for-profit ($n = 128$)	*P*-value for association with profit status
Profit status				
For-profit	99 (43.6%)			
Not-for profit	128 (56.4%)			
Facility level				<0.001
Dispensary	125 (55.1%)	81 (81.8%)	44 (34.4%)	
Health centre	66 (29.1%)	18 (18.2%)	48 (37.5%)	
Hospital	36 (15.9%)	0 (0.0%)	36 (28.1%)	
Location				<0.001
Rural	96 (42.3%)	13 (13.1%)	83 (64.8%)	
Peri-Urban	61 (26.9%)	39 (39.4%)	22 (17.2%)	
Urban	70 (30.8%)	47 (47.5%)	23 (18.0%)	

P-values derived from chi-squared test for association.

outcome for each of the three domains of harm (economic, clinical and public health), with additional outcomes of specific interest defined for economic and public health harms (Table 2). We calculated the prevalence of these outcomes overall and by case. These outcomes capture the presence of any overprovision within a consultation rather than the intensity of overprovision, which is measured by the drug and test level outcomes.

To examine the role of profit status in overprovision, facilities were categorized as not-for profit if faith-based or run by an NGO, and for-profit otherwise. Hospitals were excluded from this facility level analysis as all 36 hospitals in the sample were not-for-profit. Odds ratios for the relationship between the three overall patient-visit level outcomes and profit status were calculated for each of the four SP cases using logistic regression. In order to adjust for other facility characteristics associated with profit status, a multivariate analysis was then carried out combining the four cases. To assess the validity of pooling the four SP cases, likelihood ratio tests were performed to test for interaction between profit status and SP case for each of the three outcomes. We used multilevel logistic regression with profit status, facility level (dispensary or health centre), location type (urban, peri-urban or rural) and SP fieldworker fixed effects, and facility random effects, to calculate odds ratios for the association between the three outcomes and the facility characteristics.

Results

Of the 227 health facilities where SP visits were completed, 56.4% were not-for-profit facilities and the remaining 43.6% private for-profit (Table 3). The majority (55.1%) were dispensaries, the rest being health centres (29.1%) and hospitals (15.9%). Dispensaries were more likely to be for-profit and health centres not-for-profit. All 36 hospitals were not-for-profit. Most rural facilities were not-for-profit, while for-profit facilities dominated in peri-urban and urban areas.

Nine hundred and nine SP visits were completed. One thousand nine hundred and fifty five drug items were prescribed to the 909 SPs. The mean number of drugs prescribed was 1.8 for asthma SPs, 1.7 for NMFI, 2.4 for TB and 2.7 for URTI. The minimum number of drugs prescribed was 0 and maximum was 7. Of all drugs prescribed, 41 could not be identified and were therefore not categorized. Of the 1914 drugs categorized, 46.2% were defined as required or palliative, and 53.8% as unnecessary (Figure 2). Three percent of drugs were classed as clinically harmful, 35.3% as a public health harm and 0.3% as both. SPs presenting with TB symptoms were most likely to be prescribed unnecessary drugs (60.2%), and those presenting with asthma least likely (46.6%).

Eight hundred ninety one tests were ordered for the 909 SPs. The mean number of tests ordered was 0.5 for asthma, 1.8 for NMFI, 0.9 for TB and 0.8 for URTI. The minimum number of tests ordered was 0 and maximum was 6. Of all tests ordered, 56.7% were categorized as required or appropriate and 43.3% as unnecessary. No tests were classified as having public health or clinical harms (Figure 3). The percentage deemed unnecessary ranged from 26.5% for TB SPs to 85.0% for asthma SPs.

At the patient-visit level, the prevalence of economic and public health harms was generally high, while clinical harm measures were substantially lower (Table 4). In 81.4% of visits, SPs were ordered some kind of unnecessary care, with 72.8% prescribed unnecessary medication and 29.8% ordered an unnecessary test. Unnecessary care was almost universal among those with URTI symptoms, with 97.8% receiving some unnecessary care, mainly unnecessary medications (prescribed to 95.6%), though unnecessary tests were ordered for a substantial minority (25.6% of SPs). SPs with

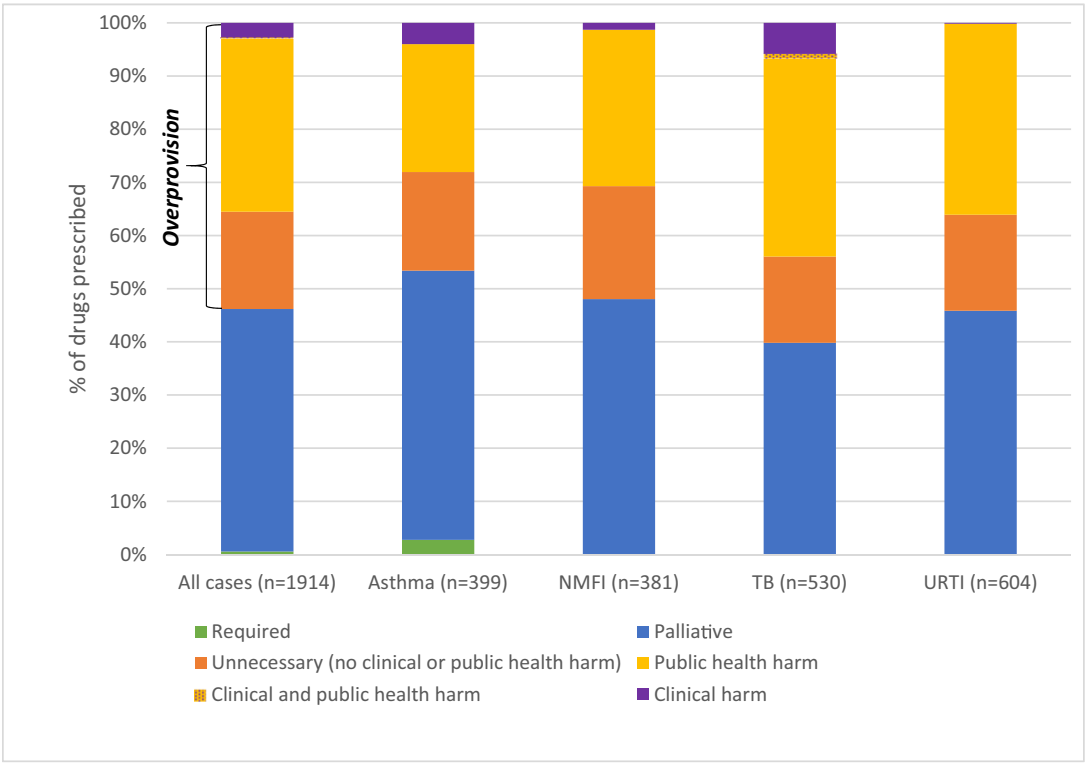

Figure 2. Drugs prescribed to SPs by overprovision category.

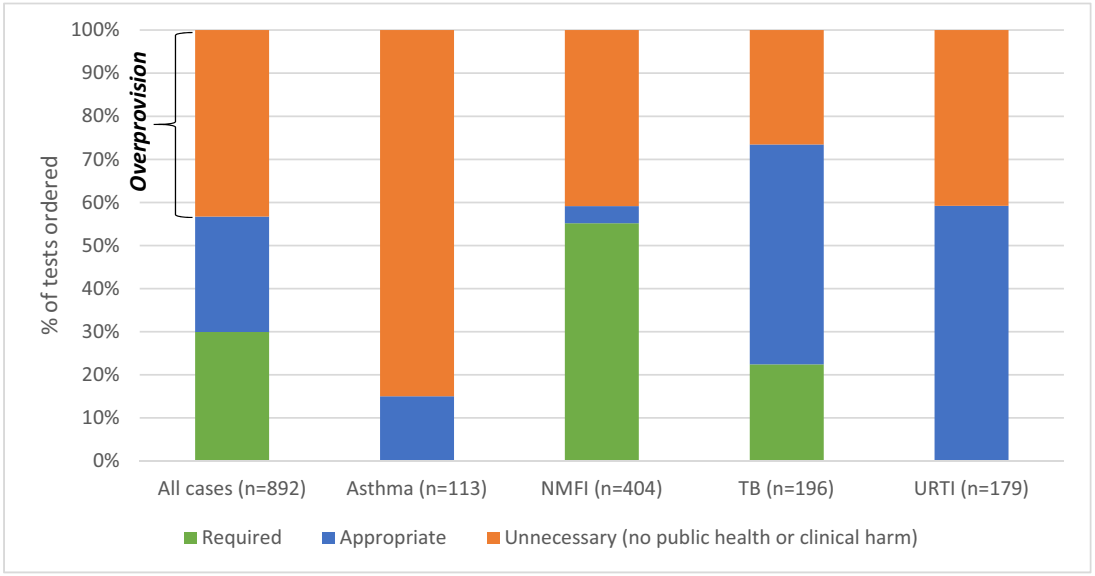

Figure 3. Tests recommended to SPs by overprovision category.

asthma symptoms were least likely to experience overprovision, though a majority still received some unnecessary care (62.1%), mainly unnecessary medications (52.4%). SPs presenting with NMFI symptoms were particularly likely (55.3%) to be ordered an unnecessary test, most frequently urinalysis (in 40.8% of NMFI SPs) and Widal testing (in 23.7%).

6.2% of SPs were prescribed a medication or IV fluids deemed clinically harmful; this was mainly driven by medications with only 0.2% of SPs ordered IV fluids. Provision of harmful medication was most common for SPs with TB symptoms (15.0%); in this case, steroids (prescribed to 12.3% of TB SPs) and fluoroquinolones (2.2% of TB SPs) were defined as clinically harmful due to their potential to supress TB symptoms (and therefore prevent diagnosis) without treating the disease. Non-steroidal anti-inflammatories were defined as harmful for the asthma case and prescribed to 5.3% of asthma SPs. Diazepam and tramadol were defined as clinically harmful in all cases due to a high risk of habit-forming and were prescribed to 0.7% and 0.6% of all SPs, respectively.

Table 4. Prevalence of overprovision at the patient-visit level (percent, 95% confidence interval)

Measures	All cases[a] ($n = 909$)	Asthma ($n = 227$)	NMFI ($n = 228$)	TB ($n = 227$)	URTI ($n = 227$)
Economic harms					
Any unnecessary care	81.4 (78.8–84.0)	62.1 (55.5–68.4)	79.4 (73.5–84.4)	86.3 (81.2–90.5)	97.8 (94.9–99.3)
Unnecessary medication	72.8 (69.7–76.0)	52.4 (45.7–59.1)	62.7 (56.1–69.0)	80.6 (74.9–85.5)	95.6 (92.0–97.9)
Unnecessary diagnostic test	29.8 (26.4–33.2)	21.1 (16.0–27.0)	55.3 (48.6–61.8)	17.2 (12.5–22.7)	25.6 (20.0–31.7)
Clinical harms					
Any clinically harmful treatment	6.2 (4.6–8.0)	7.0 (4.1–11.2)	2.2 (0.7–5.0)	15.0 (10.6–19.3)	0.4 (0.0–2.4)
Public health harms					
Any public health harm	67.3 (63.9–70.7)	41.0 (34.5–47.7)	58.3 (51.6–64.8)	78.4 (72.5–83.6)	91.6 (87.2–94.9)
Any antimalarial	8.9 (6.8–11.0)	0.9 (0.1–3.1)	24.1 (18.7–30.2)	2.6 (1.0–5.7)	7.9 (4.8–12.2)
Any antibiotic	62.7 (59.3–66.1)	40.5 (34.1–47.2)	42.5 (36.0–49.2)	78.0 (72.0–83.2)	89.9 (85.2–93.5)
Multiple antibiotics	5.5 (3.9–7.1)	1.8 (0.5–4.5)	4.4 (2.1–7.9)	11.0 (7.3–15.8)	4.8 (2.4–8.5)
Any WHO Watch or Reserve list antibiotic	13.1 (10.7–15.5)	5.7 (3.1–9.6)	18.9 (14.0–24.6)	16.3 (11.7–21.8)	11.5 (7.6–16.3)
Correct care					
Correct treatment provided	28.2 (25.7–30.7)	5.7 (3.3–9.6)	71.9 (65.7–77.4)	24.7 (19.5–30.7)	10.1 (6.8–14.8)
Correct treatment provided without any unnecessary care	8.6 (6.9–10.6)	3.5 (1.8–6.9)	19.3 (14.7–25.0)	9.8 (6.1–13.8)	2.2 (0.9–5.2)
Correct treatment not provided and unnecessary care given	61.8 (58.7–64.8)	59.9 (53.3–66.1)	26.8 (21.4–32.9)	70.9 (64.6–76.5)	89.9[b] (85.2–93.2)

[a]95% Confidence intervals in this column adjusted to account for clustering by facility.
[b]As the definition of correct treatment for URTI was not prescribing an antibiotic, all those who did not receive correct treatment by definition received unnecessary care.

Care likely to be harmful to public health was widespread, with 67.2% of SPs prescribed an unnecessary antibiotic or antimalarial. This was dominated by unnecessary antibiotic prescriptions (62.7% of SPs), rather than unnecessary antimalarials (8.9%). Unnecessary antimalarials were prescribed to 24.1% of SPs presenting with NMFI symptoms, who told the doctor that they thought they had malaria but were not actually parasitaemic. Unnecessary antibiotic prescriptions were especially common among those with TB symptoms (78.0%) and URTI symptoms (89.9%). Some particularly concerning practices were also observed, with 13.1% of SPs prescribed an antibiotic on the WHO Watch or Reserve lists of antibiotics which are designated as a high priority for antimicrobial stewardship. This was most frequent for SPs with NMFI symptoms, of whom 18.9% were prescribed a Watch antibiotic, most commonly ciprofloxacin. Among other case types the most common Watch antibiotics were azithromycin and erythromycin. 5.5% of SPs were prescribed two or more antibiotics in one visit, including 11.0% of SPs with TB symptoms.

Overprovision was often accompanied by underprovision, with 61.8% SPs receiving unnecessary care while not receiving the recommended treatment. Even among SPs who did receive the correct treatment (28.2%), additional unnecessary treatment was common, with only 8.6% overall receiving the correct treatment without any unnecessary care.

Univariate analysis of the association between profit status and overprovision harms among health centres and dispensaries is presented in Table 5. The results suggested no significant relationships between profit status and economic or clinical harms in any single SP case, but profit status was associated with public health harms For SPs presenting with asthma symptoms, 50.5% of visits to for-profit facilities resulted in an unnecessary antibiotic or antimalarial prescription compared to 34.8% in not-for-profit facilities (OR = 1.91, $P = 0.029$). A similar relationship was observed among NMFI SPs, with 70.0% of those visiting for-profit facilities receiving care harmful to public health, compared to 53.3% at not-for-profit facilities (OR= 2.05, $P = 0.018$). Although rates were also higher among TB and URTI SPs at for-profit facilities, the relationships were not significant. A pooled analysis across cases found strong evidence of increased public health harms in for-profit facilities (OR = 1.64, $P = 0.009$) but weaker evidence of increased clinical harm (OR = 1.92, $P = 0.060$). Likelihood ratio tests showed no evidence of interaction between SP case and profit status ($P = 0.3586$ for any unnecessary care, $P = 0.5890$ for any public health harm and $P = 0.6910$ for any clinical harm).

When combining SP cases and adjusting for facility level and location in multivariate models, different patterns emerged (Figure 4). Profit status was no longer a significant predictor of public health harms; the relationship appears to be confounded by facility level, with some evidence that health centres were less likely to provide care harmful to public health than dispensaries (OR = 0.62, $P = 0.078$). For-profit status was a significant predictor of clinically harmful care in the multivariate model (OR 3.15, $P = 0.016$). Univariate analysis had underestimated the relationship between profit status and clinically harmful care, perhaps due to negative confounding by location; urban facilities (which were most likely to be for-profit, see Table 3) were less likely to provide clinically harmful care than those in rural areas (OR = 0.36, $P = 0.043$). Full multivariate results are given in Supplementary Appendix Table A3.

Discussion

Overprovision of all types was high in this setting: over half of drugs prescribed and more than two-fifths of tests ordered were classified as unnecessary. Analysis at the patient-visit level revealed that four out of five SPs received some

Table 5. Univariate analysis of association between overprovision measures and profit status for health centres and dispensaries,[a] by SP case

		Economic (any unnecessary care)			Clinical (any harmful medication or IV drip)			Public health (any antibiotic or antimalarial)		
		%	OR	*P*-value	%	OR	*P*-value	%	OR	*P*-value
Asthma	Not-for profit	60.9			6.5			34.8		
($n = 191$)	For-profit	65.7	1.23 (0.68–2.22)	0.493	9.1	1.43 (0.49–4.20)	0.511	50.5	1.91 (1.07–3.43)	0.029
NMFI	Not-for profit	76.1			0.0			53.3		
($n = 192$)	For-profit	84.0	1.65 (0.81–3.38)	0.172	2.0	–		70.0	2.05 (1.13–3.70)	0.018
TB	Not-for profit	87.0			10.9			78.3		
($n = 191$)	For-profit	89.9	1.34 (0.55–3.26)	0.525	18.2	1.82 (0.79–4.19)	0.157	81.8	1.25 (0.61–2.55)	0.539
URTI	Not-for profit	98.9			0.0			90.2		
($n = 191$)	For-profit	96.0	0.26 (0.03–2.38)	0.234	2.0	–		92.9	1.43 (0.51–4.00)	0.501
All cases[b]	Not-for profit	80.7			4.4			64.1		
($n = 909$)	For-profit	83.9	1.25 (0.85–1.85)	0.261	7.8	1.92 (0.97–3.80)	0.060	73.8	1.64 (1.13–2.37)	0.009

[a]All 36 hospitals are excluded from this analysis as all were not-for-profit.
[b]Pooled analysis adjusted for clustering at facility level.

(a) Any unnecessary care/economic harm

(b) Any antimalarial or antibiotic/public health harm

(c) Any clinically harmful care

Figure 4. Odds ratios and 95% confidence intervals from multivariate models for (a) any unnecessary care/economic harm, (b) any antimalarial or antibiotic/public health harm and (c) any clinically harmful care. Odds ratios are from multilevel logistic models adjusting for the random effects of facility and fixed effects of individual SP fieldworker, as well as all other variables shown. The reference categories were not-for-profit for profit status, rural for location, and dispensary for facility level. All 36 hospitals are excluded from this analysis as all were not-for-profit.

type of unnecessary care when visiting the outpatient department of private health facilities. Practices harmful to public health were also prevalent: nearly two-thirds were prescribed an unnecessary antibiotic, with more than one-tenth prescribed an antibiotic labelled high priority for antimicrobial stewardship and over 5% prescribed multiple unnecessary antibiotics, while nearly 10% were prescribed an unnecessary antimalarial. It was also concerning that a minority of patients (6%) were prescribed a medicine which could cause clinical harm. Profit status was not as universally associated with overprovision as hypothesized: after adjusting for facility level and location, for-profit health centres and dispensaries were more likely to provide clinically harmful care, but not care that was harmful to public health, or unnecessary care as a whole.

An SP study in Nairobi with some similar cases (asthma, TB, child diarrhoea and unstable angina) found that 49% of SPs were prescribed unnecessary antibiotics, lower than in this work; while the Nairobi study included public facilities (unlike this one), public clinics were just as likely to give unnecessary antibiotics so that alone does not explain the different practices (Daniels *et al.*, 2017). Similarly, a study in India found no significant difference in the probability of prescribing unnecessary treatment when comparing public and private facilities (Das *et al.*, 2016b). Research in China found that 61% of SPs presenting with TB symptoms were prescribed an unnecessary antibiotic, 7% a fluoroquinolone and 5% a steroid (Sylvia *et al.*, 2017). They were less likely to be prescribed antibiotics (but not the clinically harmful steroids and fluoroquinolones) at higher level county hospitals than lower level township health centres or villages clinics, reflecting a similar relationship between level and overprovision to the one we found in Tanzania. Township health centres were less likely than village clinics to dispense unnecessary medications for SPs with child diarrhoea and unstable angina (Sylvia *et al.*, 2015).

The study had a number of strengths. Using SPs allows us to control for case mix, which means our estimates are not biased by the different types of patients (and their conditions) which may attend different types of facilities. The Hawthorne effect is minimized, so it is unlikely that provider behaviour has changed in response to measurement. SPs also allow us to control exactly how patients present and define what care each case is meant to receive based on the national standard treatment guidelines, which means we can categorize what is necessary and unnecessary care to measure the rate of overprovision directly. This is one of few large-scale studies that have used SPs to estimate the prevalence of overprovision, which is typically measured using indirect methods (Brownlee *et al.*, 2017).

The univariate analysis results showing that for-profit facilities are more likely to provide unnecessary antibiotics or antimalarials for asthma and NMFI than not-for-profit facilities align with other studies comparing private and public sectors (Barros *et al.*, 2011; Kotwani *et al.*, 2012; World Health Organization, 2009) and are consistent with the idea that providers may induce demand if they have a financial incentive to do so (Evans, 1974). However, profit status is hard to untangle from other associated factors: for-profit facilities in this sample were more likely to be of a lower level and in urban or peri-urban areas, and these factors themselves are associated with public health harms. Lower level facilities are likely to have staff with fewer qualifications and limited diagnostic skills, which might lead to routine presumptive use of antimicrobials (Laxminarayan *et al.*, 2013). That overuse of antibiotics and antimalarials is less common in rural areas runs contrary to arguments that prescription of presumptive medicines is necessary when patients may live some distance from a health facility and would struggle to return if their condition deteriorated rather suggesting that overuse is a response to market conditions. When all factors are adjusted for together, only facility level has a weak relationship with public health harms, suggesting that provider skill is more important in preventing this kind of overprovision than changing incentives.

Clinically harmful care was associated with profit status when adjusting for facility level and location. However, it is notable that this relationship between profit status and overprovision does not hold when examining unnecessary care as a whole. This lack of a stronger relationship between profit and unnecessary care is surprising given the incentive for for-profit facilities to sell tests and drugs. It may be that not-for-profit facilities also face these incentives, as they also charge for most care and are otherwise reliant on voluntary donations. It could also be that profit status does not capture the full variation in provider incentives across different mechanisms for facility reimbursement. The limited association with for-profit status may also suggest that overprovision is not only driven by financial incentives in our setting, but by ingrained clinical norms, learnt either through medical education or from colleagues in clinical practice. Cognitive bias may also explain why clinicians provide unnecessary care; at least 40 types of cognitive biases have been identified in medical decision-making (Croskerry, 2003). One bias particularly pertinent to overprovision is commission bias, a preference for action over inaction because it appears better to do something than nothing, even if the action could have harmful consequences (Croskerry, 2002). Clinicians aim to relieve suffering, and so may find it difficult not to take any action (Doust and Del Mar, 2004). Patients themselves may play an important role in overprovision, whether through directly demanding unnecessary tests or treatments (although in our study SPs were trained not to do this) or through providers' perceptions of what patients understand to be 'good care'.

These findings have important implications for both public health and health systems financing. The widespread prescription of unnecessary antibiotics and antimalarials may contribute to the development of AMR in the community, reducing the effectiveness of existing drugs at treating infections. The prescription of fluoroquinolones and steroids to patients with TB symptoms risks those symptoms being masked, and the patients therefore failing to receive the correct diagnosis and treatment, increasing the chances of onward transmission of TB. The use of habit-forming benzodiazepines and opioids (diazepam and tramadol in this setting) in outpatients with mild symptoms is concerning, especially given the widespread misuse of prescription drugs now observed in West Africa (Klein *et al.*, 2020). It is also clear that a large part of household expenditure on health costs, and likely the expenditure of social health insurance schemes that empanel private facilities, is on care that provides no benefit to the patient and could be put to better use. An analysis of the estimated value of unnecessary care will be presented in a separate paper. It is notable that many patients who receive unnecessary care did

not receive the required or recommended treatment, that is, overprovision and underprovision coexist even within a single patient (James *et al.*, 2011).

Policy interventions to curb overprovision may act at system, provider or patient levels (OECD, 2017). In this work, we were only able to measure overprovision to patients who paid out-of-pocket for their care. In reality, with the roll-out of social health insurance, an increasing proportion of patients will be covered by insurance (Lagomarsino *et al.*, 2012). Social health insurance purchasers could use strategic purchasing arrangements such as capitation to limit incentives for overprovision on the supply side and co-payments on the patient side. Regulation could also play a role in tackling overprovision, for example, on the degree to which clinicians are able to sell medicines or whether they could only be dispensed by independent pharmacies. Strategies involving the education, training and support of health workers could also be used. Pre-service medical education, as well as ongoing professional development programmes, could place greater emphasis on the harms of unnecessary care and the importance of evidence-based decision-making, and incorporate tools for 'de-biasing' (cognitive methods for reframing decision-making) (Ludolph and Schulz, 2018). Patient education programmes could also be used to improve awareness of when clinicians might make errors in decision-making and encourage patients to be more active in making decisions about their health, as well as reducing demand for treatments such as antibiotics. The evidence base on the impact of these various strategies is very limited, with the exception of some antibiotic studies (Godman *et al.*, 2020; Wilkinson *et al.*, 2019), but given the extent of overprovision and consequences for individual patients and the health system, we urgently need to turn our attention to addressing this concern.

There are several key limitations of the SP method. First, SPs are not real patients. In practice, real patients may mitigate against overprovision by choosing not to undergo certain tests or buy certain medications, so overprovision recommended by clinicians may be greater than that actually obtained by patients. Second, only a limited number of cases are feasible with SPs. Our conceptualization of the harms of overprovision was developed with outpatient curative care in mind. Further refinement would be required if the framework was to be extended to encompass preventative and inpatient care. Moreover, the use of healthy fieldworkers as SPs necessitates choosing relatively 'mild' cases and types of disease, where most care is defined as unnecessary. Taken together, it is possible that in genuine patients presenting at health facilities, more care is likely to be necessary, and our choice of SP cases leads to an overestimate of the true prevalence of overprovision. These SPs cannot measure the experience of HIV-positive patients: the 10% of SPs asked their HIV status said they did not know it, and the 6% ordered an HIV test declined to be tested.

Other study limitations include the need for expert advisors to define which care is unnecessary, with some decisions open to legitimate debate. There are also harms that were not measured by this study, such as anxiety caused to patients through believing themselves to be unwell, and the opportunity cost of time spent visiting health facilities and receiving treatment. The study was conducted entirely in private health facilities, and, as already discussed, it is often assumed that the private-for-profit sector has a higher prevalence of overprovision than public health facilities (Barros *et al.*, 2011), although widespread antibiotic overprovision has been documented in all sectors in Kenya, for example (Daniels *et al.*, 2017). The private sector's focus does not make the findings unimportant for the Tanzanian health system as a whole: 30% of Tanzania's health facilities are non-governmental, approximately half of these being for-profit and half not-for-profit (White *et al.*, 2013). The private sector accounts for 31% of health expenditure in facilities and approximately 27–30% of outpatient care-seeking when including private retailers (White *et al.*, 2013). Private health facilities are also increasingly likely to be empanelled in government-backed social health insurance schemes: 30% of real patients we surveyed in exit interviews in study facilities reported that their care was paid for by social health insurance (unpublished data).

Conclusion

We developed a novel conceptualization of the harms of overprovision and used this to estimate the prevalence of different types of overprovision in Tanzanian private health facilities. We found that unnecessary care that was wasteful, harmful to public health and potentially dangerous to patients was widespread. After adjusting for facility level and location, we found that for-profit facilities were not more likely than not-for-profit facilities to provide unnecessary care and conclude that overprovision cannot be explained by a motivation to increase profits but may instead be more deeply ingrained in medical practice. We recommend that policymakers tackle overprovision through medical education and in-service training including 'di-biasing', as well as system-level interventions such as regulating the sale of medicines in health facilities and strategic purchasing arrangements.

Supplementary data

Supplementary data is available at *Health Policy and Planning* online

Data availability

The data used in this article and code required to reproduce tables and figures are available at datacompass.lshtm.ac.uk .

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Conflict of interest statement

None declared.

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6 Chapter 6: Patient knowledge and overprovision

6.1 Overview

In Chapter 5 I explored the facility level factors which may be associated with overprovision cross-sectionally. In Chapter 6, I use an experimental study design to better understand the role of supplier-induced demand in overprovision.

Central to supplier-induced demand is the idea of information asymmetry; the patient does not know that a certain intervention is unnecessary, and so a provider is able to induce more demand than would have been the case if the patient were fully informed. To explore the role of information asymmetry in the overprovision of antibiotics to patients with uncomplicated upper respiratory tract infection (URTI), we nested an experiment within the standardised patient (SP) data collection. Half of SPs were randomised to make a statement signalling knowledge that antibiotics were unnecessary after they described their symptoms to the provider. In theory, this reduces or removes the opportunity for the provider to artificially induce demand, because there is no longer information asymmetry.

The paper that follows explains the design of the study and presents the results. Further details of the results, including full regressions for the tables, are given in the supplementary material for the paper, which is attached in Appendix 11. The paper was published in Health Affairs in April 2022, and is reproduced with permission of Project Hope. A cover sheet with further details follows, and the license agreement is attached in Appendix 3.

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Surname/Family Name	King		
Thesis Title	Too much of nothing: measuring, understanding and explaining the overprovision of healthcare in the Tanzanian private sector		
Primary Supervisor	Timothy Powell-Jackson		

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SECTION E

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Date	15/08/2022

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By Jessica King, Timothy Powell-Jackson, James Hargreaves, Christina Makungu, and Catherine Goodman

Pushy Patients Or Pushy Providers? Effect Of Patient Knowledge On Antibiotic Prescribing In Tanzania

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ABSTRACT **Antimicrobial resistance is one of the most serious threats to global health, but little progress has been made in reversing its spread. Inappropriate use of antibiotics in humans is a major driver of antimicrobial resistance, and rates are high and growing in lower- and middle-income countries. Antibiotics are thought to be subject to supplier-induced demand, whereby providers prescribe them to patients who do not know they are unnecessary. We conducted a randomized field experiment in 227 private health facilities in Tanzania, with standardized patients presenting uncomplicated upper respiratory tract infection symptoms. Standardized patients were randomly assigned to express knowledge (informed) or not (uninformed) that antibiotics were not required to treat them. There was a very high rate of inappropriate antibiotic prescription, with 86.0 percent of informed standardized patients and 94.8 percent of uninformed standardized patients prescribed an antibiotic, for an adjusted difference of 7.8 percentage points between the groups. This small effect suggests that broader health systems factors are at play and that interventions should be aimed at systems, health facilities, and providers.**

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Antimicrobial resistance, or the evolution of pathogens that are resistant to existing antimicrobial drugs, is considered to be one of the most serious global health threats.[1] Drug-resistant infections are predicted to cause up to ten million deaths annually by 2050,[2] as average resistance levels continue to rise in low- and middle-income countries and are now generally higher than in high-income countries.[3]

Overuse and inappropriate use of antibiotics in humans is a major driver of the spread of antimicrobial resistance.[4] Antibiotic consumption rates in low- and middle-income countries have converged on (and in some countries surpassed) those seen in high-income countries, with an increase in per capita consumption in low- and middle-income countries of 77 percent between 2000 and 2015.[5] Stewardship of existing antibiotics has been insufficient worldwide.[6] Low- and middle-income countries, in particular, face barriers such as poor regulation and inadequate training of health care professionals in promoting stewardship.[3]

There is evidence that the inappropriate provision of antibiotics is more common in low- and middle-income countries than in high-income countries,[7] with a systematic review finding that 50 percent of patients attending primary care for any reason in low- and middle-income countries were recommended an antibiotic.[8]

There are a number of potential drivers of inappropriate provision of antibiotics. It has been argued that patients demand antibiotics and that providers, who are often short of time, prefer to

give a prescription instead of explaining why one is unnecessary.[9] Inappropriate antibiotic provision may also be a "supply-side" phenomenon, with evidence that providers may prescribe inappropriate antibiotics for several reasons: poor knowledge, as a preventive measure, out of fear of a bacterial infection being missed and untreated, because they believe patients want antibiotics, or because of financial incentives.[10] Antibiotics may be particularly susceptible to supplier-induced demand because there is a low risk of them causing harm to individual patients, who are unlikely to know whether they are necessary or not.[11]

Antibiotics are frequently prescribed for upper respiratory tract infections in primary care settings globally, with antibiotic use in such infections described as the greatest misuse of antimicrobials worldwide.[12] Experiments with covert standardized patients (trained field workers who pose as patients with upper respiratory tract infection symptoms) have been used to examine drivers of inappropriate antibiotic provision.[13] A study in Chinese public primary care facilities found that providers were more likely to recommend unnecessary antibiotics to standardized patients than to a hypothetical patient with the same symptoms,[14] suggesting that poor knowledge alone cannot explain unnecessary prescriptions. Research in Chinese public hospital outpatient departments found that standardized patients who stated that they would buy any drugs that were prescribed elsewhere—not at the hospital—were less likely to be prescribed unnecessary antibiotics, suggesting that prescriptions were partially motivated by financial incentives.[15] Finally, another experiment in the same setting found that standardized patients had a reduced likelihood of receiving unnecessary antibiotic prescriptions when they stated that they knew antibiotics were not needed.[11] This eliminated the information asymmetry required for supplier-induced demand, as patients expressed knowledge that antibiotics were unnecessary, as well as removing the potential perception that the patient wanted antibiotics. In this study we conducted a similar experiment, investigating the effect of patient knowledge on antibiotic prescription practices in outpatient clinics in the private sector in Tanzania.

Study Data And Methods

DESIGN We conducted a randomized field experiment in 227 private health facilities in mainland Tanzania. Facilities were recruited as part of a wider evaluation of the SafeCare quality improvement program (registered in the ISRCTN registry as ISRCTN93644888), which is described elsewhere.[16] Facilities were randomly assigned to receive an "informed" patient, who demonstrated their knowledge of appropriate antibiotic prescribing, or an "uninformed" patient, who did not. This research was approved by the ethics committees of the Ifakara Health Institute (Ref. No. IHI/IRB/No:04-2016) and the National Institute of Medical Research (Ref. No. NIMR/HQ/R.8a/Vol.IX/2415) in Tanzania and the London School of Hygiene and Tropical Medicine (Ref. No. 10493) in the United Kingdom.

PARTICIPANTS Facilities taking part in the study were those participating in the SafeCare evaluation in the Northern, Eastern, Central, Southern, and Southern Highlands zones of Tanzania. The facilities were eligible if they were dispensaries or health centers in the Association of Private Health Facilities in Tanzania (which represents mainly for-profit facilities) or dispensaries, health centers, or hospitals in the Christian Social Services Commission (which represents most faith-based facilities). Facilities were recruited through those umbrella organizations and were ineligible if they provided specific services only (for example, mental health or maternity services) or were tertiary hospitals (further details are in the online appendix).[17] Facilities in both sectors are free to set their own fees for consultation, diagnostic tests, and drugs, and they increasingly invoice social or private health insurance as well as treating patients who pay out of pocket. The faith-based sector is closely tied to the public sector, with some facilities receiving funding from the church, government grants, or government-salaried health workers.[18] Faith-based facilities may provide free care for certain conditions or to the poorest patients. Most facilities had a small laboratory with the capacity to carry out some testing, such as malaria microscopy and blood counts, but not more specialist testing, such as blood cultures or antibiotic sensitivity. Study facilities were widely dispersed across both urban and rural areas in eighteen of mainland Tanzania's twenty-two regions. The facility manager gave written informed consent to participate in the SafeCare evaluation at the time of recruitment, and then again specifically for visits from undercover standardized patients during a later visit.

RANDOMIZATION AND MASKING We randomly assigned facilities to receive informed or uninformed standardized patients in a ratio of 1:1. Randomization was stratified by SafeCare study arm (control or intervention) and partner organization (Association of Private Health Facilities in Tanzania or Christian Social Services Commission), so that the proportion of facilities

The relationships between patient knowledge, provider effort, and unnecessary care require further exploration.

receiving each of the two standardized patient types was the same within each stratum. Randomization was performed using a computer-generated random number in Stata, version 14.1.

Facility managers were asked to consent to visits from undercover standardized patients that would take place on an unspecified date over the course of the next three months. They were given no details of who the standardized patients would be, what conditions or symptoms they would present with, or which outcomes were being measured. Standardized patient methodology precluded blinding the field workers playing standardized patients from knowing their allocation as informed or uninformed, but they were blinded from knowing the outcome measure.

PROCEDURES Data were collected through standardized patient visits carried out between May 3 and June 12, 2018. A standardized patient presenting at a facility reported symptoms of an uncomplicated upper respiratory tract infection, saying, "I have a cough, and my head and throat hurt." Informed standardized patients only then made the additional statement: "But I don't know what to do because my friend told me he read on the internet that you don't need antibiotics for a simple cough." We adapted this text from that used in the original experiment ("I learned from the internet that simple flu/cold patients should not take antibiotics") to better fit the norms of patient behavior in Tanzania. If asked for further details, standardized patients reported that they had had symptoms for three days and confirmed that they had a blocked nose and sneezing but denied fever, breathing difficulties, or other symptoms. If asked about other health care seeking, they said that they had not taken any medication or seen any other provider.

We trained eight standardized patients for two weeks with extensive piloting and testing to ensure faithful presentation of case scripts and accurate recall of events. They were organized into four teams, with one man and one woman in each team. Whether the case would be portrayed by the female or male standardized patient was randomly assigned by a statistician before data collection. Teams were allocated to facilities according to geographical region, not randomly. Standardized patients completed a debriefing questionnaire on a smart phone using the ODK Collect survey application immediately after the visit, and fieldwork supervisors verified the information with the standardized patient the same day. The questionnaire recorded history taking by the clinician, laboratory tests ordered and their results, diagnoses given by the clinician, treatments prescribed and dispensed, and any fees paid. For safety reasons, standardized patients refused venous blood draws, sputum tests, X-rays, and HIV tests but did record them as having been ordered. If asked about their HIV status, standardized patients said that they did not know. Standardized patients underwent other laboratory tests, including fingerprick tests for malaria, and provided urine samples if requested by the clinician. They bought any drugs prescribed but did not buy treatments that would be administered at the facility (such as injections) or agree to any other type of treatment, such as receiving a saline drip. Drug names and doses were recorded in the debriefing questionnaire, and then drugs were returned to the study team to verify details. If a standardized patient received a positive malaria result from a facility, a trained supervisor carried out a rapid diagnostic test to confirm whether this was a true or false positive. After fieldwork was completed, a telephone survey with facility managers assessed rates of standardized patient detection.

OUTCOMES The primary study outcome was a binary measure of the prescription of any antibiotic drug. Secondary binary outcomes were the prescription of any drug; the prescription of an antibiotic that is on the World Health Organization (WHO) Watch or Reserve lists of antibiotics that are designated as a high priority for antimicrobial stewardship (because of concerns over resistance);[19] and the prescription of any nonantibiotic drug, to monitor substitution effects. Continuous secondary outcomes were total number of drugs prescribed (disaggregated into antibiotics and nonantibiotics), total number of diagnostic tests ordered, total expenditure (including consultation fee, diagnostic tests that were completed, and any drugs prescribed that the facility had in stock), and total number of items completed from a checklist of history-taking questions and physical exams (further details are in the appendix).[17]

ANALYSIS The sample size was 114 standardized patients in the informed arm and 113 in the uninformed arm. Although this experiment was not powered to detect a hypothesized effect estimate (as it was nested in another study), we carried out an ex ante sample size calculation. Based on an assumed antibiotic prescription rate of 64 percent in the control arm,[11] the minimum detectable difference at 5 percent significance with a power of 80 percent was a reduction in antibiotic prescriptions of 18.4 percentage points.[11]

We analyzed binary outcomes using logistic models and adjusting for study strata fixed effects (SafeCare study arm and implementing partner), with absolute differences calculated from predictive margins. Effect estimates for continuous outcomes were from linear regression (ordinary least squares) models, which also adjusted for study strata. We tested for interactions between patient knowledge and partner organization profit status; SafeCare study arm; and facility level, location, and incentive structure for the primary outcome, using likelihood ratio tests.

We carried out an ex post analysis of the prescriptions received by standardized patients who were not prescribed an antibiotic, as this was a rare outcome that merited further exploration. We recorded all drugs prescribed to standardized patients who did not receive an antibiotic; calculated the prevalence of prescription of each of those drugs in standardized patients who did and did not receive an antibiotic; and estimated the odds ratio for receiving those drugs, comparing the two groups with logistic models that adjusted for study strata fixed effects.

LIMITATIONS Our methodology had a number of limitations. The standardized patients were not real patients, and the case they portrayed of an otherwise healthy person attending a facility with mild symptoms may have been unusual. It could be argued that the provider might have assumed that symptoms were more serious or long-standing than the standardized patient described because a person of working age would otherwise consider the time and expense of a visit to a facility unnecessary. However, providers should still not be prescribing antibiotics for these symptoms. This experiment was conducted in private health facilities, so we could not generalize these findings to the public sector, where incentives and expectations may be different. It was also not possible to generalize to other diagnoses for which antibiotics may be overprescribed. It is also important to note that this study was not powered to detect the small effect actually estimated and that the relatively wide confidence interval included a larger reduction of 16.4 percent, which we would regard as a modest effect. Finally, our study design did not allow us to examine the role of patient demand in driving unnecessary antibiotic prescriptions.

Broader intervention is needed beyond patient education to reduce unnecessary antibiotic prescription in Tanzania.

Study Results

All 228 facilities that were open at the time of seeking consent agreed to visits from standardized patients. Of these, one facility was only open to staff who worked at a private organization, so standardized patients could not be sent there. Standardized patient visits were carried out in all 227 remaining facilities, with 114 visits in which the standardized patient played the role of the informed patient and 113 visits in which the standardized patient played the role of the uninformed patient (appendix figure A1).[17] Facility managers identified twelve standardized patients (5.3 percent) in a follow-up detection survey. Exhibit 1 presents the characteristics of facilities; they were broadly balanced between study arms. Intervention facilities were more likely than control facilities to be dispensaries or hospitals and were also more likely than control facilities to be in peri-urban locations.

Exhibit 2 shows the pattern of drug prescriptions by study arm. Four standardized patients (1.8 percent) were not prescribed any drugs (exhibit 2), and one (0.4 percent) was prescribed six drugs (data not shown). Eleven (4.9 percent) were prescribed one drug, seventy-four (32.6 percent) were prescribed two drugs, 108 (47.6 percent) were prescribed three drugs, twenty-two (9.7 percent) were prescribed four drugs, and seven (3.1 percent) were prescribed five drugs (data not shown). A total of 86.0 percent of informed standardized patients were prescribed any antibiotic, compared with 94.8 percent of uninformed standardized patients—a reduction of 7.8 percentage points after adjustment for study strata fixed effects ($p = 0.074$; exhibit 2). There was no evidence of interaction

EXHIBIT 1

Health care facility characteristics, by study arm, randomized field experiment of patient knowledge on antibiotic prescribing practices in Tanzania, 2018

	Study arm				
	Informed (n = 114)		Uninformed (n = 113)		
Characteristics	Number	Percent	Number	Percent	p value[a]
Partner organization					0.641
APHFTA	57	50.0	53	46.9	
CSSC	57	50.0	60	53.1	
SafeCare intervention arm					0.843
Treatment	55	48.2	56	49.6	
Control	59	51.8	57	50.4	
Facility level					0.125
Dispensary	65	57.0	60	53.1	
Health center	27	23.7	39	34.5	
Hospital	22	19.3	14	12.4	
Facility location					0.709
Inside Dar es Salaam	20	17.5	22	19.5	
Outside Dar es Salaam	94	82.5	91	80.5	
Location type					0.146
Rural	46	40.4	50	44.2	
Peri-urban	37	32.5	24	21.2	
Urban	31	27.2	39	34.5	
Incentive structure for outpatient clinicians					0.223
Fixed salary only	96	84.2	88	77.9	
Bonuses	18	15.8	25	22.1	

SOURCE Authors' analysis of data collected by authors. **NOTES** Sample sizes are numbers of standardized patient visits to the facilities. APHFTA is Association of Private Health Facilities in Tanzania. CSSC is Christian Social Services Commission. [a]Based on chi-square tests.

between patient knowledge and any facility characteristics. Informed standardized patients were no less likely than uninformed standardized patients to be prescribed a drug overall (98.2 percent in both arms; $p = 0.991$). This may be explained by the fact that informed standardized patients were slightly more likely to be prescribed a nonantibiotic, although this difference

EXHIBIT 2

Prevalence and means of experimental outcomes overall, by study arm, and differences between arms, randomized field experiment of patient knowledge on antibiotic prescribing practices in Tanzania, 2018

		Study arm		Difference between study arms		
Outcomes	Total (n = 227)	Informed (n = 114)	Uninformed (n = 113)	Estimate	95% CI	p value
Prescriptions						
Prescribed any antibiotic	204	98	106	−7.8%	−16.4, 0.8	0.074
Prescribed any drug	223	112	111	0.0%	−3.5, 3.5	0.991
Prescribed WHO Watch antibiotic	26	17	9	6.6%	−2.1, 15.2	0.139
Prescribed drug other than antibiotic	215	109	106	2.0%	−4.0, 8.0	0.505
Intensity of care (per visit)						
Mean total expenditure ($ US)	5.62	5.49	5.74	0.18	−0.73, 1.09	0.700
Mean tests ordered	0.79	0.71	0.87	−0.14	−0.40, 0.11	0.273
Mean drugs prescribed	2.70	2.70	2.69	0.02	−0.22, 0.27	0.844
Antibiotics	0.95	0.91	0.99	−0.08	−0.19, 0.03	0.147
Nonantibiotics	1.74	1.79	1.70	0.10	−0.12, 0.32	0.359
Mean checklist items completed (out of 20)	5.95	6.35	5.64	0.60	−0.07, 1.27	0.077

SOURCE Authors' analysis of data collected by authors. **NOTES** Sample sizes are numbers of standardized patient visits to the facilities. Differences between study arms estimated from logistic regression controlling for study strata for binary outcomes, and linear regression controlling for study strata for continuous outcomes. Full regressions for this exhibit are in the appendix; see note 17 in text. WHO is World Health Organization.

was not statistically significant (95.6 percent versus 93.8 percent; $p = 0.505$).

No antibiotics designated Reserve—the WHO's highest risk category for antimicrobial stewardship—were prescribed in either arm; a list of antibiotic types is in exhibit 3. Informed standardized patients were slightly more likely to be prescribed an antibiotic in the WHO's medium-risk Watch category (14.9 percent versus 9.0 percent; exhibit 2), but the evidence for this was limited ($p = 0.139$). Antibiotics prescribed that were in the Watch category included macrolides azithromycin, erythromycin, and clarithromycin (7.9 percent for informed patients versus 2.7 percent for uninformed; $p = 0.107$) and fluoroquinolones ciprofloxacin, levofloxacin, and norfloxacin (7.0 percent versus 5.3 percent; $p = 0.669$) (data not shown). A total of 212 (93.5 percent) of the total 216 antibiotics prescribed were broad spectrum (exhibit 3), and twelve standardized patients were prescribed only narrow-spectrum antibiotics (data not shown).

All treatments prescribed to the twenty-three standardized patients who were not prescribed an antibiotic are described in exhibit 4. Inappropriate treatments were antihistamines and antimalarials, and appropriate treatments were drugs for the management of symptoms (painkillers or cough syrups) or prescribing nothing. Not being prescribed an antibiotic was associated with increased odds of being prescribed an

EXHIBIT 3

Total numbers of antibiotics prescribed to standardized patients, by type, World Health Organization (WHO) stewardship category, and spectrum of action—randomized field experiment of patient knowledge on antibiotic prescribing practices in Tanzania, 2018

Antibiotic types/names	Total prescribed	WHO stewardship category and spectrum of action[a]	Proposed route of administration
Penicillins	158	Access	
Benzyl penicillin	2	Narrow	Parenteral
Phenoxymethylpenicillin	13	Narrow	Oral
Amoxicillin + flucloxacillin	2	Broad	Oral
Ampicillin + cloxacillin	70	Broad	Oral
Co-amoxiclav	6	Broad	Oral
Amoxicillin	61	Broad	Oral
Ampicillin	4	Broad	Oral
Cephalosporins	13	Access	
Cefadroxil	2	Broad	Oral
Cephalexin	10	Broad	Oral
Cephradine	1	Broad	Oral
Fluoroquinolones	13	Watch	
Ciprofloxacin	11	Broad	Oral
Levofloxacin	1	Broad	Oral
Norfloxacin	1	Broad	Oral
Macrolides	12	Watch	
Clarithromycin	1	Broad	Oral
Erythromycin	5	Broad	Oral
Azithromycin	6	Broad	Oral
Imidazole derivatives	4	Access	
Metronidazole	4	Broad	Oral
Sulfonamides and trimethoprim	8	Access	
Co-trimoxazole	8	Broad	Oral
Tetracyclines	5	Access	
Doxycycline	5	Broad	Oral
Amphenicols	2	Access	
Chloramphenicol	2	Broad	Oral
Combinations of antibacterials	1	Access	
Norfloxacin + tinidazole	1	Broad	Oral

SOURCE Authors' analysis of data collected by authors. [a]The WHO Essential Medicines List classifies antibiotics into three categories on the basis of toxicity and resistance concerns: "Access" is antibiotics listed as first and second choices in treatment because of their relatively low toxicity and few resistance concerns, and "Watch" is those with higher toxicity concerns or resistance potential. "Reserve" antibiotics are used as last-resort options in treatment. See Sharland M et al. Classifying antibiotics in the WHO Essential Medicines List for optimal use—be AWaRe (note 19 in text). No Reserve antibiotics were prescribed in either arm of this study.

EXHIBIT 4

Prevalence of all treatments prescribed to standardized patients not given antibiotics—randomized field experiment of patient knowledge on antibiotic prescribing practices in Tanzania, 2018

	Not prescribed an antibiotic (*n* = 23)		Prescribed an antibiotic (*n* = 204)				
Treatments	**Number**	**Percent**	**Number**	**Percent**	**OR**	**95% CI**	***p* value**
Inappropriate treatment							
Prescribed an antimalarial	4	17.4	14	6.9	2.95	0.86, 10.16	0.086
Prescribed an antihistamine	10	43.5	45	22.1	2.77	1.13, 6.81	0.026
Appropriate treatment							
Prescribed drugs for management of symptoms (painkillers or cough syrups)	19	82.6	187	91.7	0.43	0.13, 1.43	0.170
No drugs prescribed	4	17.4	—[a]	—[a]	—[a]	—[a]	—[a]

SOURCE Authors' analysis of data collected by authors. **NOTES** Sample sizes are numbers of standardized patient visits to the facilities. Full regressions for this exhibit are in the appendix; see note 17 in text. OR is odds ratio. [a]Not applicable.

antihistamine (odds ratio: 2.77; $p = 0.026$), and there was some evidence of increased odds of antimalarial prescription (OR: 2.95; $p = 0.086$).

Mean fee expenditure per visit was similar in the two groups (US$5.49 for informed standardized patients versus US$5.74 for uninformed patients; $p = 0.700$), as was the mean number of drugs prescribed (2.70 versus 2.69; $p = 0.844$) (exhibit 2). Providers carried out an average of 6.35 of the recommended twenty history questions and physical examinations with informed standardized patients compared to 5.64 with uninformed standardized patients—with an adjusted increase of 0.60 items ($p = 0.077$). When the checklist items were explored individually, three history questions were significantly more likely to be asked of informed patients. These were whether symptoms varied with time of day (19.3 percent of informed patients versus 6.2 percent of uninformed patients; OR: 3.54; $p = 0.006$), whether the patient had experienced breathing difficulties (15.8 percent versus 7.1 percent; OR: 2.51; $p = 0.043$), and whether the patient had already sought any care for their complaint (55.3 percent versus 35.4 percent; OR: 2.26; $p = 0.003$) (appendix table A1).[17]

Discussion

We conducted a randomized field experiment in 227 facilities in Tanzania to test the hypothesis that patients who demonstrated awareness that antibiotics were not recommended for symptoms of uncomplicated upper respiratory tract infection would be less likely than uninformed patients to be prescribed antibiotics. We found moderate evidence of a reduction of 7.8 percentage points in antibiotic prescriptions. Providers expended slightly more effort with informed standardized patients, completing, on average, 6.4 of 20 items on the history taking and physical exam checklist, compared with 5.6 items with uninformed standardized patients. This suggests that patients showing some treatment literacy encourages more effort on the part of clinicians.

Inappropriate antibiotic prescriptions were very common in both study arms, with nine of ten standardized patients receiving an antibiotic. This is in line with findings from retrospective record extraction in other countries in sub-Saharan Africa: 73 percent of outpatients in the private sector had an antibiotic prescribed for a upper respiratory tract infection in Botswana,[20] 86 percent of patients with that condition were prescribed antibiotics in public and private primary health centers in Ghana,[21] and 78 percent of patients with that condition were prescribed antibiotics in a referral hospital in Namibia.[22] These findings suggest that routine prescription of unnecessary antibiotics is standard practice for real patients. Our 5 percent rate of facilities detecting standardized patients, which is in line with other standardized patient studies,[13] gives further confidence that standardized patients were treated similarly to other patients. An analysis of several studies of non-upper respiratory tract infection (angina, asthma, diarrhea, and suspected tuberculosis) standardized patient consultations across low- and middle-income countries (China, India, and Kenya) also found widespread prescription of unnecessary antibiotics, with rates ranging from 9 percent to 60 percent, depending on country and presenting condition,[23] although no setting reached the levels observed in our study. That analysis, when considered alongside our research, also suggests that misuse of the WHO's higher-priority Watch and Reserve antibiotics is much more prevalent in Asia, whereas in both Tanzania and Kenya,

more than 80 percent of antibiotics prescribed were in the WHO's Access category.

This study had a number of strengths. The use of the standardized patient method allowed robust measurement of unnecessary antibiotic prescription, as the case history and symptoms were designed to represent circumstances in which antibiotics were definitively not required. This avoided uncertainty on whether antibiotics may or may not have been appropriate in each case, which is often a concern in record abstraction or clinical observations.[24] It also controlled case-mix, allowing us to be certain that the same patients with the same symptoms were attending different types of facilities, which is not the case with real patients. Facilities were randomly assigned to receive an informed or uninformed standardized patient, which allowed causal links to be drawn between patient knowledge and antibiotic prescriptions, as randomization should balance measured and unmeasured confounders between study arms. The high participation of eligible facilities and low loss to follow-up after randomization suggests that this study was unlikely to be subject to selection bias.

This study built on an experiment in Chinese public hospitals, where patient knowledge reduced unnecessary antibiotic prescriptions from 64 percent to 39 percent.[11] Although the direction of the effect was the same, it is striking that antibiotic prescription rates were much higher in the Tanzanian private sector, suggesting that inappropriate antibiotic use is more likely to be standard practice in this setting. The smaller effect of patient knowledge could be explained by differential incentives, with the Chinese clinicians having higher-powered incentives for drug sales, and therefore provider knowledge having a potentially larger corrective effect on any resulting supplier-induced demand. In our sample, only a minority of providers were remunerated through bonuses based on revenue (exhibit 1), so individual clinician incentives to induce demand through drugs sales may be low.

For patient knowledge to reduce antibiotic prescriptions, providers themselves must believe that antibiotics are not, in fact, necessary, and then change their behavior, but this know-do gap may vary between settings and providers.[25] It may be that the providers in these private Tanzanian facilities were less likely than Chinese hospital doctors to know that antibiotics were unnecessary. There may also have been a rational motivation for prescribing antibiotics presumptively in small Tanzanian facilities—with less capacity for diagnostic testing, a higher burden of infectious disease in the community, and more concern that patients might not be able to return if their condition worsens—than in the Chinese hospitals.

The relationships between patient knowledge, provider effort, and unnecessary care require further exploration. In contrast to this study, patient knowledge did not increase the effort exerted by physicians in Chinese hospital outpatient departments.[11] Another experiment with standardized patients in Chinese primary care found that providers who carried out more history taking and physical exams were less likely to prescribe an unnecessary antibiotic,[14] a relationship that we did not find.

The very poor antibiotic prescription practices found in this setting indicate that unnecessary prescription of antibiotics is entrenched in medical practice in this context. The small effect size suggests that patient education alone cannot eradicate inappropriate antibiotic prescribing, especially as we cannot say that education would change patient behavior, but it may be an important part of a combination strategy. A systematic review of patient-centered interventions in high-income countries has found that providing patient information via mass media did not have an impact on antibiotic prescriptions for upper respiratory tract infections.[26] Antibiotic overprovision may be partly explained by poor provider knowledge, providers' entrenched beliefs that this is what patients want, or their concerns about the risks of withholding antibiotics. This could be combated by preservice medical education or professional development, including training providers on recognizing cognitive biases that may hinder evidence-based decision making.[27]

Other health system factors are also likely to be relevant, including the culture of treatment provision, financial incentives, absence of point-of-care diagnostic tests, and lack of clinical audit or systematic antimicrobial stewardship programs. Although providers in our study setting did not have strong individual financial incentives to prescribe unnecessary antibiotics, there might be facility-level pressures from managers to prescribe a certain volume of drugs, given the fee-for-service model.[28] Interventions to tackle this could include strategic purchasing arrangements with social health insurers, which could refuse to reimburse providers for inappropriate antibiotic prescriptions, or government regulation—for example, by requiring medicines to be dispensed by independent pharmacies. One year after the start of implementation of Tanzania's National Action Plan on Antimicrobial Resistance,[29] implementation of stewardship activities was found to be low and inconsistent across facilities.[30] Interventions are thus likely required at the provider and health system levels. A systematic review of behavioral

interventions with health professionals in low- and middle-income countries found that multifaceted interventions, including regulation as well as provider education, were necessary to have an impact on the prescription of unnecessary antibiotics.[31] A review of national action plans in high-income countries also found that systemic interventions such as antibiotic committees, clinical guidelines, and prescribing restrictions were effective at reducing antibiotic prescriptions, whereas evidence for educational interventions was mixed.[32] Taken with this existing evidence, our findings suggest that broader intervention is needed beyond patient education to reduce unnecessary antibiotic prescription in Tanzania. ■

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7 Chapter 7: Provider effort and overprovision

7.1 Overview

In Chapter 6, I explored the association between patient knowledge and overprovision of antibiotics for standardised patients (SPs) with symptoms of upper respiratory infection (URTI). One finding was that providers exerted more effort, in terms of asking more history questions and carrying out more physical exams, when SPs signalled knowledge of appropriate antibiotic use than when they did not.

In Chapter 7, I explore provider effort in more detail. To understand the relationship between effort and both correct care and overprovision, I focus on two SP cases – asthma and TB – where correct care and overprovision are independent from each other. For the URTI and non-malarial febrile illness cases, the definition of correct care included not giving specified unnecessary medicines, so overprovision and correct management could not be separated.

I use item response theory to develop a latent score of provider effort based on a checklist of recommended history taking and physical exams; I then examine the association between this effort score and correct care, overprovision, and the fees charged. The methods and results are presented in the form of a paper manuscript, and additional details on the development of the effort index is given in Appendix 12. The paper has not yet been submitted for publication. A cover sheet with further details follows.

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Thesis Title	Too much of nothing: measuring, understanding and explaining the overprovision of healthcare in the Tanzanian private sector		
Primary Supervisor	Timothy Powell-Jackson		

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SECTION E

Student Signature	Jessica King
Date	15/08/2022

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Date	25/08/2022

7.2 Does increased provider effort improve quality of care? Evidence from a standardised patient study on correct and unnecessary treatment

7.2.1 Abstract

Poor quality of care is a major public health concern around the world, including in low- and middle-income countries. One aspect of poor quality which is rarely addressed in low- and middle-income countries is overprovision, or unnecessary care. Increased provider effort, defined here as actions taken in a consultation, has been shown to improve correct treatment in standardised patient studies in several settings. The effect of effort on overprovision is less well understood; it is not clear if providers who make more effort give more treatment overall, both correct and unnecessary, or whether effort is associated with reduced unnecessary care. We explore the association between effort and correct and unnecessary care, and the fees that a provider can demand.

Undercover standardised patients visited 227 private-for-profit and faith-based outpatient health facilities in Tanzania, carrying out 454 visits and presenting symptoms of two cases: asthma and TB. Standardised patients recorded the history questions asked and physical examinations carried out by the provider, as well as laboratory tests ordered, treatments prescribed, and fees paid. The tests and treatments were categorised as necessary or unnecessary. A measure of provider effort was constructed using item response theory on the basis of a checklist of history taking questions and physical exams completed by the provider.

15% of SPs received the correct care for their condition (an inhaler for asthma, and referral for testing for TB). 74% received some kind of unnecessary care. Increased provider effort was associated with increased likelihood of correct care, and decreased likelihood of giving unnecessary care. Unnecessary care was more common at facilities where providers were paid a performance-based bonus or share of revenue (rather than a fixed salary), but this association was attenuated after adjusting for other facility characteristics. Providers who made more effort charged higher fees, through the mechanism of higher consultation fees, rather than increased fees for labs tests and drugs.

In line with similar studies, providers who made more effort were more likely to treat patients correctly. A novel finding of this study is that they were also less likely to provide unnecessary care, suggesting it is not simply a case of some providers doing “more of everything”, but that those who do more in the consultation give more targeted care. Providers who made more effort, independent of medical qualifications, charged higher prices, which suggests that effort is rewarded by the market.

7.2.2 Introduction

Expanding good quality healthcare, accessible to all, is a key part of the universal health coverage agenda [1, 2]. However, quality of care has been shown to be severely lacking in many settings, including in low- and middle-income countries (LMICs). There is widespread evidence of providers making incorrect diagnoses of serious illnesses [3, 4], not carrying out the correct clinical procedures [5, 6], and failing to prescribe the correct medications [7-9]. Poor quality of care has been estimated to be responsible for 10-15% of all deaths in LMICs [10].

Poor quality of care around the world reflects both underprovision, the failure to use appropriate and effective medical interventions, and overprovision, defined as medical services that are more likely to cause harm than good [11, 12]. These two phenomena coexist, even within the same patient [13], and tackling both is crucial to improving quality of care. While overprovision is often framed as a concern in high income countries [14, 15], it can be overlooked when examining quality of care in LMICs, where underprovision is widespread [12]. However, recent studies have found substantial evidence of unnecessary tests and medications in LMIC settings [3, 6, 7, 16-19]. Tackling overprovision should be a priority for health systems, as it is wasteful for the system and the individual patient [20], and can cause harm to both patients [21] and public health [22].

In this paper, we study the relationship between provider effort as reflected by the number and type of actions the provider takes in a consultation, such as asking questions about symptoms and carrying out physical exams, in order to come to a diagnosis and decide on management [23] – and quality of care, as measured by whether the correct management is given. While provider effort could be conceptualised as a component of good quality care in itself, we treat it here as on the pathway to providing correct management [24, 25]. Effort is likely to be a function of multiple factors: workload, intrinsic motivation, clinical knowledge, and training in how to make a diagnosis. At first glance, the relationship between effort and correct management may seem obvious: health care providers who exert greater effort in applying their knowledge can be expected to deliver better quality care. However, this relationship can be complicated by the fact that the health care provider has better information on what care the patient needs than the patient herself, and the patient cannot ascertain the quality of care given even after receiving it. This situation characterises what economists refer to as a credence good [26] and it creates an opportunity for providers to exploit the informational asymmetry, by either under- or overproviding health care. It is possible that better skilled and more motivated health care providers may provide more clinically unnecessary care, because they have more of an opportunity to exploit. This may be particularly

the case in the private sector, where financial incentives to treat as many patients as possible, and maximise profits, may undermine intrinsic motivation to provide good quality care.

From an empirical perspective, exploring these relationships is challenging because it is difficult to establish whether the care received by a patient is correct or unnecessary, and because measuring effort in a consultation is not straightforward. In recent years, standardised patients (SPs), who are fieldworkers trained to visit health facilities and act as real patients, have been used to measure quality of care in terms of both the effort exerted by the provider and whether correct management was provided [27]. Such studies have generally found that consultations in which providers exert more effort through longer consultations, asking more questions and doing more physical exams are more likely to result in the SP receiving correct management [16, 17, 28, 29]. However, there is limited evidence on whether those providers who make more effort are more or less likely to provide unnecessary care. Understanding the relationship between effort and the quality of care, and particularly unnecessary care, is key when it comes to choosing the type of policies and interventions needed to improve quality of care: do we need to improve providers' knowledge, motivate them to exert more effort in a consultation, or change incentive structures to discourage the provision of unnecessary care?

A further complication in understanding the incentives for exerting effort and providing quality care are the different ways that private sector facilities charge patients for their care (even without considering patients who are covered by public or private insurance, which adds further variation). The most common model is to charge a relatively low registration or consultation fee when the patient registers to see a clinician, which is a small proportion of the overall cost after individual tests and drugs are charged for. Some facilities charge a substantial fee for the consultation, perhaps signalling that the clinician's time and expertise is the main value of the visit to the facility. Others do not charge a consultation fee at all, either because the facility is not-for-profit and only drugs are paid for, or because the clinician's time is seen as 'included' in the final bill for drugs and tests. To explore whether the market rewards and incentivises provider effort, we also examine whether the effort exerted by the clinician is associated with the fees charged, in total and by component.

In this paper, we examine the relationship between provider effort and both correct care and unnecessary care in private health facilities in Tanzania, in order to explore the extent to which under and over treatment are associated with provider effort. We further explore the relationship between provider effort and fees charged for services to understand the reward mechanisms for delivering good quality care.

7.2.3 Methods

7.2.3.1 Study setting and participants

Data was collected in May-June 2018 as part of the endline survey of a randomised controlled trial of the SafeCare quality improvement programme, described elsewhere [30]. 228 private-for-profit and not-for-profit health facilities participated, location in rural and urban areas across 18 regions of mainland Tanzania. The not-for-profit faith-based sector is closely tied to the public sector, often staffed to some degree by government salaried health workers, and with some facilities receiving funding from the church or government grants [31]. Faith-based facilities may provide free care for certain conditions or to the poorest patients. The sample included dispensaries (the lowest level of health facility, often staffed by a single clinical officer with three years of post-secondary clinical training), health centres (a larger facility with more staff and which may admit patients) and hospitals (which all have inpatient wards and usually have a fully qualified doctor on staff).

7.2.3.2 Standardised patient data collection

Standardised patients (SPs) are healthy fieldworkers, trained to present at health facilities acting as real patients, and report a standardised set of symptoms and history to the clinician. Further detail on SP protocols is given in the appendix. Written consent for SP visits was sought from the facility manager, one to four months before the SP visits, without giving details of the presenting conditions of SPs. Two SPs visited each of the health facilities, one presenting a case of asthma and the other a case of suspected TB. During the consultation, they made an initial statement of their presenting complaint, shown in Table 1. Further details of other symptoms and history (also shown in Table 1) were only given if the clinician asked a relevant question. Two other SP cases (non-malaria febrile illness, and upper respiratory tract infection) which were conducted at the same time are not included in this analysis, as the definition of correct management included not giving some aspect of unnecessary care [30], so the two concepts could not be examined separately.

Immediately after finishing a visit to a facility, SPs completed a debriefing questionnaire using ODK Collect on mobile phones, reporting on history taking and physical exams carried out by the clinician, laboratory tests ordered and their results, diagnosis given by the doctor, treatments prescribed and dispensed, and any fees paid. SPs underwent laboratory tests including fingerprick tests for malaria and provided urine samples if requested by the clinician, but refused venous blood draws, sputum tests, X-rays and HIV tests (still recording them as ordered). They bought any drugs prescribed but avoided any treatments which would be administered at the facility, such as injections or drips. SPs paid for all services in cash. A supervisor verified forms at the end of each

day, and collected and labelled any drugs bought. Drugs were checked against the form by the study team at the end of fieldwork. A follow-up telephone survey with facility managers assessed whether providers detected any SPs.

7.2.3.3 Measuring provider effort

In this study, provider effort is proxied by the actions taken by the provider during a consultation with a patient in order to come to a decision on case management [23]: asking about symptoms and probing for further details, taking a medical history including family history and social history if relevant, and carrying out any appropriate physical examinations.

Provider effort was measured from a checklist of history taking and physical examinations. There were 33 checklist items for the asthma case and 29 for the TB case. The checklist of history taking and examinations was developed using Tanzanian Standard Treatment Guidelines [32] and in consultation with a panel of expert pharmacists and clinicians. A method based on item response theory (IRT), the details of which are described below, was used to construct a continuous measure of effort for each case [33]. IRT allows each checklist item to vary in its difficulty and ability to discriminate between providers, to create a measure which more accurately captures the amount of effort exerted in the consultation than simply the proportion of checklist items completed.

Item response theory (IRT) assumes the existence of a latent variable, θ, in this case provider effort. Whether or not the provider carries out each of the items on the checklist of history taking and physical exams is assumed to be a function of this latent variable. IRT relies on four key assumptions:

(1) Monotonicity: that as the latent trait score (provider effort) increases, the probability of carrying out each checklist action also increases
(2) Unidimensionality: that checklist actions measure just one latent trait
(3) Independence: that the probability of carrying out one checklist action does not depend on whether or not another action in the list was carried out
(4) Invariance: the probability of carrying out a given checklist action is the same for different providers who have equal effort scores

The latent variable is modelled through an item characteristic curve (ICC) for the probability of completing each checklist item as a function of the latent variable: the ICC for item i can be thought of as $P_i(\theta)$. The ICC is modelled using a two-parameter logistic model, where the binary outcome

is whether or not the item was completed, as a function of θ, and two parameters which can vary by item, a_i and b_i:

$$P_i(\theta) = \frac{1}{1 + e^{-a_i(\theta - b_i)}}$$

Parameter a_i is the discrimination parameter, which is proportional to the maximum slope of the ICC, and can be thought of as measuring the ability of item i to distinguish between values of θ. Parameter b_i is the difficulty parameter, and is equal to the value of θ where the probability of carrying out item i is 0.5.

The discrimination and difficulty parameters are estimated by multiplying the ICCs for every item i together to produce a likelihood function, then fitting the model using maximum likelihood estimation within Stata [34]. The distribution of θ was estimated separately for TB and asthma cases, based on the separate checklists, then standardised to produce effort scores with mean 0 and standard deviation 1. The frequency, discrimination and difficulty coefficients for each item are presenting in the results section.

7.2.3.4 Outcomes

Details of the correct management of SPs are given in Table 7.1. Required drugs and lab tests come from the Tanzanian Standard Treatment Guidelines [32] outlining how such patients should be managed. Palliative drugs are those for which there is guidance or evidence that they are suitable for managing symptoms associated with the condition, but giving them alone would not constitute correct management. All drugs not categorised as required or palliative are deemed unnecessary. Tests were defined as appropriate if they would give the provider useful information which would change the management of the patient. Tests were classified as unnecessary otherwise. Further details of unnecessary tests and drugs given to SPs in this sample have been published elsewhere [7]. Quality of care is measured with two binary outcomes: correct management and unnecessary care. Correct management was coded 1 if the SP was prescribed or ordered the required drugs and tests (Table 7.1) and 0 otherwise. Unnecessary care was coded 1 if the SP was prescribed or ordered any test not categorised as appropriate or any drug not categorised as required or palliative (Table 7.1). Correct management and unnecessary care are not mutually exclusive, and can occur within the same SP visit.

Total fees for all services received were converted from Tanzanian shilling to US dollars using the World Bank official exchange rate average for 2018 (2,263.78 TZS=1.00 USD). Where available, a breakdown of separate fees paid for consultation with the clinician, lab tests and drugs is reported.

Table 7.1: Standardised patient (SP) case presentation and correct management

Case	Initial presentation	Further details given if probed	Required drugs and tests	Palliative drugs[1]	Appropriate tests[2]
Asthma	"I have had a problem with breathing, and last night it became terrible"	Shortness of breath when moving furniture/cleaning. Wheezing and non-productive cough throughout attack. Attacks at night for a year with increasing frequency and severity. Attacks brought on by cleaning or physical activity. Had coughing fits as a child, and a sibling with a similar problem.	Prescription of salbutamol or another beta-2 antagonist or steroid inhaler.	Other $\beta_2$antagonists and steroids, antihistamines, xanthines.	Allergy tests, ECG, HIV, X-ray.
TB	"I have had a cough that is not getting better"	Productive cough for three weeks, one week course of amoxicillin without improvement. Low grade fevers, chest pain, loss of appetite, weight loss, night sweats.	Order or refer for sputum TB testing (including referral to a higher-level public health facility which could test for TB, even if testing was not mentioned).	Cold and flu combinations, cough syrups, NSAIDs and paracetamol.	Complete blood count, HIV, malaria, X-ray, Widal.

[1]Drugs which are suitable for managing symptoms associated with the condition
[2]Tests which may give the provider useful information in planning management of the patient

7.2.3.5 Analytical approach

After calculating the provider effort score, we used multivariate linear regression to identify factors associated with provider effort. We adjusted for SP fixed effects, SP case type and intervention arm, and included the following factors of interest: gender of provider, the proportion of outpatient clinicians who were doctors with medical degrees (as opposed to a lower cadre such as clinical officer), and whether outpatient clinicians in the facility were paid a fixed salary only or some sort of bonus or other incentive, level (hospital, health centre, or dispensary), location (urban, peri-urban, or rural), whether the facility was for-profit or not-for-profit, and insurance empanelment, proxied by whether the facility had any revenue from private or public insurance funds.

We used modified Poisson regression models to estimate the relationship between provider effort and quality of care. We used two separate models for two quality of care outcomes: correct management, and unnecessary care. We then took three approaches to modelling: Model (1), the base model, included effort, SP fixed effects, SP case type (asthma or TB) and SafeCare invention arm. This was to estimate the effect of effort without adjustment. Model (2) additionally included characteristics related to the provider, their skill level and their incentives. These variables were gender of provider, provider payment mechanism and provider qualifications. Finally, model (3) added wider characteristics of the facility: level, location, profit status and insurance empanelment.

The relationship between effort and total fees paid was estimated using linear regression models, with three modelling approaches as described above. To further understand the determinants of fees paid, separate models were used to estimate consultation fees, lab fees and drugs fees.

7.2.4 Results

All 228 facilities which were open at the time of seeking consent agreed to visits from SPs. Of these, one facility was only open to staff who worked at a private organisation and so SPs could not be sent. All 227 remaining facilities received a visit from an SP presenting the asthma case and an SP presenting the TB case, and their characteristics are given in Table 7.2 . Most facilities (55%) were dispensaries, the lowest level in the Tanzanian health system, 30% were health centres and 15% were hospitals. Numbers of for-profit and not-for-profit facilities were roughly equal (44% vs 56%). 42% of facilities were in rural areas, and the rest were either urban or peri-urban. The majority of the facilities (81%) paid their outpatient clinicians with a fixed salary only, with only 19% also paying some sort of bonus based on a target for volume or revenue, or a share of revenue. 19% of facilities had a fully qualified doctor working in the outpatient department at the time of seeking consent, with the rest only having a lower cadre of clinician, such as assistant medical officer or clinical officer, available. 35% of facilities reported no income from private insurance companies or national insurance funds in the three months preceding the survey. Of the 454 consultations, 24% were with female clinicians.

Provider completion of checklist items was low for both SP types. An average of 10.5 recommended history taking questions and physical exams were done in each consultation, around one third of total recommended actions (there were 29 recommended actions for TB and 33 for asthma). The frequency of each item, and its discrimination and difficulty coefficients (and p-values for coefficients being non-zero) are given in Table 7.3. For asthma, the actions completed most frequently were asking age (86%), about the nature or type of breathing difficulty (79%) and whether the SP had chest pain (72%). All other actions were completed in less than 70% of consultations. The least frequently completed actions, carried out in less than 1% of consultations, were asking about recent weight loss, if the SP was breathless at rest during attacks, and what distance they could walk during attacks. In the IRT analysis, items with high discrimination coefficients which were significant at the 5% level included asking if the SP had eaten any new food, about the circumstances of their attack and the time of day of their symptoms. Items with high difficulty coefficients which were significant at the 5% level included examining the throat, and asking about recent weight loss or if the SP was breathless at rest during attacks.

Table 7.2: Facility and provider characteristics

Facility characteristics (n=227)	%
Level	
Dispensary	55.1
Health centre	30.0
Hospital	15.0
Ownership type	
Private for profit	43.6
Private not for profit	56.4
Urbanisation	
Urban	30.8
Peri urban	26.9
Rural	42.3
Payment of outpatient clinicians	
Fixed salary only	81.1
Bonus or payment based on volume or revenue	18.9
Proportion of doctors/medical officers among three highest qualified outpatient staff	
0/3	80.7
1/3	16.3
2/3	2.2
3/3	0.9
Insurance empanelment	
Has insurance income	65.2
No insurance income	34.8
Provider characteristics (n=454)	
Sex	
Male	76.0
Female	24.0

For TB, the actions completed most frequently were asking age (97%), about the duration or date of onset of coughing (90%) and whether cough produced mucus or sputum (81%). All other actions were completed in less than 81% of consultations. The least frequently completed actions, carried out in less than 5% of consultations, were asking about whether the SP was a smoker, drank alcohol or had diabetes. In the IRT analysis, items with the highest discrimination coefficients included asking if the SP had anyone in their family with TB or a persistent cough, or contact with anyone else with TB. Items with high difficulty coefficients which were significant at the 5% level included asking about loss of appetite, wheezing, or if anyone in the family had a persistent cough. For both asthma and TB, graphs showing the item characteristic curves for the items with the lowest, median and highest difficulty and discrimination are given in the appendix, along with the test characteristic curves showing the relationship between IRT score and number of items completed.

Table 7.3: Effort score construction

	Asthma					TB				
Item	Frequency	Discrimination		Difficulty		Frequency	Discrimination		Difficulty	
	(%)	Coefficient	p	Coefficient	p	(%)	Coefficient	p	Coefficient	p
Physical exams (both cases)										
Throat examined	4.4	0.80	0.056	4.21	0.027	8.0	0.31	0.268	7.91	0.256
Pulse taken	33.9	0.49	0.010	1.43	0.014	25.7	0.28	0.118	3.86	0.115
Blood pressure taken	55.5	0.60	0.002	-0.39	0.134	37.2	0.39	0.02	1.39	0.037
Temperature taken with thermometer	19.4	0.31	0.138	4.69	0.129	29.2	0.24	0.155	3.71	0.156
Listened to chest with stethoscope	51.1	0.05	0.760	-0.92	0.822	43.8	0.10	0.512	2.50	0.534
Symptoms (both cases)										
Time of day of symptoms	39.2	1.33	<0.001	0.45	0.002	30.5	0.82	<0.001	1.14	<0.001
Any wheezing	31.3	0.56	0.004	1.51	0.005	5.3	1.88	<0.001	2.22	<0.001
Recent weight loss	0.9	2.06	0.106	3.18	0.003	22.6	1.37	<0.001	1.20	<0.001
Night sweats	7.0	1.06	0.005	2.84	<0.001	46.5	2.09	<0.001	0.13	0.244
Coughing up mucus/sputum	32.2	0.76	<0.001	1.11	0.001	80.5	1.96	<0.001	-1.15	<0.001
Chest pain	71.8	1.08	<0.001	-1.06	<0.001	53.5	0.76	<0.001	-0.21	0.305
Fevers	46.3	0.18	0.250	0.83	0.417	73.5	1.49	<0.001	-0.95	<0.001
Other history (both cases)										
Previous careseeking /medication	52.0	0.55	0.002	-0.15	0.562	77.4	0.70	0.002	-1.95	0.001
Smoker	8.8	1.08	0.003	2.57	<0.001	4.9	0.50	0.166	6.21	0.141
Age	86.3	0.16	0.471	-11.37	0.468	97.3	0.45	0.345	-8.30	0.323
Occupation	37.0	0.29	0.078	1.85	0.097	28.3	0.31	0.072	3.07	0.072
Symptoms (asthma)										
Breathless at rest during attack	0.9	2.03	0.083	3.21	0.002					
What distance can you walk during an attack	0.4	0.27	0.817	20.07	0.815					
Keeps awake at night	2.2	0.85	0.137	4.86	0.084					
Circumstances of recent attack/ what were you doing	48.5	1.41	<0.001	0.07	0.602					
Length of attack	30.4	1.09	<0.001	0.94	<0.001					
Frequency of attacks	48.5	0.53	0.003	0.13	0.640					
Shortness of breath constant or episodic	35.2	0.71	<0.001	0.95	0.002					
Any triggers for attacks	34.4	0.79	<0.001	0.93	0.001					
Any previous attacks	31.3	0.89	<0.001	1.03	<0.001					
Type of breathing difficulty	79.3	0.66	0.003	-2.25	0.001					
Date of onset of attacks	33.0	0.60	0.002	1.27	0.003					
Does anything improve attack/how to cope	26.4	0.90	<0.001	1.33	<0.001					
Other history (asthma)										
Allergies	16.7	1.06	<0.001	1.82	<0.001					

Childhood asthma or similar attacks	8.8	0.92	0.005	2.90	0.001					
Family history of asthma	40.5	0.99	<0.001	0.47	0.009					
Asthmatic/previous diagnosis of asthma	67.8	0.62	0.001	-1.30	0.002					
Any new/unusual foods	8.8	2.16	<0.001	1.74	<0.001					
Symptoms (TB)										
Duration/onset of coughing						89.8	1.31	<0.001	-2.13	<0.001
Blood in mucus/sputum						26.1	1.05	<0.001	1.21	<0.001
Loss of appetite						14.1	0.80	0.001	2.51	<0.001
Breathing difficulty /shortness of breath						23.9	0.92	<0.001	1.47	<0.001
Other history (TB)										
Contact with anyone with TB						15.9	3.28	<0.001	1.13	<0.001
Previous TB						11.9	2.31	<0.001	1.47	<0.001
Anyone in family with TB						13.3	2.63	<0.001	1.34	<0.001
Anyone in family with persistent cough						6.6	2.68	<0.001	1.80	<0.001
Drinker						3.5	-0.02	0.955	-144.78	0.955
Diabetic						1.3	0.63	0.342	7.15	0.304
HIV status						21.2	1.03	<0.001	1.53	<0.001
Type/name of medication taken						72.6	0.67	0.002	-1.60	0.001
Course length /duration of taking medication						48.2	0.62	0.001	0.13	0.592

Table 7.4 presents the results of regression analysis to identify factors associated with provider effort score. Consultation at facilities with at least three doctors on the outpatient staff had an effort score 0.72 standard deviations higher than those without any doctors (p=0.007). Consultations at hospitals had an effort score 0.39 standard deviations higher than those at dispensaries (0.008), and those at health centres were 0.23 standard deviations higher than those at dispensaries (p=0.046).

Table 7.4: Factors associated with provider effort

Factor	*Effort IRT score (in standard deviations)*
Female provider	0.14 (-0.06 – 0.34), p=0.176
Bonus (vs fixed salary)	0.03 (-0.20 – 0.26), p=0.817
% of 3 most qualified clinicians who are doctors	0.72 (0.20 – 1.23), p=0.007
Hospital (vs dispensary)	0.39 (0.01 – 0.67), p=0.008
Health centre (vs dispensary)	0.23 (0.00 – 0.45), p=0.046
For profit	-0.00 (-0.24 – 0.23), p=0.992
Peri-urban (vs rural)	-0.06 (-0.30 – 0.17), p=0.589
Urban (vs rural)	0.16 (0.08 – 0.40), p=0.184
Insurance empanelment	-0.02 (0.84 – 2.86), p=0.851
Coefficients are from a multivariate linear regression model adjusting for SP fixed effects, SP case and SafeCare intervention arm as well as all factors listed	

Only 15% of SPs received the correct management for their condition; this was 25% among the TB cases and just 6% among the asthma cases (Table 7.5). Around three quarters (74% of all SPs), received some unnecessary care: 86% of TB SPs and 62% of asthma SPs. The mean fee paid by TB SPs was USD 4.97, compared to USD 3.76 by asthma SPs. This difference seems to be almost entirely due to higher costs for drugs paid by TB SPs (USD 3.40 vs USD 2.10), with drug costs representing over two thirds of the total cost of TB consultations, compared to just over a half of the total costs of asthma consultations. Mean expenditure on consultation fees (USD 1.30) and lab tests (USD 0.30) were similar across the two conditions.

Table 7.5: Consultation outcomes, effort, and fees paid

	Asthma mean (sd)	TB mean (sd)	All mean (sd)
Outcome of consultation			
Correct management (n=454)	0.06 (0.23)	0.25 (0.43)	0.15 (0.36)
Unnecessary care (n=454)	0.62 (0.49)	0.86 (0.34)	0.74 (0.44)
Provider effort			
Number of checklist items carried out (n=453)[1]	10.91 (4.23)	10.13 (4.07)	10.52 (4.16)
Proportion of checklist terms carried out (n=453)	0.33 (0.13)	0.35 (0.14)	0.34 (0.13)
Fees paid			
Total fee USD (n=453)	3.76 (3.14)	4.97 (3.56)	4.36 (3.40)
Consultation fee (n=427)	1.31 (1.89)	1.30 (1.64)	1.30 (1.78)
Diagnostic tests fees (n=448)	0.29 (0.89)	0.31 (0.76)	0.30 (0.83)
Medicines fees (n=427)	2.10 (2.20)	3.40 (2.90)	2.72 (2.63)
[1]Target number of checklist items was 33 for asthma and 29 for TB			

There was strong evidence that increased effort was associated with providing correct care (Table 7.6), with a one standard deviation increase in IRT score associated with a near doubling in relative risk (RR) of receiving correct management (RR=1.81, p<0.001), and a reduction in the risk of providing unnecessary care by 8% (RR=0.92, p=0.002). The magnitude and direction of these relationships remained similar in models (2) and (3), when adjusting for provider and facility characteristics.

Table 7.6: Effort and quality outcomes

	Correct management	Any unnecessary care
	Relative risk	*Relative risk*
Base model		
IRT effort	1.81 (1.43 – 2.30), p<0.001	0.92 (0.87– 0.97), p=0.002
Base model + provider characteristics		
IRT effort	1.80 (1.42 – 2.30), p<0.001	0.92 (0.87 – 0.97), p =0.003
HCW female	1.74 (1.16 – 2.62) p=0.007	0.91 (0.80 – 1.04), p=0.166
Bonus (vs fixed salary)	1.41 (0.85 – 2.33), p=0.182	1.14 (1.01 – 1.29), p=0.030
% of clinicians doctors	1.61 (0.54 – 4.86), p=0.394	0.86 (0.63 – 1.17) p=0.332
Base model + provider characteristics + facility characteristics		
IRT effort	1.87 (1.47 – 2.38), p<0.001	0.93 (0.88 – 0.98), p =0.009
HCW female	1.58 (1.06 – 2.36) p=0.026	0.90 (0.79 – 1.03), p=0.138
Bonus (vs fixed salary)	1.58 (0.94 – 2.67), p=0.083	1.14 (1.00 – 1.30), p=0.059
% of clinicians doctors	1.39 (0.48 – 4.03), p=0.548	0.83 (0.60 – 1.14) p=0.247
Hospital (vs dispensary)	1.35 (0.75 – 2.43), p=0.314	0.91 (0.75 – 1.10), p=0.325
Health centre (vs dispensary)	1.26 (0.78 – 2.05), 0.348	1.03 (0.90 – 1.17), p=0.704
For profit (vs not for profit)	0.52 (0.29 – 0.94), p=0.029	1.03 (0.90 – 1.19), p=0.649
Peri-urban (vs rural)	1.86 (1.12 – 3.10), p=0.017	1.08 0.93 – 1.26), p=0.290
Urban (vs rural)	1.09 (0.62 – 1.91), p=0.761	0.99(0.85 – 1.16), p=0.944
Insurance empanelment	1.55 (0.84 – 2.86), p=0.159	1.00 (0.88 – 1.14), p=0.991
Relative risks are from modified Poisson regression models. Base model includes adjustment for SP fixed effects, SP case and SafeCare intervention arm		

Female clinicians were over 50% more likely to correctly manage SPs than male clinicians (RR=1.58, p=0.026), despite not exerting any more effort in the consultation. However, provider gender had no impact on the likelihood of unnecessary care. There was some evidence that SPs visiting facilities where outpatient providers were paid a bonus or share of revenue were more likely to receive correct management (RR=1.58, p=0.083) and unnecessary care (RR=1.14, p=0.059), than at facilities which paid a fixed salary. There was no evidence of a relationship between the qualifications of providers at the facility and either outcome.

Compared to not-for-profit facilities, for-profit facilities were about half as likely to provide correct care (RR=0.52, p=0.029), but there was no relationship between profit status and providing unnecessary care. Peri-urban facilities were nearly twice as likely as rural ones to correctly manage SPs (RR=1.86, p=0.017), but the same increase was not observed in urban facilities, and there was

no relationship with unnecessary care. The level of facility (dispensary, health centre or hospital) and insurance empanelment did not impact either outcome.

Table 7.7: Effort and fees paid

Base model	Total fee (n=452)	Consultation fee (n=426)	Labs fee (n=447)	Drugs fee (n=426)
IRT effort	0.51 (0.18 – 0.55), p=0.003	0.37 (0.18 – 0.55), p<0.001	0.06 (-0.03 – 0.14), p=0.180	0.08 (-0.19 – 0.34), p=0.563
Base model + provider characteristics				
IRT effort	0.36 (0.04 – 0.68), p=0.027	0.24 (0.07 – 0.41), p=0.006	0.05 (-0.03 – 0.14), p=0.209	0.07 (-0.19 – 0.34), p=0.591
Female provider	-0.29 (-0.98 – 0.40) p=0.408	0.16 (-0.20 – 0.53), p=0.376	-0.03 (-0.22 – 0.15), p=0.708	-0.45 (-1.02 – 0.12), p=0.122=1
Bonus (vs fixed salary)	2.09 (1.34 – 2.84), p<0.001	0.78 (0.39 – 1.17), p<0.001	0.35 (0.16 – 0.55), p<0.001	0.96 (0.35 – 1.57), p=0.002
% of clinicians doctors	4.31 (2.63 – 5.99), p<0.001	3.90 (3.03 – 4.77) p<0.001	-0.02 (-0.47 – 0.42), p=0.917	0.25 (-1.12 – 1.62), p=0.4716
Base model + provider characteristics + facility characteristics				
IRT effort	0.30 (-0.01 – 0.62), p=0.057	0.15 (-0.10 – 0.32), p=0.066	0.05 (-0.04 – 0.14), p=0.267	0.11 (-0.15 – 0.38), p=0.403
HCW female	-0.07 (-0.74 – 0.60) p=0.844	0.25 (-0.10 – 0.60), p=0.162	-0.03 (-0.22 – 0.15), p=0.717	-0.34 (-0.90 – 0.23), p=0.244
Bonus (vs fixed salary)	1.50 (0.74 – 2.26), p<0.001	0.45 (0.06 – 0.84), p=0.024	0.32 (0.11 – 0.52), p=0.003	0.71 (0.07 – 1.34), p=0.029
% of clinicians doctors	3.18 (1.47 – 4.90), p<0.001	3.28 (2.39 – 4.16), p<0.001	-0.13 (-0.60 – 0.34), p=0.659	-0.20 (-1.63 – 1.23), p=0.782
Hospital (vs dispensary)	1.29 (0.34 – 2.24), p=0.008	1.14 (0.64 – 01.64), p<0.001	0.09 (-0.18 – 0.35), p=0.517	-0.09 (-0.72 – 0.89), p=0.834
Health centre (vs dispensary)	0.58 (-0.16 – 1.31), p=0.122	0.53 (0.14 – 0.92), p=0.008	0.22 (0.01 – 0.42), p=0.035	0.01 (-0.62 – 0.63), p=0.834
For profit	1.68 (0.90 – 2.45), p<0.001	0.74 (0.33 – 1.15), p<0.001	0.16 (-0.05 – 0.37), p=0.136	0.95 (0.29 – 1.61), p=0.005
Peri-urban (vs rural)	0.25 (-0.53 – 1.03), p=0.529	-0.10 (-0.51 – 0.31), p=0.626	0.01 (-0.20 – 0.23), p=0.894	0.42 (-0.23 – 1.08), p=0.206
Urban (vs rural)	1.05 (0.26 – 1.84), p=0.010	0.54 (0.13 – 0.95), p=0.010	0.03 (-0.18 – 0.25), p=0.771	0.47 (-0.20 – 1.13), p=0.167
Insurance empanelment	0.29 (-0.42 – 1.00), p=0.420	0.42 (0.04 – 0.79), p=0.029	-0.01 (-0.21 – 0.18), p=0.902	-0.10 (-0.70 – 0.50), p=0.750

Coefficients are from linear regression models. Base model includes adjustment for SP fixed effects, SP case and SafeCare intervention arm

Provider effort was associated with higher total fees, with an increase of USD 0.51 in fees paid per one standard deviation increase in effort IRT score (p=0.003, Table 7.7). Most of this increase was explained by higher consultation fees, which had an increase of USD 0.37 for each standard deviation increase in effort IRT score (p<0.001). There was no evidence of an association between effort and lab or drug fees. When adjusting for provider and facility characteristics, the effect of effort on fees was somewhat attenuated, with a one standard deviation increase in effort

associated with a USD 0.30 increase in the overall fee (p=0.057), and a USD 0.15 increase in the consultation fee (p=0.016).

Bonus or revenue-based payments for outpatient clinicians increased mean fees by USD 1.50 (p<0.001), and this acted jointly through increases in the consultation fee (USD 0.45, p=0.024), lab fee (USD 0.32, p=0.003) and drug fee (USD 0.71, p=0.029). Mean fees were USD 1.68 higher in for-profit than not-for-profit facilities (p<0.001), and this acted through both increases in the consultation fee (USD 0.74 p=0<0.001) and drug fee (USD 0.95, p=0.005).

Fees at facilities with at least three doctors on the outpatient staff were USD 3.18 higher than those without any doctors (p<0.001), and this acted solely through the consultation fee, which was USD 3.28 higher (p<0.001). Hospitals charged an average of USD 1.29 more in fees than dispensaries (p=0.008), again driven by the consultation fee, which was USD 1.14 higher (p<0.001). Health centres charged higher consultation fees (USD 0.53, p=0.028) and lab fees (USD 0.22, p=0.035) than dispensaries, but there was little evidence that this increased fees overall (USD 0.58, p=0.122). Fees were higher in urban than rural facilities (USD 1.05, p=0.010) and this seemed to act though the consultation fee (USD 0.54, p=0.010). Insurance empanelment was associated with higher consultation fees (USD 0.42, p=0.003), but there was little evidence that this increased fees overall (USD 0.29, p=0.420)

7.2.5 Discussion

Only 1 in 18 asthma SPs received the correct management (prescription of a suitable inhaler) and only 1 in 4 TB SPs were correctly referred for testing. Unnecessary care was widespread: three-quarters of all SPs received at least one unnecessary drug or test. In general, provider effort was low, with clinicians carrying out around one third of recommended checklist items. Increased effort in the consultation was strongly associated not only with an increased likelihood of providing the correct care, but also with a decrease in the chances of giving unnecessary care. This suggests that providers who exert more effort are not simply providing 'more of everything' but that perhaps they are being more precise in their diagnosis, with the increased history taking and physical exams enabling them to avoid providing unnecessary care.

Provider effort played an important role in good quality care even after controlling for facility and provider characteristics. The qualification level of outpatient staff was not an independent predictor of either quality of care outcome in the multivariate model, when controlling for provider effort, but it was strongly correlated with provider effort itself. Effort may be a mediator on the pathway between qualification level: it may be through exerting greater effort that higher qualified

providers are able to deliver better quality of care Looking at other factors related to clinicians themselves, female providers were significantly more likely to correctly manage SPs, but no less likely to give unnecessary care. However, there was no association between provider gender and effort. Provider payment mechanism was also important: those working at facilities where they were paid a bonus or share of revenue were more likely to provide unnecessary care than at facilities which paid a fixed salary. This suggests that provider payment mechanisms with financial incentives may in fact be detrimental to patient care, increasing the likelihood of unnecessary care without increasing the likelihood of correct care, and points towards financial motivation being a potential driver for unnecessary care.

The two facility characteristics which were associated with quality of care were facility profit status and location. For-profit facilities were much less likely to provider correct care, though no more likely to provide unnecessary care. At first glance, this runs contrary to assumptions about profit-making facilities: there is no clear reason for profit to incentivise poor care, unless it is through providing more unnecessary care. However, it is worth noting that correct management of TB was ordering a sputum test, or referring to a facility which could do a sputum test. Many small facilities do not have the capacity to do the test, so for for-profit facilities a referral would mean losing the income generated from treating the patient otherwise. Peri-urban facilities were more likely than those in rural areas to correctly manage SPs, but the same effect was not observed among urban facilities, or on the unnecessary care outcome.

Factors associated with fees fell broadly into two groups: factors which increased the fees charged through the mechanism of a higher consultation fee only, without any increase in fees for tests or drugs prescribed, and factors which were associated with higher consultation, lab and drug fees. Factors associated with an increased consultation fee seemed to be related to skill and level: more effort, more outpatient clinicians being fully qualified doctors, hospitals and health centres (vs dispensaries) and urban facilities compared to rural ones. This may be a case of more skilful providers signalling their higher quality of care through the fee for the initial consultation, or that those which charge a substantial consultation fee feel the need to justify it through exerting more effort, or are incentivised to do so (since effort is still a significant predictor of consultation fee after adjusting for facility characteristics). An SP study using cases of absent children with diarrhoea or pneumonia in rural India also found that providers who made more effort (measured through both number of questions asked and length of consultation) demanded higher prices [35]. Other work in India had identified that providers in wealthier areas (where it assumed they can charge higher fees) exerted more effort in consultations [23].

The characteristics associated with higher consultation, lab and drugs fees were profit status and provider payment mechanism. In line with expectations, fees are higher at for-profit facilities and those which pay their outpatient clinicians a share of revenue or bonus, rather than a fixed salary. This may be the result of both higher fixed prices and the incentive to sell additional unnecessary tests and drugs.

The use of SPs has a number of strengths. Unlike record extraction, which relies on only the information recorded by a provider, we know exactly what care is and is not required for the SP, so correct and unnecessary care can be measured precisely and directly. We are also able to measure effort through recording whether history questions relevant to the condition were asked, whereas a medical record may only contain a brief summary of the information gathered, not the full list of questions asked. Using standardised patients removes the risk of case-mix and patient-mix bias, as all providers deal with the same comparable condition. Compared to direct observation, it removes the Hawthorne effect, whereby providers alter their behaviour because they know that they are being observed, and compared to patient exit interview it removes recall bias.

The study also has limitations. There are only a limited number of cases that are feasible for SPs to portray, so we cannot capture the general experience of adult outpatients (let alone inpatients or children) in this type of study. For safety reasons, our SPs did not do all recommended tests or buy certain types of drugs (such as injections) which may both have reduced the overall fees payable as well as affected the provider's ability to make a diagnosis (though cases were designed such that tests were not required to make the correct diagnosis and provide correct management). This study was conducted only in private health facilities, and findings are unlikely to be generalizable to the public sector due to the different incentives at play. However, the private sector plays an important role in the Tanzanian health system: 30% of Tanzanian health facilities are private, and 31% of health expenditure in facilities is in the private sector, as is approximately 27-30% of outpatient care-seeking [36]. In 39 of Tanzania's 169 districts, there is no government district hospital, so a private not-for-profit facility acts as a designated district hospital. These facilities tend to be closely linked to government, with significant government funding; 44% of our study facilities reported having at least one member of staff paid by the government.

When interpreting the results of the study, the limitations of our methods for measuring provider effort must also be taken into account. Effort is operationalised as a function of questions and physical exams in the consultation, but this is an imperfect and indirect proxy measure. The measure will almost certainly also be a function of the provider's skill and knowledge: a provider must first recognise the possibility of a TB infection before going on to ask about family history of

TB or contact with TB patients. In this case, it could be argued that the greater effort being exerted may not be leading to an increased chance of the correct management (TB testing), but is simply correlated with it, as both are associated with a third variable: the provider recognising a classic case of suspected TB. The effort measure also cannot take account of how well actions are carried out: a provider who takes several minutes to listen carefully to breathing on the front and back of the chest is rated the same as one who listens only briefly without paying much attention. Lab tests were not included as part of provider effort, as they are carried out by other technicians, and in the case of TB form part of the correct management outcome, but it could be argued that they should be, as testing, and the provider's interpretation of test results, is an important stage in coming to a diagnosis.

Our findings are in line with other SP studies in India (rural Madhya Pradesh [17] and West Bengal [16], and urban Mumbai, Patna & Delhi [29]), China [29] and Senegal [28], which have shown that when providers make more effort, they are more likely to provide correct care. Most of those studies were among private providers only, except the one set in China which included only public providers and in Madhya Pradesh which included both. The only study we have identified where effort did not predict correct management was in Kenya [37], where the result was driven by providers correctly referring TB SPs for testing despite asking very few questions [29]. The authors of that study suggest that effort does not improve management in that setting because of clear protocols to refer patients with persistent cough for TB testing, in contrast to our findings that effort in the consultation was important for correct management. In the Kenyan study, 50% of TB SPs were correctly referred, and were asked an average of 42% of the recommended nine history questions (a mean of 3.8 questions) [37], whereas we observed correct referral of only 25%, but a mean of 10.1 checklist items completed. This suggests that the role of effort may be less important than training, messaging and protocols for providers. The difference may also be explained by sector: the Kenyan study included both public and private providers.

There is mixed evidence on whether provider effort is protective against unnecessary care. Two SPs studies in rural India found no association between effort and unnecessary treatment, despite effort predicting correct management [16, 17]. Another study among public and private doctors in Delhi found that providers who made more effort prescribed more drugs, though no attempt was made to classify them as unnecessary [23]. However, an SP study in China found that increased effort was associated with reduced use of unnecessary antibiotics [18], more in line with our own findings, with the authors suggesting diagnostic uncertainty as a key driver of inappropriate antibiotic use. The variation in results across settings suggests the reasons behind the provision of

unnecessary care are context-specific, and may not be able to be tackled with the same tools in different places.

In terms of policy, our study along with some others suggest that interventions to encourage providers to exert more effort will both increase correct care and reduce unnecessary care, allowing the health system to operate more efficiently. One way to do this is through training: a randomized controlled trial of a training programme for informal providers in India found a positive effect on effort after nine months (though in this study, increased effort did not decrease unnecessary care) [16]. However, this kind of training may need to be carefully targeted at individual providers; a randomized controlled trial of a broader facility level quality improvement programme in Tanzania did not increase provider effort, or improve correct management [30].

To reduce unnecessary care and inflated fees, addressing payment structures and provider incentives may be more important than training. Facilities could be mandated to pay providers only using a fixed salary, with bonuses based on facility profits or volume of patients outlawed by regulatory mechanisms. However, this would not address incentives where the provider is also the owner of the business. Further steps could include a requirement that all prescribed medicines are dispensed by an independent pharmacy, or diagnostic tests carried out by independent labs, though more intensive regulatory intervention would be required to ensure compliance. Given the expansion of social health insurance programmes, strategic purchasing arrangements by private or public insurers, such as capitation or reimbursement based on diagnostic related groups, may play an important role in preventing unnecessary care in the future.

7.2.6 References for Chapter 7

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8 Chapter 8: Discussion

8.1 Introduction

In this thesis, I aimed to develop the conceptualisation and measurement of the overprovision of healthcare in low- and middle-income countries (LMICs), setting the research in the Tanzanian private healthcare sector. In this final chapter, I will summarise my findings with respect to the objectives laid out in the introduction and interpret the findings in the context of the published literature, discuss the strengths and limitations of the work, and propose avenues for future research and implications for policy.

8.2 Summary of findings

8.2.1 Objective 1: To develop and implement standardised patient cases to measure quality of care in Tanzanian private health facilities

In the paper in Chapter 3, I summarise the findings of a review of the use of standardised patients (SPs) to measure quality of care in clinical settings in LMICs, which formed the foundation for choosing the cases used in this thesis. I identified 45 studies and 17 different presenting conditions in the literature published to December 2016. In almost half of the studies the presenting condition was a family planning client. Based on the presenting conditions identified in the literature and common conditions reported by study facilities, I compiled a list of potential SP cases and, as described in Chapter 4, evaluated them against six criteria. Some criteria concerned suitability to setting (could the condition be feasibly recognised and treated in study facilities, and would the service be available in every study facility?), others were related to practicality and safety of fieldwork (could the symptoms be falsified, would fieldworkers be exposed to unnecessary risks?) and some about the validity of the case for measuring quality of care (was there evidence for defining correct management, does the condition have clinical or public health significance). These criteria were then expanded into the ten questions for assessing suitability presented in the paper in Chapter 3.

Cases of asthma, non-malarial febrile illness (NMFI), tuberculosis (TB), and upper respiratory tract infection (URTI) were identified as the most suitable for the study at the end of this process. Through reviews of existing tools, and a careful process of extensive consultation and piloting, as described in Chapter 4, I developed scripts for these cases which would be feasible and realistic to carry out in Tanzanian private health facilities. I oversaw the rigorous implementation of fieldwork with protocols to ensure safety and validity, including an SP detection survey.

8.2.2 Objective 2: To develop a framework for understanding the potential harms of overprovision

My framework to conceptualize the harms of overprovision is presented in the co-authored paper in Chapter 5. I argue that overprovision can be thought of as having three main types of harm: economic, clinical, and public health. Within these types, harms can take different forms. Economic harms can include inefficiency in publicly funded health systems, as well as catastrophic costs and opportunity costs to individual patients and their households. Clinical harms may include both physical side effects and mental health consequences such as the anxiety associated with false-positive results. Harms to public health include not only the evolution of pathogens resistant to current antimicrobial therapies, but the misuse of diagnostic tests which could provide false reassurance and lead to high-risk behaviour that could impact on others.

Within Chapter 5 I also present a set of outcomes based on this framework. All overprovision can be argued to have some opportunity cost, so outcomes related to economic harms were any unnecessary care, unnecessary tests, and unnecessary drugs. Public health harm outcomes were unnecessary antibiotics, unnecessary antimalarials, prescription of multiple antibiotics and prescription of antibiotics on WHO Watch or Reserve list for enhanced stewardship [1]. A single clinical harm outcome encompassed any drug or test offered with potential to cause harm to the patient, including ordering IV fluids, which presented a risk in terms of iatrogenic infection.

8.2.3 Objective 3: To measure the prevalence of types of overprovision in the Tanzanian private sector, and compare prevalence by facility characteristics

In Chapter 5, using the outcomes described above, I estimate the prevalence of the different types of overprovision in Tanzanian private health facilities in relation to my four SP cases. There was unnecessary care in 81.4% of SP visits, ranging from 61.2% of asthma visits to 97.8% of URTI visits. There was overprovision harmful to public health (unnecessary antimalarials or antibiotics) in 67.3% of visits: up to 91.6% of URTI visits, and lowest at 41.0% in asthma visits. Overprovision with potential clinical harm to the patient occurred in 6.2% of visits, ranging from 0.4% of URTI visits to 15.0% of TB visits.

Univariate analysis of the relationship between profit status of the facility and overprovision suggested that for-profit facilities were more likely than their not-for-profit counterparts to provide unnecessary care falling into the public health (OR= 1.64, 95% CI: 1.13-2.37) or clinical harm domains (OR= 1.92, 95% CI: 0.97-3.80) but no more likely to provide unnecessary care overall (OR=1.25, 95%5CI: 1.85). Multivariate analysis, additionally adjusting for facility location (urban, peri-urban or rural) and level (dispensary or health centre), did not identify any of these factors as

being associated with unnecessary care overall. In the multivariate model, profit status was no longer significantly associated with overprovision harmful to public health (OR=1.64, 95% CI: 0.89-2.99); the relationship seemed to be confounded by facility level, with some evidence that health centres were less likely to provide care harmful to public health than dispensaries (OR=0.62, 95% CI: 0.36 – 1.05). For clinically harmful overprovision, the relationship with being a profit making rather than non-for-profit facility was stronger in the multivariate model (OR=3.15, 95% CI: 1.24-8.00), and urban facilities were identified as being less likely to provide clinically harmful unnecessary care than rural ones (OR=0.36, 95% CI:0.13 – 0.97).

8.2.4 Objective 4: To assess whether patients expressing their knowledge of unnecessary practices reduces their likelihood of receiving overprovision

In Chapter 6, I report findings from a randomised field experiment designed to assess whether the level of patient knowledge about their condition and appropriate antibiotic use was associated with overprovision. SPs presenting the URTI case, which was uncomplicated and a clear case of a viral illness which did not merit antibiotics, were randomised so that half made a statement when explaining their symptoms to the provider, while the other half did not. The statement ("I don't know what to do because my friend told me he read on the internet that you don't need antibiotics for a simple cough") was designed to signal to the provider that the patient had knowledge of appropriate antibiotic prescription practices, and measure the effect of this knowledge on prescribing behaviour.

86.0% of SPs who were randomised to make the statement were prescribed an antibiotic, compared to 94.8% of those who did not make the statement. There was modest evidence of a reduction of 7.8 percentage points in the informed arm after adjusting for the facility's umbrella organisation and which SafeCare study arm (control or intervention) it was in. There was no difference between the two arms in the likelihood of being prescribed any drug (which was almost ubiquitous at 98.2%), or in fee expenditure. When SPs made the statement, providers completed more items from a checklist of recommended history taking and physical exams (5.95 items in the control arm vs 6.35 in the intervention arm), suggesting that they put in more effort.

8.2.5 Objective 5: To examine the relationship between provider effort and different components of care, including correct treatment and unnecessary care.

In Chapter 7 I explore the concept of 'provider effort' and whether a measure of provider effort was associated with correct care or overprovision. Provider effort was operationalised using item response theory to produce a continuous measure, based on checklists of 29-33 recommended history questions and physical examinations carried out by providers during the SP consultations.

In line with our expectation, a higher provider effort score was associated with increased likelihood of the SP receiving correct care (RR=1.81, 95% CI: 1.43 – 2.30), and decreased risk of overprovision (RR=0.92, 95% CI: 0.87 – 0.97). These relationships held after adjusting for a number of provider and facility characteristics. More provider effort was, however, also associated with patients being charged higher fees, mainly through the mechanism of a higher fixed consultation fee rather than fees for lab tests or drugs dispensed.

8.3 Comparison to published literature

8.3.1 Prevalence of overprovision

In the literature review in Chapter 2, prevalence of overprovision varied across studies from 0 to 100%, and was clearly dependent on method of measurement, setting, and the type of patient, condition and overprovision of interest. I will therefore discuss the results on prevalence presented in Chapter 5 of this PhD with respect to some of those study characteristics, and consider which studies in the literature are the most directly comparable to my PhD.

8.3.1.1 Prevalence of economic harms

My primary finding on prevalence of economic harms was that there was unnecessary care in 81.4% of SP visits, including unnecessary drugs in 72.8% of visits and unnecessary tests in 29.8% of visits. Unnecessary drugs were prescribed in 52.4% of asthma visits, 62.7% of NMFI visits, 80.6% of TB visits and 95.6% of URTI visits. In the language used in the literature review, these are *population prevalence* measures of overprovision. No studies identified in the literature review estimated an equivalent prevalence of any unnecessary care which included both tests and drugs. One SP study in Kenya measured the population prevalence of unnecessary lab tests, with 10% of children with diarrhoea being ordered an unnecessary test in private facilities [2]. However, comparability to this PhD study is limited, particularly given the child diarrhoea case was based on a mother describing her sick child who is at home, limiting the scope for ordering tests.

There were eight studies in the literature review which measured the population prevalence of unnecessary drugs. Four of these were SP studies, and three set in India using outpatient SP cases of angina, asthma and an absent child with diarrhoea, all of which included public and private (including informal or untrained) primary providers. In the first, set in rural Madhya Pradesh, 41.7% of SPS received unnecessary or harmful drugs [3]. Examining just asthma cases, 62.7% of SPs received unnecessary drugs, compared to 52.4% (95% CI: 45.7 – 59.1) in this PhD, but results from the former study were not broken down into private and public sectors. In a second study in rural Madhya Pradesh, 80.2% of all SPs received unnecessary drugs [4]. Restricting just to private

providers, this was 80.8%, and examining only asthma cases, 74% of SPs visiting private providers received unnecessary drugs. In the third study in rural West Bengal, which reported the results of a randomized controlled trial of a training programme for private providers, 70.7% of SPs received unnecessary or harmful drugs in the control group, 69.5% in the treatment group, and 87.9% in a reference group visiting public health facilities [5]. Results were not reported by case, so prevalence for asthma SPs is not available. Comparing all outpatient SPs, my findings in Tanzania, ranging from 52.4% to 95.6% prescribed unnecessary drugs dependent on case, were similar to the range of overprovision prevalence measures observed in India (41.7% to 87.9%). Overprovision of drugs to asthma SPs in particular was lower in my study in Tanzania (52.4%, 95% CI: 45.7 – 59.1) than in India (62.7%-74%).

The fourth SP study was set in urban Johannesburg, South Africa, and used URTI SPs visiting private providers, all of whom had formal training [6]. That study found that 99.1% of SPs received unnecessary drugs, similar to the 95.6% (95% CI: 92.0 – 97.9) among URTI SPs in this PhD. The four other studies which measured the population prevalence of any unnecessary drug, all set in Ethiopian public hospitals, had much lower prevalence measures than observed in this PhD, but they used medical record extraction, and non-comparable patients with different conditions: adult medical inpatients (population prevalence of overprovision: 29.4% [7] and 12.0% [8]) , outpatients who had a previous admission with cardiovascular disease (7.4%)[9], and outpatients with hypertension who were taking at least one drug (24.5%) [10]. The lower prevalence of overprovision of medication in these Ethiopian studies may be due to the different setting, with better qualified providers and fewer incentives to overprovide, or because those patients were more likely to require the drugs that they received than the mostly healthy outpatients in the PhD study, or could be a result of underestimation, with medical records justifying the prescription of drugs which were in fact unnecessary. Overprovision is also likely to vary with condition, so the difference in case mix will also have had an impact.

8.3.1.2 Prevalence of public health harms

My main finding on prevalence of public health harms was that 67.3% of SPs received some overprovision harmful to public health: 8.9% an unnecessary antimalarial and 62.7% an unnecessary antibiotic. Antimalarial and antibiotic overprovision were 0.9% and 40.5% respectively for asthma SPs, 24.1% and 42.5% for NMFI, 2.6% and 78.0% for TB, and 7.9% and 89.9% for URTI. Since neither antibiotics nor antimalarials were necessary in any case, these can be seen as *healthy prevalence* measures of overprovision. No studies identified in the literature review look at antibiotics and antimalarials combined. Three studies examined overprovision of antimalarials, of

which two used a healthy prevalence measure. Both used medical record extraction to measure overprovision to children with NMFI. In a study in Ghana, 84.1% of inpatient children who had a negative malaria test result were given an antimalarial, as were 78.2% who were not tested for malaria [11]. In a randomized controlled trial in Uganda, the proportion of outpatients given an antimalarial in spite of a negative test varied from 27% (in over-five year olds in the intervention arm at endline) to 65% (in under-five year olds in the control arm at baseline) [12]. In this PhD, the prevalence was 24.1% (95% CI: 18.7 – 30.2) among NMFI SPs, but unnecessary antimalarials could be prescribed without testing, after a negative test result or after a false positive. The lower prevalence is not surprising given the wider definition of when an antimalarial is unnecessary in the PhD study, as well as the general tendency to err on the side of overtreatment with children, in whom malaria is much more likely to be fatal, and that the fieldwork for the Uganda and Ghana studies was conducted in 2009-12, when presumptive treatment for malaria was a more common practice [12]. It is notable that among adults seeking care for NMFI in 2018 as part of this PhD, nearly a quarter still received an unnecessary antimalarial.

Compared to all other forms of overprovision, there is extensive evidence of overprovision of antibiotics in LMICs. I identified 33 studies in the literature review examining antibiotic overprovision alone, and an additional seven which included unnecessary antibiotics among a wider set of overprovision outcomes. Of these 40 studies, 27 used the same healthy prevalence measure as this PhD, that is, the denominator included only patients in whom they were not necessary. First, I will discuss ten studies which used adult SPs to measure the healthy prevalence of antibiotic overprovision, as these are the most directly comparable to the findings from this PhD.

Six used SPs with a case of URTI which did not require antibiotics, as in my study. In studies among private providers in urban settings in Iran [13], Malaysia [14], and South Africa [6], prevalence of antibiotic prescription was 93%, 65% and 71% respectively. In three studies in hospital outpatient departments in China, prevalence of antibiotic prescription was 50% [15], 55% [16], and 62% [17]; the reimbursement mechanisms in hospitals at the time of the Chinese studies have been argued to incentivise overprovision [18]. In this PhD study, 89.9% (95% CI: 85.2 – 93.5) of URTI SPs received unnecessary antibiotics, at the higher end of estimates in the literature.

Four further studies examined unnecessary antibiotics in a variety of SP cases. Two studies in India used SP cases of angina and asthma, and included public and private (including informal or

untrained) providers[2]. In the first study, 40% of asthma SPs visiting private providers were prescribed an unnecessary antibiotic (this was 27.9% when including angina SPs, and 27.8% when also including public providers across both cases) [4]. In the second study (reporting the results of a randomized controlled trial), 33.1% of SPs received unnecessary or harmful drugs in the private control group, 33.2% in the private treatment group, and 63.6% in a reference group visiting public health facilities [5]. Results were not reported by case, so prevalence for asthma SPs is not available. A study with SP cases of asthma, TB, angina, and an absent child with diarrhoea, in public and private facilities in urban Kenya [19] estimated that unnecessary antibiotics[3] were prescribed in 49% of visits, with a prevalence of 50% for asthma cases and 55% for TB cases. In private facilities, 50% of all SPs were prescribed an antibiotic, but this is not broken down by case. Finally, a study in rural China with SP cases of TB, angina, and an absent child with diarrhoea found that 42% were prescribed an unnecessary antibiotic, and this was 64% among TB SPs only [20]. In this PhD, the prevalence of antibiotic overprovision to asthma SPs was 40.5% (95% CI: 34.1 – 47.2), similar to the 40% among asthma SPs in India and below the 50% in Kenya. Among TB SPs, prevalence of antibiotic overprovision was 78.0% (95% CI: 72.0 – 83.2), higher than both the 55% observed in Kenya and 64% in China.

Finally, it is useful to compare the prevalence of antibiotic overprovision in studies which did not use SPs, in order to understand real practice, and the impact of different methods of measurement. There were 16 studies which measured the healthy prevalence of antibiotic overprovision, however I will limit my discussion to five studies which included adult outpatients, for better comparability to my PhD results. All five studies used medical record extraction. In a nationally representative sample of public and private GPs in Malaysia, it was estimated that 46.2% of patients with URTI were given antibiotics, which were defined as unnecessary for URTI patients [21]. Restricting to private GPs, this rose to 57.7%. A study among township health centres and village health posts in China found that 50.6% of patients diagnosed with a cold in the former, and 38.4% in the latter, were prescribed antibiotics [22]. These findings are lower than the 89.9% of URTI SPs in the PhD, as well as generally being lower than other estimates derived from the use of URTI SPs. It seems likely that this is partly a result of methodological differences: in record extraction studies, the authors rely on the recorded diagnosis, and so if a provider makes a misdiagnosis, such as recording

[2] These studies are described earlier in this chapter as including an SP case of an absent child with diarrhoea. These are the same studies as described earlier, but the authors of both studies excluded this case when analysing unnecessary antibiotic prescriptions, as they did not define antibiotics as unnecessary in all circumstances for the child diarrhoea case.

[3] In this study, the authors judged that antibiotics were always unnecessary for the absent child with diarrhoea.

pneumonia when the true condition is an uncomplicated URTI which does not require antibiotics, overprovision is underestimated.

Three studies examined overprovision of antibiotics in outpatients without a directly comparable SP case. 42% of outpatients with malaria without a clinical indication for antibiotics were prescribed them in public and private health centres in Uganda [23], 15% of private allopathic GPs and 81% of private ayurvedic GPs prescribed an antibiotic for viral fever (defined as irrational) in India [24] and 57.2% of adults with diarrhoea who did not need an antibiotic were prescribed one in Chinese public hospital outpatient departments [25].

8.3.1.3 Prevalence of clinical harms

The prevalence of clinically harmful overprovision was 6.2%. Clinical harm was not a standalone outcome used in any studies identified in the literature review, though three studies included clinical harms as a joint outcome with any unnecessary drugs [3, 6, 26], so this is a novel way of measuring the harms of overprovision.

8.3.2 Factors associated with overprovision

The papers presented in Chapters 5 and 7 of this PhD investigate the following factors with respect to overprovision: facility profit status, facility location (rural, peri-urban or urban), facility level (hospital, health centre or dispensary), whether the facility has revenue from insurance schemes, qualification level of outpatient providers at the facility, payment mechanism of outpatient providers at the facility, and the gender of the provider of healthcare. I will discuss the findings on each factor below, along with the evidence summarised on it in Chapter 2.

8.3.2.1 Facility profit status

In the Chapter 5 univariate analysis, there was an increased risk of public health harms (unnecessary antibiotics and antimalarials) and clinical harms (harmful drugs or IV drip) among for-profit facilities compared to not-for-profit facilities, but no increased risk of unnecessary care overall. In a multivariate analysis, adjusting for facility level and location, there remained only an increased risk of clinically harmful overprovision. It is important to note that in order to make a like-for-like comparison between for-profit and not-for-profit facilities, this analysis excluded all 36 hospitals in the sample, as they were all not for profit, and so only dispensaries and health centres were included. Not-for-profit hospitals are often designated district hospitals with significant government funding and staffing, and so could be expected to be among the most 'unlike' private-for-profit facilities. In the multivariate analysis of asthma and TB cases only in Chapter 7, which

included hospitals, and adjusted for provider effort as well as other facility and provider level factors, there was also no relationship between profit status and the risk of any overprovision.

None of the literature identified in Chapter 2 compared private-for-profit facilities to private not-for-profit, but comparisons between private and public sectors were available. The salient difference in such comparisons is the profit status, although there are other key differences between the public and private sector, such as regulation and local government oversight, which do not apply in the comparisons in this PhD. Three studies used similar SP cases to this PhD, two using cases of angina, asthma and an absent child with diarrhoea in India [4, 5], and one using cases of asthma, TB, angina, and an absent child with diarrhoea in Kenya [19]. The first, in rural Madhya Pradesh, found that SPs visiting public facilities were more likely to receive an unnecessary antibiotic[4] than when visiting the same doctor at their private practice ($p<0.1$), but there was no significant difference when comparing public and private sectors overall (which included informal private providers), or in the likelihood of receiving any unnecessary drug [4]. The direct comparison between doctors in their private and public practice is the most appropriate for comparison to this PhD, since it excludes informal providers, and is a stronger design than mine since it eliminates intra-facility provider level variation. That comparison contrasts with my PhD findings of modest evidence for more overprovision of specific drugs in for-profit facilities, but is similar in finding no difference in overall overprovision. The second, in rural West Bengal, found that informal private providers were less likely to prescribe unnecessary antibiotics[5] (AOR=0.24, 95% CI: 0.10 - 0.63) or any unnecessary care (AOR= 0.27, 95% CI: 0.10, 0.76) when compared to public (formal) providers; the difference in provider type means comparison with the PhD study is less immediate [5]. In urban Nairobi, where private facilities are perhaps most similar to the private-for-profit facilities in the PhD sample, there was no difference in the rate of prescription of unnecessary antibiotics or steroids between formal public and formal private facilities [19]. Unnecessary antibiotics is most similar to the 'public health harm' overprovision outcome in the PhD study, which was higher in for-profit facilities only in univariate analysis but not after adjusting for other factors. Unnecessary steroids were a key component of clinically harmful care for TB SPs in the PhD study, and in contrast to the Kenyan study, there was evidence for more overprovision of clinically harmful care in for-profit facilities.

Non-SP studies from the literature also provided mixed evidence of differences in overprovision in the public and private sectors, though the patient populations do not allow for direct comparisons

[4] As discussed above, the unnecessary antibiotics outcome excluded the absent child diarrhoea case in these studies

[5] As above

to the PhD study. Antibiotic prophylaxis for surgery was more likely to be unnecessary in a private hospital compared than a public teaching hospital in South Africa (p=0.003) [27], and MRI for lower back pain was less likely to be unnecessary in public than private hospitals in Iran (AOR=0.48, 95% CI: 0.26- 0.90) [28]. By contrast MRI was more likely to be unnecessary in public than private imaging centres (p=0.003) in another Iranian study [29].

8.3.2.2 Facility level

Facility level was examined as a covariate in the multivariate analysis in Chapter 5, as well as in the multivariate analysis in Chapter 7, for the asthma and TB cases only. In Chapter 5, there was some evidence that SPs were less likely to receive an unnecessary antibiotic or antimalarial at health centres than dispensaries when controlling for facility profit status and location, but no relationship with unnecessary care overall or clinically harmful care. In the analysis in Chapter 7, which included hospitals, and adjusted for provider effort as well as other facility and provider level factors, there was also no relationship between facility level and the risk of any overprovision.

When examining the literature in Chapter 2, evidence was also limited. A study in rural China with SP cases of TB, angina, and an absent child with diarrhoea, compared overprovision in township health centres and village clinics [20]. It found that SPs visiting clinics were more likely than those at health centres to receive unnecessary antibiotics for the angina (p=0.0004) and child diarrhoea cases (p=0.0659), but no difference for TB or when the three conditions were pooled [20]. Facility level may be confounded by setting (township or village) in this study, as it was in the PhD study, so it is hard to know whether the subtle differences can be ascribed to the differences in practice between villages and towns, or clinics and health centres. Two non-SP studies in the literature found no association with facility level: there was no difference in the proportion of patients receiving unnecessary antimalarials comparing hospitals and health centres in Uganda [12], and no difference in the proportion of caesareans which were unnecessary in regional hospitals, university hospitals and medical centres in Burkina Faso [30]. In practice, it may be almost impossible to separate facility level from a host of perhaps more important factors in driving overprovision: the qualifications and skill of clinicians, the availability of drugs, procedures and diagnostic tests, the patient load in the outpatient department, the location, and the facility's profit status and reimbursement mechanism.

8.3.2.3 Facility setting

Facility setting was examined as a covariate in the multivariate analysis in Chapter 5, as well as in the multivariate analysis in Chapter 7, for the asthma and TB cases only. In Chapter 5, there was evidence that SPs were less likely to receive clinically harmful overprovision at urban or peri-urban

facilities than rural ones, but no relationship with unnecessary care overall or unnecessary antibiotics or antimalarials, and no relationship in the analysis on overall unnecessary care in Chapter 7. Only one study identified in the literature review, in rural China with SP cases of TB, angina, and an absent child with diarrhoea, compared overprovision by facility setting [20]. It compared unnecessary antibiotic prescriptions in township health centres and village clinics, but, as discussed above, facility level and setting were colinear, so it is not clear if higher prevalence of unnecessary antibiotic prescriptions in village clinics was due to the more rural setting or the lower level of facility. Furthermore, the setting is broadly rural, so the most 'urban' facilities are in small towns, in contrast to this PhD, which included facilities in major cities.

8.3.2.4 Facility insurance empanelment

Facility insurance empanelment was only explored as a factor in Chapter 7, for the asthma and TB cases, and the analysis controlled for provider effort as well as other provider and facility level factors. Given that SPs in this study all paid cash for their care, the hypothesis for any relationship is somewhat indirect. A facility treating insured patients may have a different standard practice or approach to one which never bills insurance companies, as a result of regulatory or supervisory oversight from the insurer, and the reimbursement mechanism may incentivise or disincentivise certain behaviours such that they become ingrained. I did not find any relationship between whether a facility had revenue from government or private insurance schemes and the likelihood of overprovision. Even in studies in the literature which made the more direct comparison at the patient level (between those who were insured and those who paid cash), only one identified that insured patients were at greater risk of overprovision [31], while three others found no relationship [6, 28, 29]. There was more evidence of an effect when the whole facility's reimbursement mechanism was changed for all the care it provided, as per two studies in China, in which switching from fee-for-service payment to capitation with pay-for-performance elements [22], or case-based payments [32], reduced the prevalence of overprovision.

8.3.2.5 Provider payment mechanism (facility level)

Provider payment mechanism was only explored as a factor in Chapter 7, for the asthma and TB cases, and the analysis controlled for provider effort and gender, as well as qualification level at the facility level. In this analysis, outpatient clinicians being paid a performance-based bonus or share of facility revenue (as opposed to paid only a fixed salary) was associated with an increased risk of overprovision of any type, with a relative risk of 1.14 (95% CI: 1.01- 1.29, p=0.030), or 1.14 (95% CI: 1.00- 1.30, p=0.059) after additionally adjusting for facility level, location and profit status. There were no studies in the literature review which examined the way individual providers were paid,

but as discussed in Section 8.3.2.4, there was evidence that a change from strong incentives such as fee-for-service to weaker incentives such as capitation or case-based payment reduced the prevalence of overprovision, which aligns with the evidence that providers may be financially motivated to provide unnecessary care.

8.3.2.6 Provider gender

Provider gender was only explored as a factor in Chapter 7, for the asthma and TB cases, and the analysis controlled for provider effort, as well as qualification level and payment mechanism at the facility level. In contrast to three studies in China (one with medical record extraction [31] and two using SPs [17, 26]), I found that female providers were no less likely than their male colleagues to provide unnecessary care. All three Chinese studies examined unnecessary antibiotics as an outcome, not any unnecessary care, and antibiotics may be less ubiquitous than unnecessary care overall, and therefore more useful for such comparisons between provider groups. Additionally, while those studies adjusted for provider characteristics, they did not adjust for provider effort. However, it seems unlikely that effort was a mechanism through which gender could have acted in the PhD study, as female providers did not exert any more effort than males.

8.3.2.7 Patient knowledge and preferences

The experiment presented in Chapter 6 was designed to explore whether there was a causal relationship between a patient's lack of knowledge that a drug was unnecessary, and a provider prescribing that drug. This information asymmetry is theorised to be pivotal in allowing the existence of provider induced demand, and is in fact part of the definition: provider induced demand is the provision of healthcare which the patient would not choose *were they fully informed.* The experiment in this PhD used a case of uncomplicated URTI, which did not merit antibiotics, and randomised half of SPs to make a statement signalling knowledge that antibiotics were unnecessary. We found modest evidence of a causal relationship between patient knowledge and overprovision: expressing knowledge was associated with a drop of 7.8 percentage points (p=0.074) from a very high baseline of 94.8% being prescribed antibiotics. This was a much smaller effect than observed in the experiment which motivated our study [17], and a number of potential reasons for this difference are discussed in Chapter 8. One explanation is higher-powered incentives for drug sales in Chinese hospitals than Tanzanian health facilities. Before reforms to the health system, Chinese public hospitals were permitted to charge only low, fixed consultation fees, but could add a 15% mark-up on drug sales [18]. As a result, drug sales accounted for 50% of hospital revenue, and doctors often received performance bonuses dependent on sales [33]. By contrast, in the

Tanzanian private sector, facilities are free to set their own fees for cash patients, and have a wider range of revenue sources. Only a minority of providers were remunerated through bonuses based on revenue, so individual clinician incentives to induce demand through drugs sales may be lower. Reduced capacity for diagnostic testing alongside a higher burden of infectious disease in the community in Tanzania compared to China may also provide a rational motivation for prescription of unnecessary antibiotics.

An alternative explanation of this phenomenon, which is not discussed in Chapter 8, is that providers may change their care on the basis of the patient's expressed or perceived wants. It is commonly believed that a key driver of unnecessary antibiotic prescriptions in all settings is that patients demand them, and even if their demands are not explicit, the desire for antibiotics is ubiquitous enough that providers assume patients want them [34]. A patient expressing their knowledge that antibiotics are unnecessary can be viewed as an 'anti-request', and any change in provider behaviour a response to that. In this light, the small effect observed in Tanzania compared to China may say more about the provider-patient dynamic, with doctors in China feeling more obliged to take patient preferences into account, compared to a more paternalistic view of the doctor-patient relationship.

These findings can also be compared to other SP experiments in which patients explicitly requested drugs. In a similar Chinese hospital setting, 85% of SPs with URTI who requested unnecessary antibiotics received them compared to 15% who did not [16], again demonstrating a high degree of responsiveness to patient preferences. In private Kenyan facilities, SPs who requested amoxicillin for their absent child with diarrhoea were no more likely to receive unnecessary antibiotics, but those who requested albendazole were more likely to receive unnecessary antiparasitics (25% vs 13%, $p<0.001$) suggesting a lower degree of responsiveness [2]. In a non-experimental study based on exit interviews in public South African facilities, children whose parents reported requesting antibiotics were more likely to have received them (OR=5.9, 95% CI: 2.5 – 14.9) [35], though recall bias may play a role.

8.3.2.8 Provider effort and quality of care

In the literature review in Chapter 2, provider effort was not a factor which any study investigated with explicit reference to overprovision. However, there is a body of literature examining the relationship between provider effort and quality of care more broadly, and some of those studies include outcomes related to unnecessary care.

Firstly, my investigation of the relationship between effort and correct care identified that increased provider effort was associated with an increased likelihood of correct management of asthma and TB. The most comprehensive analysis of the relationship between checklist completion (as a proxy for effort) and correct case management of SPs has been carried out by Banerjee et al [36], who performed an analysis of data from six SP studies, all of which included asthma or TB SPs. In five of these six studies there was a positive association between effort and correct management. The settings of those five studies were somewhat different from that of this PhD. Two studies were just using TB SPs among private providers in urban India [37, 38], and two were using SPs presenting asthma, angina, and an absent child with diarrhoea in rural India: one in private informal providers [5], and one among public and private providers [4]. All four Indian studies included informal or non-medically trained providers. A study in China used TB SPs in rural public facilities [39].

The one study where an association between effort and correct management was not observed was perhaps the most similar in setting to this PhD, with SP cases of asthma, TB, angina, and an absent child with diarrhoea, in public and private facilities in urban Kenya [19]. Another study, which used TB SPs in public facilities in Senegal, found a positive relationship between provider effort and correct management [40]. My study in Tanzania is therefore contributing to a limited literature measuring the relationship between effort and quality of care outside of India. As discussed in Chapter 7, clear guidelines on referral for TB testing in Kenya seem to be responsible for the lack of relationship between effort and correct management: in that study, 50% of SPs were correctly referred despite a mean of only 3.8 checklist items being completed (compared to 25% and 10.1 in the Tanzanian sample). It could be argued that provider effort is not a requirement for correct management for that condition in that setting. In the study in Senegal, correct management was even better, at 68% of SPs, and completion of checklist items was much closer to that observed in Tanzania, at a mean of 8.7. This perhaps points to the same phenomenon seen in Kenya: in public facilities, there are very clear guidelines on patients who should be referred for TB testing. However, unlike Kenya, compliance with referral for testing is increased when the provider makes more effort.

In terms of the association between effort and overprovision, the literature is even more limited. Neither the study in Senegal nor Kenya described above examined the relationship between effort overprovision, despite both noting widespread use of unnecessary antibiotics among TB cases. Evidence from Asia is mixed, with an SP study in rural China using cases of TB, angina, and an absent child with diarrhoea finding that increased checklist completion was associated with decreased likelihood of unnecessary antibiotic prescriptions [20]. However, in the two rural India studies discussed above (with cases of asthma, angina, and an absent child with diarrhoea), there was no

association between effort and overprovision [4, 5]. These three studies, taken together with evidence from this PhD, are still too few and disparate to come to any conclusion on the role of effort in preventing overprovision, but there is clear evidence that it may play a role in certain settings, under certain circumstances.

8.4 Strengths and contributions

In this thesis I have developed a rigorous conceptualisation of different harms and types of overprovision. My framework for considering overprovision in terms of its economic, public health and clinical harms led to the definition of outcomes related to each harm and allowed me to estimate the prevalence of each harm in outpatient private health provision in Tanzania. A number of these measures, such as the prevalence of clinically harmful care and the overall prevalence of overprovision (combining unnecessary lab tests and drugs) were novel and not identified anywhere else in the literature on overprovision in LMICs. My development of a typology of overprovision prevalence measures on the basis of different denominators also allows for more accurate comparisons between studies.

My work makes other useful additions to the literature on prevalence of overprovision. It is one of few studies in LMICs which draw facilities from a nationwide sample, and to include primary care providers from private facilities; the most common type of evidence available on overprovision in LMICs is from public hospitals. It is also the only study in LMICs which compares overprovision by profit-status within the private sector, rather than between public and private sectors, isolating the role of profit. I also found that paying providers a bonus or share of revenue rather than a fixed salary increased the prevalence of overprovision, which was a novel finding on a factor not otherwise investigated in the literature. I have contributed to our understanding of the relationship between provider effort and quality of care, adding to the growing evidence that higher levels of effort are associated with an increased likelihood of correct case management, but also providing a novel contribution than effort is associated with decreased overprovision.

My use of SPs allowed for objective assessment of overprovision, unlike medical record extraction, which relies on the provider's own diagnosis as well as the quality of record keeping. The SP method is unlikely to subject to the Hawthorne effect, unlike direct observation, and not reliant on patient's ability to recall a consultation, unlike exit interviews. Furthermore, this work has a total sample size of 909 SP visits, larger than any other SP study measuring overprovision, giving more precision to estimates as well as allowing the use of multivariate models to explore associations. The use of four different SP cases captures overprovision across a broad range of conditions. The NMFI SP case had not been used before in the literature, and its use makes a notable contribution, as most other

evidence on overprovision of antimalarials is among children and at least ten years old. One other study has now used an NMFI SP, drawing on the tools and experience in this study, but no results have yet been published in a peer-reviewed format [41]. The "How to do…" paper presented in Chapter 3 is regarded as a trusted guide to the SP methodology and is frequently cited.

8.5 Limitations

While some limitations are discussed in individual results chapters, in this section I aim to take a high level look at the limitations in the overall approach of the work presented in this thesis, and the implications when interpreting its findings.

8.5.1 Conceptualising and operationalising a definition of overprovision

In the introduction of this thesis, I cited a definition of overprovision as healthcare for which the potential for harm exceeds the potential for benefit [42]. However, the weighing up of all potential harms and benefits of any test or treatment is far from straightforward. In Chapter 5, I made an implicit judgement that harms and benefits do not just apply to the individual patient: even if an antibiotic is unlikely to do harm to the patient who receives it, the potential harm in terms of antimicrobial resistance at the population level is enough to make it undesirable. Similarly, even if the patient does not pay out of pocket for care that is 'merely' wasteful, but unlikely to do them harm, that is still an economic harm to an insurer or publicly funded healthcare system, in terms of opportunity cost. This way of approaching overprovision, however, may not be the same approach taken by a clinician, whose responsibility it is to act in the patient's best interests. A clinician may argue that it is right, on balance, to give a treatment to a patient if the risk of direct harm is very low and it may bring some benefit (even if the benefit if limited or evidence for it is poor quality), regardless of any wider societal harms. The measures of overprovision used in this thesis could therefore be argued to be overestimates, as the way I have defined overprovision from a societal perspective will always classify more actions as unnecessary than a provider making decisions only in the patient's best interests.

Even within an individual patient, it can be difficult to say whether harms outweigh benefits, not only because evidence of harms and benefits can be limited, but because of the uncertainty inherent in both. A doctor may give antibiotics to a young child in a rural setting knowing that their cough is likely to be a simple self-limiting URTI, but understanding that the consequences of non-treatment in the rare occasions that the underlying cause is pneumonia, and the parent cannot return to the facility quickly, could be fatal. In many cases the antibiotics may be unnecessary, but according to that doctor's assessment of the risks and benefits, antibiotic treatment is not

overprovision. It is not possible to include that assessment of uncertainty in the definitions of overprovision used for empirical measurement. In this PhD, I classified drugs and tests as necessary or unnecessary using a combination of the Tanzanian standard treatment guidelines [43], definitions used in other SP studies, and the expert opinion of a clinician with experience of working in low-resource settings and a pharmacist specialising in the rational use of medicines. However, there will always be an element of subjectivity in determining whether care was truly necessary, and it may be the case that other clinicians or experts would classify care which I defined as overprovision as in fact necessary, or vice versa.

8.5.2 Standardised patients

While the use of SPs has a number of advantages compared to other quality of care measures, as discussed in Chapters 2-4, the method comes with limitations. First is the limited scope of care which SPs can capture. In Chapter 3 I list various outpatient conditions which were excluded because symptoms could not be easily falsified (such as injuries) or because venous blood would be required for testing (such as typhoid). But the limitations go further than this: SPs have not been used for measuring quality of inpatient care, care of chronic conditions which require multiple follow up visits, care of patients with co-morbidities such as diabetes or HIV, or maternal and child health services. While some SP cases could be developed for some of those scenarios, many will remain impossible, either practically or ethically, to measure with SPs. They represent a large and important part of healthcare provision, in terms of both clinical importance of the care provided (and potential consequences of poor quality care) and numbers of patients and healthcare expenditure. It is quite possible that the most extensive and dangerous examples of overprovision are in those types of cases, rather than the simple one-off outpatient cases that SPs can portray. SPs are strangers to the providers who are treating them, but in reality, particularly in primary care, patients and providers often have an established relationship, with providers having a good understanding of the medical history of their patients. Providers may be inclined to treat new patients differently, and could perhaps be overcautious and provide unnecessary care in case the patient has some undisclosed co-morbidity.

Additionally, because the types of cases SPs can portray are, by definition, mild, they require few interventions. It may therefore be better to interpret estimates of the prevalence of overprovision as 'worst case scenarios', of what happens when a patient who requires little or no intervention seeks care anyway. Typical outpatients visiting health facilities would probably require more care than the SPs in this study, and so less of the care they receive would be defined as overprovision. This also highlights the artificiality of the SP method, and that this study may be unrepresentative

of real care seeking patterns: if very few otherwise healthy adults are likely, in reality, to visit a health facility with symptoms of a mild URTI, how much does it matter that nine out of ten are given an unnecessary antibiotic? This study artificially creates a scenario in which it is hard for the provider to avoid overprovision, particularly in the private sector, where providers might reasonably assume patients attend because they want investigations and treatments, not to be told their condition will pass without the need for intervention. This, however, does not excuse overprovision or make its harms any less real.

The SP method is very resource intensive: fieldworkers must be recruited and trained, and make visits, often lengthy, to each health facility to be assessed. This means that the sample size of this study, while large compared to some other SP studies, is small relative to many which use medical record extraction. This may have impacted on the ability to detect differences in overprovision between groups; the sample size calculations in Chapter 6, for example, suggested that the patient knowledge experiment was underpowered to detect the small difference observed.

8.5.3 Patient driven overprovision

In the introduction, I explained that I use the word overprovision in preference to the term overuse, which implies that patients are the main or only initiator of unnecessary healthcare, because my interest is in the multiple factors which can drive unnecessary care. However, the design of the studies in this PhD, and the use of SPs, make it difficult to measure and understand overprovision which is driven by patients. Firstly, as discussed above, it could be argued that by attending a health facility with, for example, an uncomplicated URTI, an SP is driving overprovision, as they do not need any care at all, and the whole consultation is unnecessary. This PhD does not attempt to estimate the rationality or appropriateness of patient-initiated health facility visits, and therefore cannot say what proportion of unnecessary care is caused by the patient's decision to use care. The SPs did not ask for particular treatments, and if, in practice, patients do make specific drugs requests, overprovision may be even higher in reality. I also cannot measure how broader societal factors such as education and wealth may play a role in driving, or indeed preventing, overprovision.

8.5.4 Individual provider variation and characteristics

This study only included one SP visit of each of the four cases to each facility. This means that the variation in overprovision, and quality of care more generally, within individual facilities cannot be measured. Intra-facility variation may be large, and if so, precision in prevalence estimates and the power to detect associations will be limited, but the extent to which this is the case is unknown. Measurement of the extent of intra-facility variation would also give more insight into how much overprovision is caused by facility level factors, and how much is down to individual clinicians. The

design also does not allow of exploration of inter-patient variability in quality of care within the same provider, which if associated with specific patient characteristics may indicate discrimination.

The only characteristic of healthcare providers collected at the individual level for SP visits was the gender of the provider. This is because of the practical difficulties involved in collecting more detailed data in an SP study. Other data, such as qualification, years of experience, or provider knowledge, would have needed to be collected during the health facility survey visit (during which consent for SP visits was sought), up to three months before the SP visit. This could only have been collected from providers who were employed by the facility at that time, and working in the facility on the day of survey. Then, during the SP visit itself, the SP would have needed to find out the name of their provider; while in some cases this might have been offered on introduction, it is not common practice for Tanzanian clinicians to wear name badges, and to ask for the provider's name may have drawn attention to the SP, risking them being revealed. The combined risk of incorrectly identifying the provider, or being revealed as an SP, or the provider who was seen not being recorded in the original survey because of staff turnover or rostering, meant that I decided not to collect provider level data. Other studies have been able to collect this data, but often in single provider-facilities, where it is more feasible, or in a limited geographical area, allowing return visits to collect missing data, which was not possible on a national scale within our study resources.

This choice comes with considerable drawbacks in terms of limiting conclusions which can be drawn from the study. Firstly, the relationship between overprovision and factors such as qualifications and provider payment can only be made at the facility level: but these factors are associated with many other facility characteristics, such as the profit status and level of facility, and so it is difficult to separate them out. Secondly, other SP studies have collected far richer data to help explain provider behaviour, such as by testing knowledge with vignettes [44], or measuring their job satisfaction [40]. This kind of data would give a much better insight into why effort was low, or quality of care was poor, whereas in this PhD I can only hypothesise as to the reason.

8.5.5 Generalisability

This study was conducted in a large (n=227) sample of private health facilities across mainland Tanzania. There are several reasons to believe the participating facilities may not be a representative sample of the entire population of private facilities in Tanzania. As discussed in Chapter 4, facilities were recruited through two partner organisations: the Association of Private Health Facilities of Tanzania (APHFTA) and the Christian Social Services Commission (CSSC). It is not a requirement for private facilities to be a member of either organisation, and those who join may

be more interested and motivated in improving quality of care than those which do not. Similarly, informal or untrained providers, and facilities which operate without a licence, will not be represented by APHFTA or CSSC. Furthermore, study facilities were not randomly selected from the entire membership of these two organisations. For APHFTA facilities, the organisation produced a list of 156 facilities likely to be eligible to participate, all of which were approached for consent. For CSSC, 124 facilities were randomly selected from a list of 513 potentially eligible facilities. In both cases, the umbrella organisations played a role in selecting potential participants, and it is possible that facilities with motivated and engaged management and staff, who were thought to be more amenable to a quality improvement programme, were proposed. This effect is likely to have been compounded by approximately 15% of facilities declining to participate – again, likely to be the facilities with least interest in quality improvement – and nine facilities closing between baseline and endline, which may also be associated with poor performance.

All these factors mean that study facilities may underrepresent the poorest performing private facilities with the least interest in quality improvement. What this means for estimates of, and factors associated with, overprovision is more difficult to say: as discussed above, lower level facilities may have less overprovision simply as a function of fewer drugs and tests being available, but poorly trained staff could be associated with increased overprovision.

8.1 Implications for policy and future research

8.1.1 Policy implications

The most important message from this work for policymakers in Tanzania is that there is a high prevalence of overprovision of care in the private sector, at least in relation to the SP cases I investigated. There are a number of reasons to regard poor quality private healthcare provision as a public health concern which should be addressed by government, aside from the argument that it is within the remit of the government to protect the health and wellbeing of all its citizens, including those who use private health facilities. Firstly, several private facilities in this study were designated district hospitals which receive government funding, and of which there are 36 in Tanzania. Other faith-based facilities in the study received implicit subsidies through the posting of government salaried health workers. Secondly, as Tanzania moves towards Universal Health Coverage, one tool will be the expansion of social health insurance schemes, which are government subsidised, and cover care at private facilities. It is important that this subsidy is used as efficiently as possible. Thirdly, the spread of antimicrobial resistance as a result of inappropriate use of antibiotics in the private sector is a negative externality which will impact the effectiveness of existing antibiotics in the whole country. Finally, given the widespread overprovision in the not-for-

profit sector, and that studies elsewhere have found prevalence of overprovision to be similar, or higher, in the public than private sector, it would be naïve to assume that overprovision does not exist in the Tanzanian public sector.

Options for policy makers to improve quality of care have been classified into delivery arrangements, financial arrangements and governance arrangements [45]. Delivery arrangement interventions could include adding recommendations on inappropriate use to standard treatment guidelines [46], and developing evidence-based criteria to aid medical decision making on whether or not to prescribe a treatment [47]. It may also involve direct engagement with providers, such as audits in individual facilities [48], and providing educational materials for clinicians [49]. Evidence of the effectiveness of such interventions to reduce overprovision is mixed. An evaluation of two different types of intervention to improve malaria case management in Ugandan health facilities found that on-site training, mentoring and continuous quality improvement support was effective at reducing unnecessary antimalarial prescriptions, but off- site classroom training was not, suggesting support needs to be aimed at facilities not just individual clinicians [12]. A randomised control trial of a training program for informal providers to improve quality of care in India found no effect on prescriptions of antibiotics or unnecessary drugs overall [5]. Two quality improvement programmes in individual facilities were effective in combating overprovision, one in reducing the rate of unnecessary antibiotic use in an Indian neonatal intensive care unit [50], and another in reducing a number of types of overprovision for children with bronchiolitis in a hospital in Jordan [51]. Two interventions including training and quality improvement support to reduce unnecessary caesarean sections in Burkina Faso [52] and Uganda [53] had contrasting results, found to be effective in the former, with a reduction of 17%, but not in the latter.

Broadening from reducing overprovision to improving quality of care more widely, a systematic review of strategies to improve healthcare provider performance in LMICs suggested that approaches which include training, supervision or group problem solving elements were more effective than those which only include technological or printed aids [54]. This PhD analysis was nested in within a quality improvement programme, SafeCare, whose theory of change is centred around engaging private facilities with a business motivation: the aim is that improvements in quality will attract more revenue from patients and institutional purchasers, and improved business performance then allows greater investment in quality improvement [55]. This raises concerns that, without specific elements to tackle overprovision, such quality improvement interventions could highlight financial incentives for providing unnecessary care and lead to its increase. However, there is no empirical evidence of such an effect: The SafeCare intervention was not associated with

an increase or decrease in overprovision in Tanzania, and neither was a similar market-based intervention for private facilities in Kenya [41].

Another way to address overprovision through delivery arrangements is with patient education, engagement or public messaging [56]. The evidence from the PhD study that patient knowledge changed provider behaviour, albeit modestly, may support this approach. However, there is limited evidence on the best way to educate patients, particularly in LMICs. While broad approaches to educate the whole population on appropriate antibiotic use are sometimes proposed, a systematic review of patient-centred interventions in HICs found that providing patient information via mass media did not have an impact on antibiotic prescriptions for URTIs [57]. Alternatively, patient information leaflets could help to address the difficulty that outpatient providers often have in explaining the difference between viral and bacterial infections, and why antibiotics are unlikely to be beneficial, in a time-pressured consultation [58]. The use of leaflets in primary healthcare settings in HICs has been shown to reduce unnecessary antibiotic prescription rates for a range of conditions including respiratory tract infections, conjunctivitis, urinary tract infections, gastroenteritis and tonsillitis [59]. Another review found that education for patients, including leaflets, could be effective at reducing inappropriate antibiotic prescriptions in certain settings, particularly as part of a multifaceted intervention which also contained education and audit aimed at clinicians [60]. However, this evidence is also HIC focussed, as the review only included five studies in LMICs, and none of these had a patient education element [60].

An alternative patient-focused approach is delayed prescriptions for antibiotics in outpatient care, which typically follows one of two models: either giving the patient a prescription but instructing them not to fill it unless their symptoms have not improved after three days, or post-dating the prescription so that is not possible for the patient to fill it until the specified time has elapsed. Delayed prescription has been shown to be one of the most effective ways to reduce outpatient antibiotic use in HICs [57, 60], and the implementation of a delayed prescription model in the outpatient department of a hospital in Ghana found that only one of 37 URTI patients who given a post-dated prescription for antibiotics filled the prescription and took the antibiotics after three days [61]. However, there may be little incentive for private facilities in Tanzania, who both prescribe and dispense drugs, to introduce such an approach.

Changes to financial arrangements are another important policy lever: facilities where providers had strong incentives for overprovision, because their pay included bonuses or was dependent on facility revenue, had higher prevalence of overprovision. In order to reduce incentives for individual providers, regulation could require that they are only paid a fixed salary, though this has the

disadvantage that it does not incentivise providers to work beyond their contracted hours or duties to provide high quality care [62]. Additionally, there are many private facilities in Tanzania owned and run by a single provider, in which this kind of regulation could not be applied because the provider does not rely on a salary for income but instead the profit made by the facility.

At the facility level, changes to reimbursement mechanisms could remove the existing incentives for overprovision to NHIF patients; facilities are currently reimbursed on a fee-for-service basis [63]. Capitation has the advantage of increasing coverage and promoting equity in a publicly funded system where the whole population is eligible for inclusion [62], and a recent high profile commission has argued that capitation-based provider payment systems are the best way to achieve coverage of high quality primary health care [64]. A move from fee-for-service to capitation removes financial incentives for overprovision, and has shown to be effective in reducing the overprovision of antibiotics in China [22]. However, capitation may incentivise underprovision or the referral of patients for higher levels of care outside what is funded [62].

Case-based payments and payments based on diagnosis-related groups (DRGs) are another alternative reimbursement mechanism. Under these systems, patients are classified into groups according to their diagnosis, as well as their potential complicating factors such as age, severity and co-morbidities; facilities are then paid a fixed fee for providing the care, based on the expected average cost for treating such a patient [65]. Case-based or DRG-based payments are used to reimburse acute inpatient care in almost all HICs, as the mechanism is effective in containing costs in complex cases [66]. A move to case-based payments from fee-for-service was shown to reduce overprovision in a Chinese hospital [32], but the introduction of such a mechanism in a setting where there is concern about widespread underprovision alongside overprovision would need to be carefully designed.

Another option is for insurers, public or private, to only reimburse facilities for care which is provided according to their guidelines, or national standard treatment guidelines [67]. This could be on the basis of diagnosis, for example, not reimbursing facilities for antibiotics dispensed to patients whose condition is coded as an uncomplicated URTI. Treatment which is established to have no benefits, for example herbal remedies, can be excluded from reimbursement schedules entirely.

Finally, governance arrangements can be used to address overprovision. Regulation requiring that drugs are dispensed by independent pharmacies, separate from the prescribing facility, may be effective in reducing unnecessary prescriptions to both cash and insured patients, and could act as a disincentive for overprovision at the facility as well as individual provider level. Implementation

of such a policy in Taiwan reduced prescription rates and drug expenditure in outpatient visits [68], and a review comparing the practices of dispensing and non-dispensing doctors suggested the former prescribed more drugs [69].

At a higher level, changes to the overall strategy of the governance and regulation of healthcare, such as including overprovision as a key priority, will help to shift the approach and focus efforts to tackle it. Developing a regulatory framework for the preservation of antimicrobial agents is identified as a priority action in Tanzania's National Action Plan on antimicrobial resistance [70]. Specific activities include the development of policy guidelines, a review of national medicines policy and the strengthening of regulations on prescriptions, but more detail is required on who regulations will be aimed at or how they could be enforced. Organisations such as APHFTA and CSSC, which are already involved in quality improvement work with private facilities, could have an important role to play. Indicators on overprovision could be added to the existing star rating assessment which the Ministry of Health uses to monitor quality in every health facility, public and private [71].

8.1.2 Future research agenda

Overprovision is coming to the fore as a quality issue, with a recent World Bank policy report [72] discussing the evidence presented in this thesis and other studies. Further research could improve our understanding of its prevalence, drivers and ways to tackle it.

The high prevalence of overprovision in the Tanzanian private sector suggests that unnecessary care is part of normal medical practice, and may be common in the public sector. A survey of public health facilities in Tanzania, including a range of facility levels and geographies, would be helpful to understand the extent of overprovision in the public sector, where interventions need to be targeted, and differences in practice compared to the private sector. A balance will need to be struck between reliability of methodology and the sample size which could be surveyed; it is unlikely to be practical to send SPs to a large number of widely dispersed facilities, but a more limited use of SPs could be combined with patient exit interviews or medical record extraction, which would allow researchers to gauge the prevalence of prescription of drugs of interest, such as antibiotics, if not the prevalence of overprovision.

As discussed above, the study design of this PhD did not allow for many useful conclusions on the role of individual provider motivations and training on overprovision. The literature discussed in Chapter 2 also offered limited evidence, other than a trend (among a small number of studies) of overprovision being less common among providers with higher level qualifications, and female providers, but little explanation of the mechanisms. However, understanding more about provider

level factors will be key to designing appropriate interventions and policies to tackle overprovision. Future research on overprovision should attempt to gather individual provider level data, not only on demographic and training details, but also including additional surveys to measure provider knowledge and motivation, as is common in other studies on quality of care.

In terms of other provider level drivers of overprovision, it is perhaps simplistic to consider that overprovision is either due to inadequate knowledge or effort, or due to deliberately induced demand. Given the uncertainty inherent in medical decision making, cognitive biases – systematic errors in judgement – may also play a role in overprovision [73], and further work could also investigate the extent to which cognitive biases drive overprovision in LMICs. While there is some evidence of cognitive biases in medical decision making in high-income countries [74], little exists in LMICs. Furthermore, there is reason to believe that certain cognitive biases may specifically lead to or be associated with overprovision, such as confirmation bias resulting in an incorrect diagnosis and associated unnecessary care [75, 76], or commission bias causing a provider to prefer giving a treatment than withholding it, even when the latter may be more beneficial [77]. Understanding whether these biases are a cause or driver of overprovision, and their specific role in LMICs, may be an important step in designing training and interventions to reduce overprovision.

In the literature review, I identified a huge variety of definitions and denominators used when measuring overprovision, which made comparisons difficult; even in studies measuring, for example, unnecessary antibiotics for URTI, there was variation in whether only patients who received antibiotics, or only patients who did not need them, were included in the denominator. A key step for any future work on the topic will be clear explanation of how components of care were classified into necessary and unnecessary, and which patient populations were included. This will allow for better comparison across studies and more robust conclusions.

There are also a number of potential avenues for further development of methods for measuring overprovision. SPs could be improved to allow the measurement of quality of ongoing care rather than initial visits only; a pilot study in India has used a case of TB where the SP makes a return visit if asked by the provider (for example, with a chest x-ray report, or for follow-up after a certain period) [78]. This is a welcome development, but more innovation, and creative solutions to falsifying test results, will be required for using SPs for chronic conditions. One solution could be to train SPs who have chronic health conditions, such as HIV or diabetes, to carry out such cases; this would require careful consideration of whether such people would be fieldworkers or patient research subjects, and any resultant ethical issues. SP cases could also be developed specifically to measure overprovision; an example of one recently implemented was an SP with lower back pain,

who requests an unnecessary test [79, 80]. Other types of care, such as caesarean sections for women in labour, and other surgical and inpatient care, will never be able to be measured using SPs, yet are likely to significant sources of overprovision. New approaches will need to be developed to fully understand the prevalence of such care; patient exit interviews specifically designed to capture whether or not a procedure is necessary, with more extensive history taking than a typical interview, could be one solution.

With more evidence now available on the prevalence of overprovision, the focus can now shift towards solutions, including evaluating interventions explicitly aimed at reducing overprovision, as well as incorporating measures of overprovision as outcomes for more general quality improvement interventions. Evaluation approaches will depend on the intervention; for delivery arrangements aimed at individual facilities and providers, randomised control trials offer the highest quality evidence and ability to draw causal inference. However, for changes to governance or financial arrangements, which are normally made at a regional or national level, quasi-experimental designs including interrupted time-series, difference-in-differences or synthetic controls offer a way of identifying effects on measures of overprovision.

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9 Appendices to thesis

Appendix 1: Literature review supplementary material

Search strategy

LMIC filter:

(afghanistan or albania or algeria or american samoa or angola or "antigua and barbuda" or antigua or barbuda or argentina or armenia or armenian or aruba or azerbaijan or bahrain or bangladesh or barbados or republic of belarus or belarus or byelarus or belorussia or byelorussian or belize or british honduras or benin or dahomey or bhutan or bolivia or "bosnia and herzegovina" or bosnia or herzegovina or botswana or bechuanaland or brazil or brasil or bulgaria or burkina faso or burkina fasso or upper volta or burundi or urundi or cabo verde or cape verde or cambodia or kampuchea or khmer republic or cameroon or cameron or cameroun or central african republic or ubangi shari or chad or chile or china or colombia or comoros or comoro islands or iles comores or mayotte or democratic republic of the congo or democratic republic congo or congo or zaire or costa rica or "cote d'ivoire" or "cote d' ivoire" or cote divoire or cote d ivoire or ivory coast or croatia or cuba or cyprus or czech republic or czechoslovakia or djibouti or french somaliland or dominica or dominican republic or ecuador or egypt or united arab republic or el salvador or equatorial guinea or spanish guinea or eritrea or estonia or eswatini or swaziland or ethiopia or fiji or gabon or gabonese republic or gambia or "georgia (republic)" or georgian or ghana or gold coast or gibraltar or greece or grenada or guam or guatemala or guinea or guinea bissau or guyana or british guiana or haiti or hispaniola or honduras or hungary or india or indonesia or timor or iran or iraq or isle of man or jamaica or jordan or kazakhstan or kazakh or kenya or "democratic people's republic of korea" or republic of korea or north korea or south korea or korea or kosovo or kyrgyzstan or kirghizia or kirgizstan or kyrgyz republic or kirghiz or laos or lao pdr or "lao people's democratic republic" or latvia or lebanon or lebanese republic or lesotho or basutoland or liberia or libya or libyan arab jamahiriya or lithuania or macau or macao or republic of north macedonia or macedonia or madagascar or malagasy republic or malawi or nyasaland or malaysia or malay federation or malaya federation or maldives or indian ocean islands or indian ocean or mali or malta or micronesia or federated states of micronesia or kiribati or marshall islands or nauru or northern mariana islands or palau or tuvalu or mauritania or mauritius or mexico or moldova or moldovian or mongolia or montenegro or morocco or ifni or mozambique or portuguese east africa or myanmar or burma or namibia or nepal or netherlands antilles or nicaragua or niger or nigeria or oman or muscat or pakistan or panama or papua new guinea or new guinea or paraguay or peru or philippines or philipines or phillipines or phillippines or poland or "polish people's republic" or portugal or portuguese republic or puerto rico or romania or russia or russian federation or ussr or soviet union or union of soviet socialist republics or rwanda or ruanda or samoa or pacific islands or polynesia or samoan islands or navigator island or navigator islands or "sao tome and principe" or saudi arabia or senegal or serbia or seychelles or sierra leone or slovakia or slovak republic or slovenia or melanesia or solomon island or solomon islands or norfolk island or norfolk islands or somalia or south africa or south sudan or sri lanka or ceylon or "saint kitts and nevis" or "st. kitts and nevis" or saint lucia or "st. lucia" or "saint vincent and the grenadines" or saint vincent or "st. vincent" or grenadines or sudan or suriname or surinam or dutch guiana or netherlands guiana or syria or syrian arab republic or tajikistan or tadjikistan or tadzhikistan or tadzhik or tanzania or tanganyika or thailand or siam or timor leste or east timor or togo or togolese republic or tonga or "trinidad and tobago" or trinidad or tobago or tunisia or turkey or turkmenistan or turkmen or uganda or ukraine or uruguay or uzbekistan or uzbek or vanuatu or new hebrides or venezuela or vietnam or viet nam or middle east or west bank or gaza or palestine or yemen or yugoslavia or zambia or zimbabwe or northern rhodesia or global south or africa south of the sahara or sub-saharan africa or subsaharan africa or africa, central or central africa or africa, northern or north africa or northern africa or magreb or maghrib or sahara or africa, southern or southern africa or

africa, eastern or east africa or eastern africa or africa, western or west africa or western africa or west indies or indian ocean islands or caribbean or central america or latin america or "south and central america" or south america or asia, central or central asia or asia, northern or north asia or northern asia or asia, southeastern or southeastern asia or south eastern asia or southeast asia or south east asia or asia, western or western asia or europe, eastern or east europe or eastern europe or developing country or developing countries or developing nation? or developing population? or developing world or less developed countr* or less developed nation? or less developed population? or less developed world or lesser developed countr* or lesser developed nation? or lesser developed population? or lesser developed world or under developed countr* or under developed nation? or under developed population? or under developed world or underdeveloped countr* or underdeveloped nation? or underdeveloped population? or underdeveloped world or middle income countr* or middle income nation? or middle income population? or low income countr* or low income nation? or low income population? or lower income countr* or lower income nation? or lower income population? or underserved countr* or underserved nation? or underserved population? or underserved world or under served countr* or under served nation? or under served population? or under served world or deprived countr* or deprived nation? or deprived population? or deprived world or poor countr* or poor nation? or poor population? or poor world or poorer countr* or poorer nation? or poorer population? or poorer world or developing econom* or less developed econom* or lesser developed econom* or under developed econom* or underdeveloped econom* or middle income econom* or low income econom* or lower income econom* or low gdp or low gnp or low gross domestic or low gross national or lower gdp or lower gnp or lower gross domestic or lower gross national or lmic or lmics or third world or lami countr* or transitional countr* or emerging economies or emerging nation?).ti,ab,sh,kf.

Overprovision of healthcare filter

((overuse or overprov* or unnecessary or irrational*) adj3 ("medical care" or healthcare or diagnostic* or drug* or medicine*))

Data extraction table

The data extraction table is two pages wide and eight pages long (16 pages total) and is presented horizontally overleaf.

Authors	Year published	Title	Year(s) data collected	Country data collected	World Bank income group	WHO region	Hospital or primary health facility?	Public or private sector?	Facility sample size	Representative / random sample	National/ regional/ city	Patient sample size
Ab Rahman et al	2016	Antibiotic prescribing in public and private practice: A cross-sectional study in primary care clinics in Malaysia	2014	Malaysia	Upper-middle income	Western Pacific	Primary	Both	545	Yes	National	2857
Agarwal et al	2021	Antibiotic stewardship in a tertiary care NICU of northern India: a quality improvement initiative	2019-2010	India	Lower-middle income	South-East Asia	Hospital	Private	1	NA	NA	2292
Alabid et al	2014	Antibiotics dispensing for URTIs by community pharmacists (CPs) and general medical practitioners in Penang, Malaysia: a comparative study using simulated patients (SPs)	2011	Malaysia	Upper-middle income	Western Pacific	Primary	Private	20	No	Regional	20
Alavi et al	2014	Antibiotics use patterns for surgical prophylaxis site infection in different surgical wards of a teaching hospital in Ahvaz, Iran	2011-12	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	1	NA	NA	8586
Alvi et al	2012	A study of 'rational use of investigations' in a tertiary hospital	NS	India	Lower-middle income	South-East Asia	Hospital	Public	1	NA	NA	90
Amidi et al	1975	Antibiotic use and abuse among physicians in private practice in Shiraz, Iran	NS	Iran	Lower-middle income	Eastern Mediterranean	Primary	Private	40	Yes	City	40
Aminu et al	2014	Reasons for performing a caesarean section in public hospitals in rural Bangladesh	2011	Bangladesh	Lower-middle income	South-East Asia	Hospital	Public	5	Yes	Regional	530
Awad et al	2020	Bronchiolitis clinical practice guidelines implementation: surveillance study of hospitalized children in Jordan	2016-2017	Jordan	Upper-middle income	Eastern Mediterranean	Hospital	Private	1	NA	NA	179
Basu et al	2007	Antibiotic misuse in children by the primary care physicians-an Indian experience	NS	India	Lower-middle income	South-East Asia	Hospital	Public	1	NA	NA	2427

Authors	Year published	Medical condition /patient type (category)	Medical condition/patient type (detail)	Type of overprovision (category)	Type of overprovision (detail)	Assessment of overprovision	Measure of overprovision	Type of prevalence	Point prevalence estimate	Factors associated?	Intervention?	Statistical tests?
Ab Rahman et al	2016	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Medical record extraction	% of URTI patients given antibiotics	Healthy	46.2%	Yes	No	No
Agarwal et al	2021	Various/any inpatients	Neonates in ICU	Antibiotics	Antibiotics	Medical record extraction	Proportion of days with antibiotics for blood culture negative patients	Healthy	451/1000 days fell to 361/1000 days	No	Yes	Yes
Alabid et al	2014	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Standardised patients	% of URTI patients given antibiotics	Healthy	65.0%	no	no	NA
Alavi et al	2014	Surgery and labour	Patients who received prophylactic antibiotics before surgery	Antibiotics	Unnecessary prophylactic antibiotics	Medical record extraction	% of prophylaxis unnecessary	Treatment	44%	Yes	No	No
Alvi et al	2012	Various/any inpatients	Inpatients	Diagnostics	Unnecessary laboratory tests	Medical record extraction	% of tests avoidable	Treatment	70.10%	Yes	No	No
Amidi et al	1975	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Standardised patients	% given unnecessary antibiotics	Healthy	93%	No	No	NA
Aminu et al	2014	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections unnecessary	Treatment	16%	No	No	NA
Awad et al	2020	Respiratory tract infections	Bronchiolitis in children <24 months	Mixed/various	Complete blood count, blood culture, urinalysis, chest radiography, respiratory syncytial virus test, influenza test, scheduled salbutamol, salbutamol trial, nebulized saline, inhaled steroid, systemic steroid, inappropriate antibiotics, chest physiotherapy	Medical record extraction	% getting specified unnecessary care	Healthy	97.7% to 100%/ 61.4% to 54.9%/ 40.9% to 39.6%/ 100% to 100%/ 71.7% to 50.5%/ 45.5% to 40.7%/ 50.0% to 31.9%/ 27.3% to 23.1%/ 44.3% to 8.8%/ 3.4% to 3.3%/ 9.1% to 5.5%/ 35.2% to 16.5%/ 8.0% to 8.8%	No	Yes	Yes
Basu et al	2007	Various/any outpatients	Child outpatients prescribed antibiotics	Antibiotics	Antibiotics	Reassessing patients	% of antibiotics unnecessary	Treatment	35.3%	Yes	No	Yes

Authors	Year published	Title	Year(s) data collected	Country data collected	World Bank income group	WHO region	Hospital or primary health facility?	Public or private sector?	Facility sample size	Representative / random sample	National/ regional/ city	Patient sample size
Bekele et al	2021	Magnitude and determinants of drug-related problems among patients admitted to medical wards of southwestern Ethiopian hospitals: A multicenter prospective	2020	Ethiopia	Low-income	Africa	Hospital	Public	3	No	Regional	313
Beri et al	2013	The Pattern of Drug Use in Acute Fever by General Practitioners (GPs) in Pune City, India	NS	India	Lower-middle income	South-East Asia	Primary	Private	20	Yes	City	400
Chang et al	2019	Clinical pattern of antibiotic overuse and misuse in primary healthcare hospitals in the southwest of China	2018	China	Upper-middle income	Western Pacific	Hospital	Public	31	Yes	Regional	57,009
Choez et al	2018	Appropriateness and adequacy of antibiotic prescription for upper respiratory tract infections in ambulatory health care centers in Ecuador	2015	Ecuador	Upper-middle income	The Americas	Primary	Public	1	NA	NA	1393
Currie et al	2011	Patient knowledge and antibiotic abuse: Evidence from an audit study in China	2008-9	China	Upper-middle income	Western Pacific	Hospital	Public	70	Yes	Regional	229
Currie et al	2013	Social networks and externalities from gift exchange: Evidence from a field experiment	2012	China	Upper-middle income	Western Pacific	Hospital	NS	80	No	City	640
Currie et al	2014	Addressing antibiotic abuse in China: An experimental audit study	2011-2012	China	Upper-middle income	Western Pacific	Hospital	NS	140	Yes	City	620
Daniels et al	2017	Use of standardised patients to assess quality of healthcare in Nairobi, Kenya: a pilot, cross-sectional study with international comparisons	2014	Kenya	Lower-middle income	Africa	Primary	both	42	No	City	166
Das et al	2009	Unnecessary appendectomy in suspected cases of acute appendicitis.	2003-2008	India	Lower-middle income	South-East Asia	Hospital	Public	1	NA	NA	912
Das et al	2012	In urban and rural India, a standardized patient study showed low levels of provider training and huge quality gaps	2010	India	Lower-middle income	South-East Asia	Primary	Private	241	Yes	Regional	677
Das et al	2016	Quality and Accountability in Healthcare Delivery: Audit-Study Evidence from Primary Care in India	2010-11	India	Lower-middle income	South-East Asia	Primary	Both	224	Yes	Regional	440

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Bekele et al	2021	Various/any inpatients	Adult medical inpatients	Any/various drugs	Any unnecessary drug	Medical record extraction	% received any unnecessary drug	Population	29.4%	No	No	NA
Beri et al	2013	Other infectious diseases	Viral fever	Antibiotics	Antibiotics	Medical record extraction	% of patients with viral fever prescribed antibiotics	Healthy	81% ayurvedic GPs, 15% allopathic GPs, p<0.001	Yes	No	Yes
Chang et al	2019	Various/any outpatients	All outpatients prescribed antibiotics	Antibiotics	Antibiotics	Medical record extraction	% of antibiotic prescriptions unnecessary	Treatment	84.1%	Yes	No	Yes
Choez et al	2018	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Medical record extraction	% of antibiotics unnecessary	treatment	90.25%	yes	no	no
Currie et al	2011	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Standardised patients	% prescribed antibiotics	Healthy	62%	Yes	No	Yes
Currie et al	2013	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Standardised patients	% prescribed antibiotics	Healthy	50%	yes	no	yes
Currie et al	2014	Respiratory tract infections	URTI	Antibiotics	Antibiotics	Standardised patients	% prescribed antibiotics	Healthy	55%, 85% if requests antibiotics, 10% if says will buys drugs elsewhere, 16% if both	Yes	No	Yes
Daniels et al	2017	Various/any outpatients	Adults with unstable angina, asthma or TB, and children with diarrhoea	Any/various drugs	Unnecessary steroids & antibiotics	Standardised patients	% received steroids, % received antibiotics	Healthy	2% / 49%	Yes	No	Yes
Das et al	2009	Surgery and labour	Suspected appendicitis	Other therapeutic interventions	Appendectomy	Medical record extraction	% of appendectomies negative for appendicitis	Treatment	36.4%	Yes	No	Yes
Das et al	2012	Various/any outpatients	Adults with unstable angina and asthma, and children with dysentery	Any/various drugs	Any unnecessary of harmful treatment	Standardised patients	% of SPs received any unnecessary or harmful treatment	Population	41.70%	no	No	NA
Das et al	2016	Various/any outpatients	Adults with unstable angina and asthma, and children with dysentery	Any/various drugs	Any unnecessary drug / unnecessary antibiotics	Standardised patients	% of SPs received any unnecessary drug/ % received antibiotics	Population/healthy	80.2%/27.8%	Yes	No	Yes

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Das et al	2016	The impact of training informal health care providers in India: A randomized controlled trial	2013-14	India	Lower-middle income	South-East Asia	Primary	Both	273	Yes	Regional	790
Davoodian et al	2012	Inappropriate use of urinary catheters and its common complications in different hospital ward	2005	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Public	1	NA	NA	206
Dubey et al	2021	Barriers to optimal and appropriate use of uterotonics during active labour and for prevention of postpartum haemorrhage in public health care facilities: An exploratory study in five states of India	2010-11	India	Lower-middle income	South-East Asia	Both	Public	56	No	Regional	1479
Dumont et al	2016	Determinants of non-medically indicated caesarean deliveries in Burkina Faso	2014	Burkina Faso	Low-income	Africa	Hospital	Public	22	Yes	National	100
Gasson et al	2018	Antibiotic prescribing practice and adherence to guidelines in primary care in the Cape Town Metro District, South Africa	2016	South Africa	Upper-middle income	Africa	Primary	Public	8	yes	City	449
Gelchu & Abdela	2019	Drug therapy problems among patients with cardiovascular disease admitted to the medical ward and had a follow-up at the ambulatory clinic of Hiwot Fana Specialized University Hospital: The case of a tertiary hospital in eastern Ethiopia	2017	Ethiopia	Low-income	Africa	Hospital	Public	1	NA	NA	216
Gorleku et al	2021	The degree and appropriateness of computed tomography utilization for diagnosis of headaches in Ghana	2016-2018	Ghana	Lower-middle income	Africa	Hospital	Both	5	No	National	11,806
Graham et al	2016	Rational use of antibiotics by community health workers and caregivers for children with suspected pneumonia in Zambia: a cross-sectional mixed methods study	2012	Zambia	Lower-middle income	Africa	Primary	Public	90 (community health workers)	Yes	Regional	537

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Das et al	2016	Various/any outpatients	Adults with unstable angina and asthma, and children with dysentery	Any/various drugs	Any unnecessary drug / unnecessary antibiotics	Standardised patients	% of SPs received any unnecessary drug/ % received antibiotics	Population/healthy	Any unnecessary drugs: 87.9% in public, 70.7% in private control, 69.5% in private treatment . Antibiotics: 63.6% in public, 33.1% in private control, 33.2% in private treatment	Yes	Yes	yes
Davoodian et al	2012	Various/any inpatients	Patients with catheters	Other therapeutic interventions	Catheter	Medical record extraction	% of catheters unnecessary	Treatment	20.6%	Yes	No	No
Dubey et al	2021	Surgery and labour	Low risk women in labour	Specific non-antibiotic drugs	Uterotonics to augment labour	Direct observation	% received uterotonics for augmentation of labour	Healthy	48.7%	Yes	No	No
Dumont et al	2016	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections not medically indicated	Treatment	24%	Yes	No	Yes
Gasson et al	2018	Other infectious diseases	Any infection	Antibiotics	antibiotics	Medical record extraction	% of antibiotics not required	Treatment	17.1%	yes	no	yes
Gelchu & Abdela	2019	Non-communicable conditions	Cardiovascular diseases (previously admitted, returned for follow-up as outpatients)	Any/various drugs	Any unnecessary drug	Medical record extraction	% received any unnecessary drug	Population	7.4%	No	No	NA
Gorleku et al	2021	Non-communicable conditions	Outpatients with headache	Diagnostics	Computed tomography	Medical record extraction	% of computed tomography unnecessary	Treatment	69%	No	No	NA
Graham et al	2016	Respiratory tract infections	Children with suspected pneumonia	Antibiotics	Antibiotics	Direct observation	% of children given antibiotics who had normal breathing (assessed by expert)/ % of children with normal breathing (measured by CHW) giving antibiotics	Treatment/healthy	35% /5%	Yes	No	Yes

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Gupta et al	2021	Component wise financial implications of inappropriate blood transfusion on Indian healthcare system	2021	India	Lower-middle income	South-East Asia	Other	Both	9	No	Regional	6910
Hadi et al	2008	Audit of antibiotic prescribing in two governmental teaching hospitals in Indonesia	2001-2002	Indonesia	Lower-middle income	South-East Asia	Hospital	Public	2	No	Regional	1153
Hatam et al	2011	Economic burden of inappropriate antibiotic use for prophylactic purpose in Shiraz, Iran	2004	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	6	No	City	1000
Hatam et al	2013	Adherence to American heart association and American college of cardiology standard guidelines of angiography in Shiraz, Iran	2012	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Both	7	Yes	City	280
Hoa et al	2011	Unnecessary antibiotic use for mild acute respiratory infections during 28-day follow-up of 823 children under five in rural Vietnam	2007	Vietnam	Lower-middle income	Western Pacific	Both	Both	NS (multiple)	No	Regional	654 /1048
Hou et al	2013	Management of acute diarrhea in adults in China: a cross-sectional survey	2011	China	Upper-middle income	Western Pacific	Hospital	Public	20	No	Regional/ city	800
Jame et al	2014	Indications and Overuse of Computed Tomography in Minor Head Trauma	2012	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Public	3	No	City	400
Jame et al	2014	The Extent of Inappropriate Use of Magnetic Resonance Imaging in Low Back Pain and its Contributory Factors	2012	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Both	4	No	City	400
Kaboré et al	2019	DECIDE: a cluster-randomized controlled trial to reduce unnecessary caesarean deliveries in Burkina Faso	2014-2016	Burkina Faso	Low-income	Africa	Hospital	Public	22	Yes	National	4174
Kaur et al	2018	A study of antibiotic prescription pattern in patients referred to tertiary care center in Northern India	2016-2017	India	Lower-middle income	South-East Asia	Hospital	Public	1	NA	NA	517

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Gupta et al	2021	Various/all	Recipients of blood products	Other therapeutic interventions	Blood transfusion	Medical record extraction	% of blood components irrational	Treatment	67.1%	No	No	NA
Hadi et al	2008	Various/any inpatients	Patients who were hospitalized in various wards for 5 days or more	Antibiotics	Antibiotics	Medical record extraction	% of prescriptions without indication	Treatment	41.7%	Yes	No	Yes
Hatam et al	2011	Surgery and labour	Surgical patients	Antibiotics	Unnecessary prophylactic antibiotics	Medical record extraction	% of prophylaxis unnecessary / % of those not needing prophylaxis given it	Treatment/healthy	8.6%/97.7%	No	No	NA
Hatam et al	2013	Various/any outpatients	Outpatients	Diagnostics	Angiography	Reassessing patients	% of angiography unnecessary	Treatment	14.3%	Yes	No	Yes
Hoa et al	2011	Respiratory tract infections	Children with mild respiratory tract infection	Antibiotics	Antibiotics	Household survey	% of children with mild ARI given antibiotics	Healthy	73% in private clinic, 80% in public clinic (retrospective), 67% in private clinic, 65% in public clinic (prospective)	Yes	No	No
Hou et al	2013	Other infectious diseases	Adults with diarrhoea (outpatients)	Antibiotics	Antibiotics	Medical record extraction	% of patients who received unnecessary antibiotics / % of patients not needing antibiotics who received them	Population/healthy	47.9% /57.2%	No	No	NA
Jame et al	2014	Non-communicable conditions	Minor head trauma	Diagnostics	Computed tomography	Reassessing patients	% of computed tomography unnecessary	Treatment	36.80%	Yes	No	Yes
Jame et al	2014	Non-communicable conditions	Lower back pain	Diagnostics	MRI	Patient exit interview	% of MRIs unnecessary	Treatment	48.9%	Yes	No	Yes
Kaboré et al	2019	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections not medically indicated	Treatment	18.96% fell to 6.56%	No	Yes	Yes
Kaur et al	2018	Various/any outpatients	Adult outpatients (who were prescribed antibiotics)	Antibiotics	Antibiotics	Reassessing patients	% of antibiotic prescriptions unnecessary / % of all patients receiving unnecessary antibiotics	Treatment/population	43.9%/25.0%	No	No	NA

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Kawanami & Fortale	2011	Factors predictive of inappropriateness in requests for parenteral antimicrobials for therapeutic purposes: A study in a small teaching hospital in Brazil	2005	Brazil	Upper-middle income	The Americas	Hospital	Public	1	NA	NA	963
Kirkil et al	2013	Appendicitis scores may be useful in reducing the costs of treatment for right lower quadrant pain	2009-2010	Turkey	Upper-middle income	Europe	Hospital	NS	1	NA	NA	64
Knox et al	2015	Improving paediatric clinical outcome indicators by a collaborative retraining of child health professionals	2013-14	Burundi	Low-income	Africa	Hospital	NS	2	No	City	NS
Kouanda et al	2013	Audit of cesarean delivery in Burkina Faso	2009-10	Burkina Faso	Low-income	Africa	Hospital	NS	10	No	National	300
Kwan et al	2022	Do private providers give patients what they demand, even if it is inappropriate? A randomised study using unannounced standardised patients in Kenya	2019	Kenya	Lower-middle income	Africa	Primary	Private	200	Yes	National	400
Lagarde & Blaauw	2022	Overtreatment and benevolent provider moral hazard: Evidence from South African doctors		South Africa	Upper-middle income	Africa	Primary	Private	113	yes	City	226
Liang et al	2011	Unnecessary use of antibiotics for inpatient children with pneumonia in two counties of rural China	2007-2008	China	Upper-middle income	Western Pacific	Both	Public	5	No	Regional	226
Maaløe et al	2012	Prolonged labour as indication for emergency caesarean section: a quality assurance analysis by criterion-based audit at two Tanzanian rural hospitals	2009-10	Tanzania	Lower-middle income	Africa	Hospital	Private	2	No	Regional	144
Masoompour et al	2017	Evaluation of Adherence to American Society of Health-System Pharmacists Guidelines: Stress Ulcer Prophylaxis in Shiraz, Iran	2013	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Public	1	NA	NA	380
Mathibe & Zwane	2020	Unnecessary antimicrobial prescribing for upper respiratory tract infections in children in Pietermaritzburg, South Africa	NS	South Africa	Upper-middle income	Africa	Primary	Public	1	NA	NA	306

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Kawanami & Fortale	2011	Various/any inpatients	Inpatients	Antibiotics	Antibiotics	Medical record extraction	% of therapeutic parenteral antibiotics unnecessary	Treatment	7.7%	Yes	No	Yes
Kirkil et al	2013	Surgery and labour	Patients admitted for appendectomy	Other therapeutic interventions	Appendectomy	Medical record extraction	% of appendectomies negative for appendicitis	Treatment	17.2%	No	No	NA
Knox et al	2015	Other infectious diseases	Children with malaria	Antibiotics	Antibiotics for malaria	Medical record extraction	% of children with malaria given antibiotics	Healthy	14.2% fell to 11.6%	No	Yes	No
Kouanda et al	2013	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections not medically indicated	Treatment	12.0%	Yes	No	Yes
Kwan et al	2022	Other infectious diseases	Child with diarrhoea	Mixed/various	Unnecessary lab tests, antibiotics, antiparasitics	Standardised patients	% received any unnecessary lab test, % prescribed antibiotics, % prescribed antiparasitic	Healthy	10%/25%/56%	Yes	No	Yes
Lagarde & Blaauw	2022	Respiratory tract infections	acute bronchitis	Any/various drugs	Any unnecessary drug/any antibiotic/any unnecessary non-antibiotic	Standardised patients	% received any unnecessary drug/% received any antibiotic/% received any unnecessary non-antibiotic	Population/healthy	99.1%/70.8%/80.5%	yes	no	yes
Liang et al	2011	Respiratory tract infections	Inpatients with pneumonia under 14 years old	Antibiotics	Antibiotics	Medical record extraction	% of children with pneumonia given unnecessary antibiotics	Population	43%	No	No	NA
Maaløe et al	2012	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections with prolonged labour as only indication but no actual prolonged labour	Treatment	26%	Yes	No	Yes
Masoompour et al	2017	Various/any inpatients	Inpatients at low risk for stress ulcer	Specific non-antibiotic drugs	Prophylactic proton pump inhibitors	Reassessing patients	% of patients who received unnecessary proton pump inhibitors	Healthy	82%	No	No	NA
Mathibe & Zwane	2020	Respiratory tract infections	Children under 5 with URTI	Antibiotics	Antibiotics	Patient exit interview	% of children with URTI given antibiotics	Healthy	76%	Yes	No	Yes

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Mbonye et al	2014	Effect of Integrated Capacity-Building Interventions on Malaria Case Management by Health Professionals in Uganda: A Mixed Design Study with Pre/Post and Cluster Randomized Trial Components	2009-2010	Uganda	Low-income	Africa	Primary	Both	36	No	National	753074
Means et al	2014	Correlates of Inappropriate Prescribing of Antibiotics to Patients with Malaria in Uganda	2009-2010	Uganda	Low-income	Africa	Primary	Both	36	No	National	45591
Meidani et al	2016	A review on laboratory tests' utilization: A trigger for cutting costs and quality improvement in health care settings	NS	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Public	1	NA	NA	9541
Mekonnen et al	2013	Implementing ward based clinical pharmacy services in an Ethiopian University Hospital	2011	Ethiopia	Low-income	Africa	Hospital	Public	1	NA	NA	300
Minh et al	2020	Antibiotic use and prescription and its effects on Enterobacteriaceae in the gut in children with mild respiratory infections in Ho Chi Minh City, Vietnam. A prospective observational outpatient study	2009-2010	Vietnam	Lower-middle income	Western Pacific	Hospital	Public	1	NA	NA	561
Mohammadi et al	2016	Appropriateness of physicians' lumbosacral MRI requests in private and public centers in Tehran, Iran	2014	Iran	Lower-middle income	Eastern Mediterranean	Hospital	Both	2	No	City	277
Mokhtari et al	2014	Venous thromboembolism risk assessment, prophylaxis practices and interventions for its improvement (AVAIL-ME Extension Project, Iran)	2008-09	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	20	No	National	177
Mondragon et al	2021	Identification of the most frequent mistakes in the prescription of antibiotics using the 'time-out' strategy, in a pediatric hospital in mexico city	2020	Mexico	Upper-middle income	The Americas	Hospital	Public	1	NA	NA	196
Nelson	2017	Indications and appropriateness of caesarean sections performed in a tertiary referral centre in Uganda: A retrospective descriptive study	2014-15	Uganda	Low-income	Africa	Hospital	Public	1	NA	NA	200
Nguyen et al	2020	Antibiotic use in children hospitalised with pneumonia in Central Vietnam	2017-18	Vietnam	Lower-middle income	Western Pacific	Hospital	Private	1	NA	NA	2911

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Mbonye et al	2014	Other infectious diseases	Non-malarial febrile illness	Specific non-antibiotic drugs	Antimalarials	Medical record extraction	% febrile patients with negative malaria test given antimalarial	Healthy	Intervention arm: Under 5: 56% fell to 37%, 5 and above: 42% fell to 27%. Control arm : Under 5: 65% fell to 60%, 5 and above: 47% fell to 44%.	Yes	Yes	Yes
Means et al	2014	Other infectious diseases	Malaria	Antibiotics	Antibiotics	Medical record extraction	% of patients with malaria prescribed antibiotics without an indication	Healthy	42%	Yes	No	Yes
Meidani et al	2016	Various/any inpatients	Any inpatient	Diagnostics	Unnecessary laboratory tests	Medical record extraction	% of laboratory tests inappropriate	Treatment	26.40%	No	No	NA
Mekonnen et al	2013	Various/any inpatients	Any inpatient	Any/various drugs	Any unnecessary drug	Medical record extraction	% received any unnecessary drug	Population	12.0%	No	No	NA
Minh et al	2020	Respiratory tract infections	Children with mild respiratory infections	Antibiotics	Antibiotics	Medical record extraction	% given antibiotics inappropriately	Treatment	90.1%	No	No	NA
Mohammadi et al	2016	Non-communicable conditions	Lower back pain	Diagnostics	MRI	Patient exit interview	% of MRIs unnecessary	Treatment	24.4%	Yes	No	Yes
Mokhtari et al	2014	Various/any inpatients	Patients who were low risk for venous thromboembolism	Mixed/various	Venous thromboembolism prophylaxis (drug and mechanical)	Medical record extraction	% of low risk patients receiving unnecessary prophylaxis	Healthy	39.5%	No	No	NA
Mondragon et al	2021	Various/any inpatients	Any paediatric inpatient prescribed antibiotics	Antibiotics	Antibiotics	Medical record extraction	% of antibiotic prescriptions not medically justified	Treatment	23%	Yes	No	No
Nelson	2017	Surgery and labour	Women in labour	Other therapeutic interventions	Caesarean section	Medical record extraction	% of caesarean sections where alternative forms of care might have been more appropriate	Treatment	55%	No	Yes	Yes
Nguyen et al	2020	Respiratory tract infections	Children aged 2–59 months with a primary admission diagnosis of pneumonia	Antibiotics	Antibiotics	Medical record extraction	% of intravenous antibiotics for pneumonia unnecessary	Treatment	68%	No	No	NA

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Nigmatkulova et al	2020	Adherence to clinical quidelines on preoperative assessment and correction of cardiovascular risk in non-cardiac surgery	2018	Russia	Upper-middle income	Europe	Hospital	Private	1	NA	NA	102
Nikbakhsh et al	2010	Preoperative medical evaluation in elective surgery versus standard criteria	2008-09	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	2	No	City	498
Orish et al	2016	Overdiagnosis and overtreatment of malaria in children in a secondary healthcare centre in Sekondi-Takoradi, Ghana	2010-2012	Ghana	Lower-middle income	Africa	Hospital	Public	1	NA	NA	1160
Pema et al	2018	Demand management by electronic gatekeeping of test requests does not influence requesting behaviour or save costs dramatically	2013-2014	South Africa	Upper-middle income	Africa	Other	Public	1	NA	NA	1E+06
Refahi et al	2016	Is prescription of knee MRI according to standard clinical guideline	2014	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	1	NA	NA	115
Sanz et al	2005	Prescribers' indications for drugs in childhood: A survey of five European countries (Spain, France, Bulgaria, Slovakia and Russia)	1997-2000	Bulgaria/Russia	Upper-middle income	Europe	Primary	NS	14	No	NS	1874/2194
Sattayalertyanyong et al	2020	The inappropriate use of proton pump inhibitors during admission and after discharge: a prospective cross-sectional study	2016-2017	Thailand	Upper-middle income	South-East Asia	Hospital	Public	1	NA	NA	256
Smith	2012	The use of clinical audit during a successful medical engagement in Afghanistan	2011	Afghanistan	Low-income	Eastern Mediterranean	Primary	Public	1	NA	NA	144
Sylvia et al	2014	Survey Using Incognito Standardized Patients Shows Poor Quality Care in China's Rural Clinics	2013	China	Upper-middle income	Western Pacific	Primary	both	48	Yes	Regional	82
Tegegne et al	2015	Drug therapy problem and contributing factors among ambulatory hypertensive patients in Ambo General Hospital, West Shoa, Ethiopia	2014	Ethiopia	Low-income	Africa	Hospital	Public	1	NA	NA	151
Van Der Sandt et al	2019	Surgical antimicrobial prophylaxis among pediatric patients in south africa comparing two healthcare settings	2015	South Africa	Upper-middle income	Africa	Hospital	Both	2	No	NS	224
Van Duijn et al	2021	Connected diagnostics to improve accurate diagnosis, treatment, and conditional payment of malaria services in Kenya	2017-18	Kenya	Lower-middle income	Africa	Both	Private	5	No	Regional	2738

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Nigmatkulova et al	2020	Surgery and labour	Patients admitted for elective non cardiac surgery	Diagnostics	Electrocardiogram and echocardiography	Medical record extraction	% of exams unnecessary	Treatment	50.5% electrocardiogram/72.0% echocardiography	No	No	NA
Nikbakhsh et al	2010	Surgery and labour	Elective general surgery patients	Diagnostics	Laboratory tests	Medical record extraction	% of tests unnecessary	Treatment	Various, 0% to 77%	No	No	NA
Orish et al	2016	Other infectious diseases	Non-malarial febrile illness	Specific non-antibiotic drugs	Antimalarials	Medical record extraction	% of malaria negative/untested children given antimalarial	Healthy	84.1% negative test/78.2 % untested	Yes	No	Yes
Pema et al	2018	Various/all	Laboratory tests	Diagnostics	Unnecessary repetition of laboratory tests	Medical record extraction	% of laboratory tests that are unnecessary repeats	Treatment	3.18%	No	No	NA
Refahi et al	2016	Various/any outpatients	Patients for knee MRIs	Diagnostics	MRI	Patient exit interview	% of MRIs unnecessary	Treatment	45.2%	Yes	No	No
Sanz et al	2005	Various/any outpatients	Outpatients under 15	Antibiotics	Antibiotics	Medical record extraction	% of antibiotics incorrect	Treatment	46.0% Bulgaria, 60.2% Russia	No	No	NA
Sattayalertyanyong et al	2020	Various/any inpatients	Patients prescribed proton pump inhibitors	Specific non-antibiotic drugs	Proton pump inhibitors	Reassessing patients	% of proton pump inhibitor prescriptions without indication	Treatment	41.4%	No	No	NA
Smith	2012	Other infectious diseases	Under 5s with diarrhoea	Antibiotics	Antibiotics	Medical record extraction	% prescribed antibiotics	Healthy	90% pre audit 23% post audit	No	Yes	No
Sylvia et al	2014	Various/any outpatients	Adults with unstable angina, child with dysentery	Any/various drugs	unnecessary/harmful drugs	Standardised patients	% of medicines which were unnecessary/harmful	Treatment	64% village clinics, 55% town health centres	yes	no	yes
Tegegne et al	2015	Non-communicable conditions	Hypertension outpatients given at least one drug	Any/various drugs	Any unnecessary drug	Medical record extraction	% received any unnecessary drug	Population	24.5%	No	No	NA
Van Der Sandt et al	2019	Surgery and labour	Children undergoing surgery	Antibiotics	Unnecessary prophylactic antibiotics	Medical record extraction	% of cases where antibiotics not indicated but given anyway	Healthy	34.7%	Yes	No	Yes
Van Duijn et al	2021	Other infectious diseases	Non-malarial febrile illness	Specific non-antibiotic drugs	Antimalarials	Medical record extraction	% of antimalarials unnecessary	Treatment	28%	No	No	NA

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Vessal et al	2010	Evaluation of prophylactic antibiotic administration at the surgical ward of a major referral hospital, Islamic Republic of Iran	2008	Iran	Lower-middle income	Eastern Mediterranean	Hospital	NS	1	NA	NA	155
Xavier et al	2017	Instilling fear makes good business sense: unwarranted hysterectomies in Karnataka	NS	India	Lower-middle income	South-East Asia	Hospital	Private	NS (multiple)	No	Regional	66
Xue et al	2019	Diagnostic ability and inappropriate antibiotic prescriptions: a quasi-experimental study of primary care providers in rural China	2015	China	Upper-middle income	Western Pacific	Primary	NS	339	Yes	Regional	545
Yip et al	2014	Capitation combined with pay-for-performance improves antibiotic prescribing practices in rural China	2011-12	China	Upper-middle income	Western Pacific	Primary	NS	NS (multiple)	Yes	Regional	1E+06
Zalloum et al	2016	Inappropriate prescribing of proton pump inhibitors among patients in two jordanian tertiary health facilities	2013	Jordan	Upper-middle income	Eastern Mediterranean	Hospital	NS	2	No	City	193
Zhang & Sun	2022	Impacts of case-based payments reform on healthcare providers' behaviour on cataract surgery in a tertiary hospital in China: An eight-year retrospective study	2011-2019	China	Upper-middle income	Western Pacific	Hospital	NS	1	NA	NA	400

Authors	Year published	Medical condition /patient type (category)	Medical condition/patient type (detail)	Type of overprovision (category)	Type of overprovision (detail)	Assessment of overprovision	Measure of overprovision	Type of prevalence	Point prevalence estimate	Factors associated?	Intervention?	Statistical tests?
Vessal et al	2010	Surgery and labour	Surgical patients	Antibiotics	Unnecessary prophylactic antibiotics	Medical record extraction	% of prophylaxis unnecessary / % of those not needing prophylaxis given it	Treatment/healthy	30.3%/93.9%	No	No	NA
Xavier et al	2017	Surgery and labour	Women who had hysterectomy	Other therapeutic interventions	Hysterectomy	Medical record extraction	% of hysterectomies unnecessary	Treatment	67%	No	No	NA
Xue et al	2019	Various/any outpatients	Adults with TB or unstable angina, child with viral gastroenteritis	Antibiotics	antibiotics	Standardised patients	% received antibiotics	Healthy	42%	yes	no	yes
Yip et al	2014	Respiratory tract infections	Cold	Antibiotics	Antibiotics	Medical record extraction	% received antibiotics	Healthy	Control groups: township health centres 50.6%, village posts 38.4%	no	Yes	Yes
Zalloum et al	2016	Various/any inpatients	Recipients of proton-pump inhibitors	Specific non-antibiotic drugs	Proton-pump inhibitors	Medical record extraction	% of proton pump inhibitor prescriptions without indication	Treatment	72.5%	No	No	NA
Zhang & Sun	2022	Surgery and labour	Cataract surgery patients	Any/various drugs	Systemic antibiotics, systemic steroid prophylaxis, adjuvant drugs, multiple antibiotic eye drops	Medical record extraction	% getting specified unnecessary care	Healthy	35.0% fell to 3.0%/92.5% fell to 10.5%/85.0% fell to 0.0%/86.0% fell to 37%	No	Yes	Yes

Appendix 2: Supplementary materials for Chapter 3 (as published)

Appendix: Standardised Patient Systematic Review Search Strategy

We conducted a systematic review of methods for SP studies in health facilities in LMICs for all studies published in English up to 16 December 2016.

EconLit, EMBASE, Global Health and MEDLINE databases were searched on 16 December 2016 for all years available, using the following terms:

"standardi?ed client*"
"standardi?ed caller*"
"standardi?ed careseeker*"
"standardi?ed shopper*"
"standardi?ed mother*"
("standardi?ed patient*" not (model* or student*))
"simulated patient*" not (model* or student*)
"patient simulation" not (model* or student*)
"simulated client*"
"simulated caller*"
"simulated shopper*"
"simulated careseeker*"
"simulated mother*"
undercover AND (patient* or mother* or client* or caller* or careseeker* or shopper*)
unannounced AND (patient* or mother* or client* or caller* or careseeker* or shopper*)
(incognito NOT tinea) AND (patient* or mother* or client* or caller* or careseeker* or shopper*)
"mystery shopper*"
"mystery patient*"
"mystery client*"
"mystery caller*"
"mystery careseeker*"
"mystery mother*"
"pseudo shopper*"
"pseudo patient*"
"pseudo client*"
"pseudo caller*"
"pseudo careseeker*"
"pseudo mother*"
"covert shopper*"
"covert patient*"
"covert client*"
"covert caller*"
"covert careseeker*"
"covert mother*"

After removal of duplicates 1841 records were identified. Abstracts were reviewed and excluded if:

- provider was aware that SP was not genuine patient
- provider was a pharmacist or other retailer
- clinical care was not provided (e.g. checking availability of drugs or appointments)
- purpose of SP was to test student
- no face-to-face contact with provider (e.g. telemedicine)
- SP visit was not under real practice conditions
- insufficient detail given of symptoms/conditions of SP
- study conducted in non-LMIC country
- study was non-empirical (e.g. review)

63 papers and conference abstracts were included, covering 45 distinct studies, and are detailed in table A1 below.

Table A1: Studies included in systematic review

STUDY ID	Papers	Country of study	Cases used	Purpose of study	Consent method
1	Alabid et al. (2013a) Alabid et al. (2013b) Alabid et al. (2014) Ibrahim et al. (2013) Neoh et al. (2009)	Malaysia	Common cold	Cross-sectional/comparative	Individual providers
2	Bachmann et al. (2004) Colvin et al. (2006)	South Africa	STI symptoms	Evaluation (randomised trial)	Individual providers
3	Chin-Quee (2004)	Paraguay	Family planning client	Evaluation (non-randomised)	Not specified
4	Clyde et al. (2013)	Mexico	Suspected pregnancy seeking abortion	Cross-sectional	Not specified
5	Crabbe et al. (1998)	Cameroon	STI symptoms	Evaluation (non-randomised)	Not specified
6	Currie et al. (2011) Currie et al. (2014)	China	Influenza-like illness	Audit/experiment	Not specified
7	Das et al. (2016a)	India	Angina; asthma; diarrhoea (child absent)	Evaluation (randomised trial)	Not specified
8	Das et al. (2012) Das et al. (2016b)	India	Angina; asthma; diarrhoea (child absent)	Cross-sectional/comparative	Waiver of consent
9	Das et al. (2015)	India	TB	Cross-sectional	Waiver of consent
10	Geary et al. (2013) Geary et al. (2015)	South Africa	Family planning client	Evaluation (non-randomised)	Facility level
11	Harrison et al. (1998) Harrison et al. (2000)	South Africa	STI symptoms	Evaluation (randomised trial)	Facility level
12	Jennings and Binanga (2009) Leon et al. (2007) Leon et al. (2008)	India	Family planning client	Evaluation (policy)	Not specified
13	Jennings et al. (2011)	Peru	Family planning client	Evaluation (non-randomised)	Individual providers
14	Johnson and Ugaz (2016)	Nigeria	Family planning client	Cross-sectional	Not specified

STUDY ID	Papers	Country of study	Cases used	Purpose of study	Consent method
15	Katz and Nare (2002) Nare et al. (1997)	Senegal	Family planning client	Cross-sectional	Not specified
16	Larke et al. (2010) McHome et al. (2015)	Tanzania	Family planning client; STI testing after partner notification	Evaluation (randomised trial)	Facility level
17	Leon et al. (2001)	Peru	Family planning client	Cross-sectional	Waiver of consent
18	Leon et al. (2005)	Guatemala	Family planning client	Evaluation (non-randomised)	Not specified
19	Leon et al. (2006)	Rwanda	Family planning client	Evaluation (non-randomised)	Individual providers
20	Li et al. (2014)	China	HIV testing	Evaluation (randomised trial)	Individual providers
21	Mathews et al. (2009)	South Africa	HIV testing	Evaluation (non-randomised)	Individual providers
22	Maynard-Tucker (1994)	Haiti	Family planning client	Cross-sectional	Facility level
23	Mohanan et al. (2014) Mohanan et al. (2015)	India	Diarrhoea (child absent); pneumonia (child absent)	Cross-sectional	Facility level
24	Nalwadda et al. (2011)	Uganda	Family planning client	Cross-sectional/comparative	Individual providers
25	Ogwal-Okeng et al. (2004)	Uganda	Acute respiratory infection; malaria	Cross-sectional/comparative	Not specified
26	O'Hara et al. (2001)	Kenya	STI symptoms	Cross-sectional	Facility level
27	Olowu (1998)	Nigeria	Family planning client	Cross-sectional	Not specified
28	Osei et al. (2005)	Ghana	Family planning client	Cross-sectional	Not specified
29	Planas et al. (2015)	Peru	Family planning client	Audit/experiment	Waiver of consent
30	Pongsupap and Van Lerberghe (2006b) Pongsupap and Van Lerberghe (2006a)	Thailand	Anxiety	Cross-sectional/comparative	Not specified
31	Poyer et al. (2015)	Kenya	Acute respiratory infection; malaria	Cross-sectional	Facility level
32	Rowe et al. (2012)	Benin	Diarrhoea (child absent); pneumonia (child absent)		Individual providers
33	Sarma and Oliveras (2011)	Bangladesh	STI symptoms	Evaluation (non-randomised)	Not specified
34	Schuler et al. (1985)	Nepal	Family planning client	Cross-sectional	Not specified
35	Shah et al. (2007)	Pakistan	STI symptoms	Evaluation (randomised trial)	Not specified

STUDY ID	Papers	Country of study	Cases used	Purpose of study	Consent method
36	Shahabudin et al. (1994)	Malaysia	Anxiety	Cross-sectional	Individual providers
37	Shirazi et al. (2011) Shirazi et al. (2013)	Iran	Depression	Evaluation (randomised trial)	Not specified
38	Smith and Mertens (2004)	India	STI symptoms	Cross-sectional	Not specified
39	Stanback and Janowitz (2003)	Ghana	Family planning client	Cross-sectional	Not specified
40	Subramanian et al. (2010)	Ghana	Family planning client	Evaluation (non-randomised)	Not specified
41	Sylvia et al. (2015)	China	Angina; diarrhoea (child absent)	Cross-sectional	Individual providers
42	Tatum et al. (2005)	Mexico	Family planning client	Cross-sectional	Facility level/ individual providers
43	Tumlinson et al. (2014)	Kenya	Family planning client	Cross-sectional/comparative	Not specified
44	Waxler-Morrison (1988)	Sri Lanka	Common cold; diarrhoea; lower back pain	Cross-sectional/comparative	Not specified
45	Yeung et al. (2011a) Yeung et al. (2011b) Yeung et al. (2015)	Cambodia	Malaria	Cross-sectional	Not specified

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Chapter 5 in thesis: King JJ, Powell-Jackson T, Makungu C, Hargreaves J, Goodman C. How much healthcare is wasted? A cross-sectional study of outpatient overprovision in private-for-profit and faith-based health facilities in Tanzania. Health policy and planning. 2021 ;36(5):695-706.

Chapter 6 in thesis: King J, Powell-Jackson T, Hargreaves J, Makungu C, Goodman C. Pushy Patients Or Pushy Providers? Effect Of Patient Knowledge On Antibiotic Prescribing In Tanzania: Effect of patient knowledge on antibiotic prescribing in Tanzania. Health Affairs. 2022;41(6):911-20.

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Expected presentation date	Sep 2022
Portions	Entire article in full
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e) The License described in the Order Confirmation shall be governed by and construed under the law of the State of New York, USA, without regard to the principles thereof of conflicts of law. Any case, controversy, suit, action, or proceeding arising out of, in connection with, or related to such License shall be brought, at CCC's sole discretion, in any federal or state court located in the County of New York, State of New York, USA, or in any federal or state court whose geographical jurisdiction covers the location of the Rightsholder set forth in the Order Confirmation. The parties expressly submit to the personal jurisdiction and venue of each such federal or state court.

Appendix 4: Trial profile for SafeCare evaluation

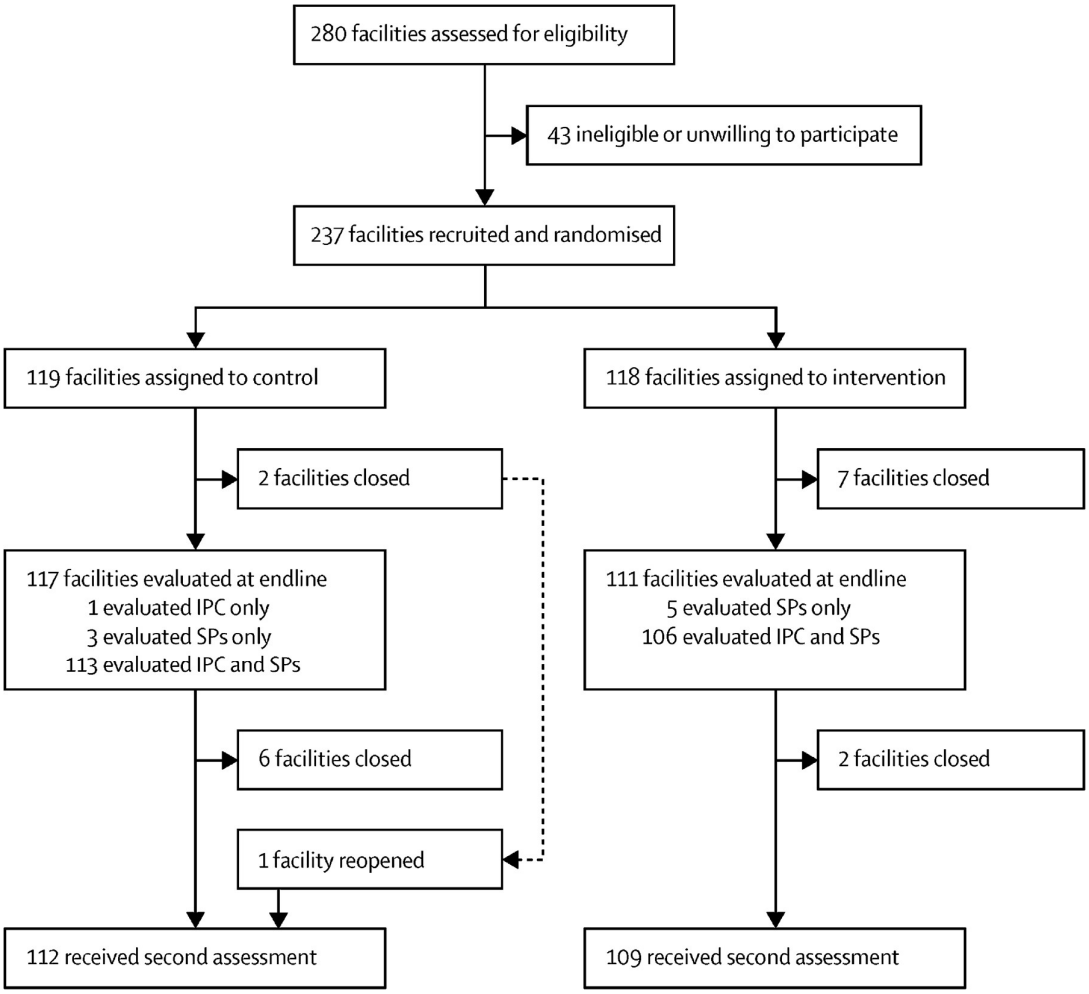

Figure reproduced from: King JJ, Powell-Jackson T, Makungu C, Spieker N, Risha P, Mkopi A, Goodman C. Effect of a multifaceted intervention to improve clinical quality of care through stepwise certification (SafeCare) in health-care facilities in Tanzania: a cluster-randomised controlled trial. The Lancet Global Health. 2021;9(9):e1262-72.

Appendix 5: Study tools

Standardised patient scripts

Asthma

Opening statement:

Doctor, I have had a problem with breathing, and last night it became terrible.

What difficulties were you having with your breathing?

I was short of breath; I couldn't take a full breath.

What happened last night?

I was at my cousin's place and we were moving around furniture/cleaning. At night I had an attack of breathing problems.

How long was the attack last night?

It was bad for 15 minutes; then I felt a bit better, but didn't feel well for about 2 hours. Even after that I was exhausted.

Were you coughing?

Last night, I was having cough.

How long did you cough for?

Throughout the attack

Did you cough any sputum/mucus?

No.

Were you wheezing/whistling?

Yes, I was last night

Did the attack stop you sleeping?

After the attack I was able to sleep fine

Did you eat anything new last night?

No, I ate rice/ugali/bananas with beans which I often have

Have you had any attacks like this before?

Yes, a number of times, but this is the worst I have had.

Do the attacks wake you up at night?

Yes, sometimes they do

Since when have you had this problem with breathing?

This began one year ago.

Is the shortness of breath constant or does it come and go?

It comes and goes

How often does this happen?

Over the last 3-4 months, it has occurred about once a month. Over the last week this started happening every day.

What brings on the shortness of breath?

It occurs when I am cleaning something, or running a lot or doing any hard work

How long does an attack last?

Earlier it was mild and lasted for only a few minutes. But it has been getting worse over the last 3-4 months, and lasting about an hour.

Is it worse in the morning or evening?

Most of the times I have had attacks it has been evening or night.

Have your lips ever turned blue from struggling to breathe?

No

Have you taken any medication for this problem?

No, never

Is there anything you do to help you cope with an attack?

I get up and walk around

How far can you walk during an attack?

A few metres

Are you breathless even at rest during an attack?

Yes, I still struggle to breathe

Does anyone else in your family have this [breathing] problem?

Yes, my brother also has the same difficulties

Does he take medication for it?

I don't know

Does anyone else in your family have asthma?

I don't know

Does anyone in your family take medication for asthma?

I don't know

Have you ever had a test for asthma?

No

Did you have this breathing problem as a child?

I don't remember, but my mother says I used to cough a lot.

Do you have fever?

No.

Do you have chest pain?

No.

Are you losing weight?

No.

Have you lost your appetite?

No.

Are you having night sweats?
No.

Have you had any sore throat, cold, sneezing or stuffiness?
No.

Do you smoke?
No.

Do you drink?
No
Are you allergic to any medicines?
No
Do you have any other problems?
No

When was your last period?
About two weeks ago

Are you/could you be pregnant?
No

Non-malarial febrile illness

Opening statement:

Doctor, I have a fever and I think I have malaria

Why do you think it's malaria?

Because I have a fever and a headache

What are your symptoms?

I have a fever and headache.

Which symptom started first?

They started at the same time

How long have you had these symptoms for?

For three days

Is the fever constant or does it come and go?

It comes and goes

Does the fever go up and down?

Yes

When you have a fever is it very high?

Sometimes high, sometimes low

Have you been able to eat and drink?

Yes, I ate a small breakfast and drank some water

Have you had any vomiting or diarrhoea?

No.

Have you taken any medicines?

Just panadol

For how long?

Two days

Have you taken a malaria test?

No

When was the last time you had malaria?

About one year ago

Have you travelled recently?

Yes, I've been to Tanga/Morogoro/Mtwara/Mwanza

Have you had difficulty breathing?

No

Have you had any wheezing?

No.

Have you had any muscle or joint pain?
Yes, my muscles and joints ache

Do you have chest pain?
No.

Do you have a cough?
Yes, a little coughing

Have you had a cold, sneezing, sore throat or stuffiness?
No

Does the cough produce sputum/mucus?
No

Do you have any pain on coughing?
No

Have you had any fainting or convulsions?
No.

Do you feel dizzy?
No

Do you smoke?
No.

Do you drink?
No.

Are you allergic to any medicines?
No

Do you have any other problems?
No

When was your last period?
About two weeks ago

Are you/could you be pregnant?
No

TB

Opening statement:
Doctor, I have had a cough that is not getting better.

How long have you had a cough for?
About 3 weeks

Do you cough up mucus/sputum?
Yes, some yellow mucus

Is there blood in the sputum?
No

Have you seen a doctor already?
Yes, and he gave me some medicines

Which health facility?
[Name facility in another town]

How long did you have your cough for when you saw the doctor?
One week

Did the doctor do any tests?
Yes, he did a malaria test but it was negative

What medicine did you take?
Amoxicillin

How long have you been taking the medicine for?
One week

Did you finish all the medicine?
Yes

Have your symptoms improved?
No, they haven't gone away at all.

Have you ever been tested for TB?
No

Have you ever been diagnosed with TB?
No

Has anyone in your family had TB?
No

Has anyone in your family had a cough like this?
No

Have you had any contact with any TB patients?

No

Do you have the cough throughout the day?
Yes, all day, but it comes and goes

Have you had a fever?
Yes, some fever

Was your fever very high?
Not especially

Do you have chest pain?
Yes.

Whereabouts in your chest is the pain?
All over

Have you lost your appetite?
Yes.

Have you had difficulty breathing?
No.

Have you had any wheezing?
No.

Are you losing weight?
Yes.

How much?
I don't know, just a little. My clothes feel a little looser.

How much did you weigh the last time that you weighed yourself?
I can't remember

Are you having night sweats?
Yes.

Have you had any throat pain or upper respiratory symptoms (cold, sneezing, stuffiness)?
No.

Do you smoke?
No

Do you drink?
No

Do you have diabetes?
No
Have you had diabetes in the past?
No

Have you been tested for diabetes?

No

Have you ever taken an HIV test/do you know your HIV status?

No

Are you allergic to any medicines?

No

Do you have any other problems?

No

When was your last period?

About two weeks ago

Are you/could you be pregnant?

No

URTI A (uninformed)

Opening statement:
I have a cough and my head and throat hurt

How long have you have these symptoms for?
3 days

Which symptom started first?
They started at the same time

Do you have a fever?
No

Have you take any medications?
No

Do your symptoms get worse at night/change through the day?
No, they are the same at day and night

Did you cough any sputum?
Yes, a little

Is there blood in the sputum?
No

Do you have a running nose?
A little bit

Do you have any sneezing?
Yes

Do you have a blocked nose?
Yes, I feel a bit stuffy

Do you have any allergies?
No

Do you have chest pain?
No.

Have you lost your appetite?
No.

Do you have pain on swallowing?
Yes

Have you had difficulty breathing?
No.

Have you had any wheezing?

No.

Are you losing weight?
No.

Are you having night sweats?
No.

Do you smoke?
No.

Do you drink?
No

Are you allergic to any medicines?
No

Do you have any other problems?
No

When was your last period?
About two weeks ago

Are you/could you be pregnant?
No

URTI B (informed)

Opening statement:

I have a cough and my head and throat hurt, but I don't know what to do because my friend told me he read on the internet that you don't need antibiotics for a simple cough

Is your friend a doctor?

No

How long have you have these symptoms for?

3 days

Which symptom started first?

They started at the same time

Do you have a fever?

No

Have you take any medications?

No

Do your symptoms get worse at night/change through the day?

No, they are the same at day and night

Did you cough any sputum?

Yes, a little

Is there blood in the sputum?

No

Do you have a running nose?

A little bit

Do you have any sneezing?

Yes

Do you have a blocked nose?

Yes, I feel a bit stuffy

Do you have any allergies?

No

Do you have chest pain?

No.

Have you lost your appetite?

No.

Do you have pain on swallowing?

Yes

Have you had difficulty breathing?
No.

Have you had any wheezing?
No.

Are you losing weight?
No.

Are you having night sweats?
No.

Do you smoke?
No.

Do you drink?
No

Are you allergic to any medicines?
No

Do you have any other problems?
No
When was your last period?
About two weeks ago

Are you/could you be pregnant?
No

	N Times 0 Timings

N InterviewerCode 1 Interviewer code	select_one interviewer_list [Names redacted] ◯ Other, specify 33
N OtherInterviewer Please specify	text ${InterviewerCode}=33 R
N DistrictCode 2 District	select_one district_list ◯ Piloting 0 ◯ Arumeru 1 ◯ Arusha 2 ◯ Bagamoyo 3 ◯ Dodoma 4 ◯ Gairo 5 ◯ Hai 6 ◯ Hanang 7 ◯ Handeni 8 ◯ Ilala 9 ◯ Ileje 10 ◯ Iringa 11 ◯ Karatu 12 ◯ Kibaha 13 ◯ Kilindi 14 ◯ Kilolo 15 ◯ Kilombero 16 ◯ Kilosa 17 ◯ Kilwa 18 ◯ Kinondoni 19 ◯ Kisarawe 20 ◯ Kongwa 21 ◯ Korogwe 22 ◯ Kyela 23 ◯ Lindi 24 ◯ Longido 25 ◯ Lushoto 26 ◯ Makete 27 ◯ Masasi 28 ◯ Mbarali 29 ◯ Mbeya 30 ◯ Mbinga 31 ◯ Mbozi 32 ◯ Mbulu 33 ◯ Mkuranga 34 ◯ Momba 35

	◯ Monduli 36 ◯ Morogoro 37 ◯ Moshi 38 ◯ Mpanda 39 ◯ Mtwara 40 ◯ Mufindi 41 ◯ Muheza 42 ◯ Mvomero 43 ◯ Nachingwea 44 ◯ Namtumbo 45 ◯ Ngorongoro 46 ◯ Njombe 47 ◯ Nkasi 48 ◯ Nyasa 49 ◯ Rombo 50 ◯ Rufiji 51 ◯ Rungwe 52 ◯ Same 53 ◯ Siha 54 ◯ Simanjiro 55 ◯ Singida 56 ◯ Songea 57 ◯ Sumbawanga Urban 58 ◯ Tandahimba 59 ◯ Tanga 60 ◯ Temeke 61 ◯ Tunduru 62 ◯ Wanging'ombe 63 ◯ Other, specify 64
N OtherDistrict Please specify	text ${DistrictCode}=64 R
N FacilityName 3 Name of facility	select_one facility_list [Names redacted] district_filter=${DistrictCode} F
N Otherfacility Please specify	text ${FacilityName}=238 R
N SPCase 4 SP Case	select_one sp_case_list ◯ Asthma 1 ◯ Malaria 2 ◯ TB 3 ◯ URTI 4
N InformedExperiment	select_one informed_experiment ${SPCase}=4 R

5 Informed or uninformed patient?	◯ a- Uninformed (does not mention antibiotic knowledge) 1 ◯ b- Informed (mentions antibiotic knowledge) 2
N SymptomTime 6a Probes symptoms time of day	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N SymptomDuration 6b Probes duration of symptoms	select_one question_asked ${SPCase}!=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N CoughProbe 7a Probes cough	select_one question_asked ${SPCase}=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N MucusProbe 7b Asks if cough produces mucus/sputum	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N SputumColour 7c Asks colour of mucus/sputum	select_one question_asked ${SPCase}=4 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N SputumBlood 7d Asks if blood in sputum	select_one question_asked ${SPCase}=3 or ${SPCase}=4 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N FeverProbe 8a Probes fever	select_one question_asked ${SPCase}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information

	not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N ChestProbe a Probes chest pain	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N VandDProbe b Probes vomiting and/or diarrhoea	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N WeightProbe c Probes weight loss	select_one question_asked ${SPCase}=1 or ${SPCase}=3 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AppetiteProbe d Probes loss of appetite	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N NightSweatProbe e Probes night sweats	select_one question_asked ${SPCase}=1 or ${SPCase}=3 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N WheezingProbe f Probes wheezing	select_one question_asked ${SPCase}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N BreathingProbe g Probes breathing difficulty	select_one question_asked ${SPCase}!=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2

	◯ Question not asked but information given by fieldworker 3
N FaintsProbe h Probes fainting or convulsions	select_one question_asked ${SPCase}=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaType a Probes type of breathing difficulty (current episode)	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaCircu b Probes circumstances of episode	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaLength c Probes length of attack	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaEpidsodic d Asks if shortness of breath is constant or episodic	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaFood e Probes if had eaten anything unusual	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaPrevious f Probes previous breathing difficulties	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information

	not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaStart g Probes when difficulties started or how long they've happened for	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaFrequency h Probes frequency of attacks (how often)	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaTrigger i Probes what brings on attacks/if any trigger	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaCope j Probes if anything improves symtoms/ if you do anything to cope with it	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaWake k Does the breathing trouble/wake you at night?	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaWalk l How far can you walk during an attack?	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaBreath m Are you breathless even at rest during an attack?	select_one question_asked ${SPCase}=1 R

	◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaLips n Have your lips become blue during at attack?	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N ProbesHealthSeeking a Probes other health-seeking or medication taken	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N ProbesMedType b Probes name or type of medication	select_one question_asked ${SPCase}=3 and ${ProbesHealthSeeking}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N ProbesMedDuration c Probes duration taking mediction	select_one question_asked (${SPCase}=3 or ${SPCase}=2) and ${ProbesHealthSeeking}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N HIVProbe a Probes HIV testing/status	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N DiabetesHistory b Probes personal history of diabetes	select_one question_asked ${SPCase}=3 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N	select_one question_asked

TBHistory c Probes personal history of TB	${SPCase}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AsthmaHistory d Asks if asthmatic	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N ChildAsthma e Asks about childhood history of breathing difficulties	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N MalariaTest f Asks if taken a malaria test	select_one question_asked ${SPCase}=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N AllergyProbe g Asks if has any allergies	select_one question_asked ${SPCase}!=2 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N PregnantProbe h Asks if pregnant/could be pregnant/date of last period	select_one question_asked ${InterviewerCode}=9 or ${InterviewerCode}=12 or ${InterviewerCode}=17 or ${InterviewerCode}=18 or … R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N Age a Asks age (either on registration form seen by doctor or in person)	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2

	◯ Question not asked but information given by fieldworker 3
N Smoking b Asks if smokes	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N Drinking c Asks if drinks alcohol	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N Occupation d Asks occupation/job	select_one question_asked ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N JobGiven 13e Which job was given?	select_one job_list ${Occupation}!=2 R ◯ Buying agricultural products (e.g. cash crops, cattle) 1 ◯ Selling goods at markets (e.g. second hand clothes) 2 ◯ Other, specify 3
N OtherJob 13f Please specify other job	text ${JobGiven}=3 R
N FHBreathing a Asks about family history of breathing difficulties	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N FHAsthma b Asks about family history of asthma	select_one question_asked ${SPCase}=1 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N FHTB c Asks about family history of TB	select_one question_asked ${SPCase}=3 R

	◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N FHCough d Asks about family history of persistent cough	select_one question_asked ${SPCase}=3 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N FHContant e Have you had contact with anyone with TB?	select_one question_asked ${SPCase}=3 R ◯ Question asked by doctor 1 ◯ Question not asked, information not given by fieldworker 2 ◯ Question not asked but information given by fieldworker 3
N Pulse a Pulse measured	select_one yes_no ◯ Yes 1 ◯ No 2
N BP b Blood pressure measured	select_one yes_no ◯ Yes 1 ◯ No 2
N StethoFront c Listened with stethoscope (front)	select_one yes_no ◯ Yes 1 ◯ No 2
N StethoBack d Listened with stethoscope (back)	select_one yes_no ◯ Yes 1 ◯ No 2
N TempThermo e Temperature taken (thermometer, any type)	select_one yes_no ◯ Yes 1 ◯ No 2
N TempTouch f Temperature taken by touch	select_one yes_no ◯ Yes 1 ◯ No 2
N ThroatExam g Throat/tonsil exam	select_one yes_no ◯ Yes 1 ◯ No 2
N AbdoExam h Abdominal exam	select_one yes_no ◯ Yes 1 ◯ No 2
N OtherExam 16 Any other exams attempted?	select_one yes_no ◯ Yes 1 ◯ No 2

N ExamSpecify Please list	text ${OtherExam}=1 R
N DiagOrder 17 Were any diagnostic tests ordered?	select_one yes_no ◯ Yes 1 ◯ No 2
N MRDT a Malaria RDT	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N MBS b Malaria Bloodslide	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N HIVRDT c HIV RDT	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N Widal d Widal (typhoid)	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N FBP e Full blood picture	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N Hb f Haemoglobin/Hb	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N Glucose g Blood sugar/glucose	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N TBAFB h TB sputum test/AFB	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N Xray I Chest X-ray	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N urinalysis j Urinalysis	select_one yes_no ${DiagOrder}=1 R

	◯ Yes 1 ◯ No 2
N UPT k Urine pregnancy test	select_one yes_no ${DiagOrder}=1 and (${InterviewerCode}=9 or ${InterviewerCode}=12 or ${InterviewerCode}=17 or ${In … R ◯ Yes 1 ◯ No 2
N Worms l Stool sample (worms)	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N ESR m ESR	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N MRDTa a Malaria RDT	select_one yes_no ${MRDT}=1 R ◯ Yes 1 ◯ No 2
N MBSa b Malaria Bloodslide	select_one yes_no $=1 R ◯ Yes 1 ◯ No 2
N HIVRDTa c HIV RDT	select_one yes_no ${HIVRDT}=1 R ◯ Yes 1 ◯ No 2
N Widala d Widal (typhoid)	select_one yes_no ${Widal}=1 R ◯ Yes 1 ◯ No 2
N FBPa e Full blood picture	select_one yes_no ${FBP}=1 R ◯ Yes 1 ◯ No 2
N Hba f Haemoglobin/Hb	select_one yes_no ${Hb}=1 R ◯ Yes 1 ◯ No 2
N Glucosea g Blood sugar/glucose	select_one yes_no ${Glucose}=1 R ◯ Yes 1 ◯ No 2

N TBAFBa h TB sputum test/AFB	select_one yes_no ${TBAFB}=1 R ◯ Yes 1 ◯ No 2
N Xraya I Chest X-ray	select_one yes_no ${Xray}=1 R ◯ Yes 1 ◯ No 2
N urinalysisa j Urinanlysis	select_one yes_no ${urinalysis}=1 R ◯ Yes 1 ◯ No 2
N UPTa k Urine pregnancy test	select_one yes_no ${UPT}=1 R ◯ Yes 1 ◯ No 2
N Wormsa l Stool sample (worms)	select_one yes_no ${Worms}=1 R ◯ Yes 1 ◯ No 2
N ESRa m ESR	select_one yes_no ${ESR}=1 R ◯ Yes 1 ◯ No 2
N MRDTd a Malaria RDT	select_one yes_no ${MRDTa}=1 R ◯ Yes 1 ◯ No 2
N MBSd b Malaria Bloodslide	select_one yes_no ${MBSa}=1 R ◯ Yes 1 ◯ No 2
N Hbd f Haemoglobin/Hb	select_one yes_no ${Hba}=1 R ◯ Yes 1 ◯ No 2
N Glucosed g Blood sugar/glucose	select_one yes_no ${Glucosea}=1 R ◯ Yes 1 ◯ No 2
N urinalysisd j Urinanlysis	select_one yes_no ${urinalysisa}=1 R ◯ Yes 1 ◯ No 2
N	select_one yes_no

UPTd k Urine pregnancy test	${UPTa}=1 R ◯ Yes 1 ◯ No 2
N Wormsd l Stool sample (worms)	select_one yes_no ${Wormsa}=1 R ◯ Yes 1 ◯ No 2
N MRDTr a What was the result of the malaria RDT?	select_multiple result_list ${MRDTd}=1 R ☐ Negative 1 ☐ Positive 2 ☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5
N MBSr b What was the result of the malaria bloodslide?	select_multiple result_list ${MBSd}=1 R ☐ Negative 1 ☐ Positive 2 ☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5
N Hbr j What was the result of the Hb test?	select_multiple result_list ${Hbd}=1 R ☐ Negative 1 ☐ Positive 2 ☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5
N Glucoser g What was the result of the blood sugar test?	select_multiple result_list ${Glucosed}=1 R ☐ Negative 1 ☐ Positive 2 ☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5
N urinalysisr j What was the result of the urinalysis?	select_multiple result_list ${urinalysisd}=1 R ☐ Negative 1 ☐ Positive 2 ☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5
N Wormsr l What was the result of the stool sample?	select_multiple result_list ${Wormsd}=1 R ☐ Negative 1 ☐ Positive 2

	☐ Inconclusive/invalid 3 ☐ Result not given 4 ☐ Other, specify 5

	N DiagResOther ${DiagOrder}=1 R 22 Other results
N MRDTo a What was the result of the malaria RDT?	text selected(${MRDTr}, '5') R
N MBSo b What was the result of the malaria bloodslide?	text selected(${MBSr}, '5') R
N Hbo j What was the result of the Hb test?	text selected(${Hbr}, '5') R
N Glucoseo g What was the result of the blood sugar test?	text selected(${Glucoser}, '5') R
N urinalysiso j What was the result of the urinalysis?	text selected(${urinalysisr}, '5') R
N Wormso l What was the result of the stool sample?	text selected(${Wormsr}, '5') R

	N OtherTests ${DiagOrder}=1 R 23 Other tests
N OtherTestDone a Were any other tests done?	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2
N OtherTestOrder b Were any other tests ordered but not done?	select_one yes_no ${DiagOrder}=1 R ◯ Yes 1 ◯ No 2

	N OtherTestDetails

	${OtherTestDone}=1 or ${OtherTestOrder}=1 R 24 Other test details
N OtherTestResult a Please list tests done and results	text ${OtherTestDone}=1 R
N OtherTestSpecify b Please list tests ordered but not done	text ${OtherTestOrder}=1 R

	N Fees 25 Fees paid
N ConsulFee a Registation/consulation fees *Enter 0 if nothing, 99 if don't know*	integer
N LabFee b Lab/diagnostic fees *Enter 0 if nothing, 99 if don't know*	integer
N MedFee c Medicine fees *Enter 0 if nothing, 99 if don't know*	integer
N OtherFee d Any other fees *Enter 0 if nothing, 99 if don't know*	integer
N TotalFee e Total fees *Enter 0 if nothing, 99 if don't know*	integer

N FUP 26 Did the doctor tell you to come back for any reason?	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPbetter a If you don't feel better	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPmed b To get more medicine	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPtest c After completion of tests	select_one yes_no ◯ Yes 1 ◯ No 2
N	select_one yes_no

FUPdays d After a certain number of days	◯ Yes 1 ◯ No 2
N FUPfinish e When you have finished the course of medicine	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPmoney f when you have money to pay for treatment/tests	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPother g Other instructions	select_one yes_no ◯ Yes 1 ◯ No 2
N FUPdaysno 28 How many days?	integer ${FUPdays}=1 R
N FUPotherdetail 29 What other instructions?	text ${FUPother}=1 R
N Referral 30 Did the doctor refer you to another health facility?	select_one yes_no ◯ Yes 1 ◯ No 2

	N ReferralDetail ${Referral}=1 R 31 Please give details
N RefLetter a Were you given a referral slip/letter?	select_one yes_no ◯ Yes 1 ◯ No 2
N RefType b Were you referred to a certain type of facility?	select_one facility_ref ◯ Government hospital 1 ◯ Government health centre/dispensary 2 ◯ Private facility 3 ◯ Other, specify 4 ◯ No particular type 5
N RefName c Were you given the name of the facility?	select_one yes_no ◯ Yes 1 ◯ No 2

N RefTypeOther 32 Please specify other type of facility	text ${RefType}=4 R
N RefNameSpecify 33 Please give name	text ${RefName}=1 R

N Diagnosis 34 Did the doctor give you a possible diagnosis ?	select_one yes_no ◯ Yes 1 ◯ No 2
N DiagnosisType 35 Diagnosis	select_multiple diagnosis_list ${Diagnosis}=1 R ☐ Allergies 1 ☐ Asthma 2 ☐ Bronchitis 3 ☐ Cold 4 ☐ Malaria 5 ☐ Pneumonia 6 ☐ TB 7 ☐ UTI 8 ☐ Worms 9 ☐ Other, specify 19
N DiagnosisDetail 36 Please give details	text selected(${DiagnosisType}, '19') R
N SPSusp a Did the provider seem suspicious that you were not a real patient?	select_one yes_no ◯ Yes 1 ◯ No 2
N SPAsk b Did the provider ask if you were an SP?	select_one yes_no ◯ Yes 1 ◯ No 2
N SPOther c Did you have to reveal your idenity for any other reason?	select_one yes_no ◯ Yes 1 ◯ No 2
N SPOtherDetail 38 Please give details	text ${SPOther}=1 R

	N finalqs End of visit
N HCWSex 40 Was the provider male or female?	select_one sex ◯ Male 1 ◯ Female 2
N OwnSymptoms 41 Do you have any symptoms of illness today?	select_one yes_no ◯ Yes 1 ◯ No 2

N SymptomType 42 Which symptoms (tick all that apply)?	select_multiple symptom_list ${OwnSymptoms}=1 R ☐ Blocked nose 1 ☐ Runnng nose 2

	☐ Sore throat 3 ☐ Headache 4 ☐ Cough 5 ☐ Ear infection 6 ☐ Injury 7 ☐ Other, specify 8
N OwnSymOther 43 Please give details of other symptoms	text selected(${SymptomType}, '8') R
N MedAllergy a Did the doctor ask if you were allergic to any medicines?	select_one yes_no ◯ Yes 1 ◯ No 2
N Dispensed b Were any medicines dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2
N Prescribed c Were any medicines prescribed but not dispensed (except injections or IV fluids)?	select_one yes_no ◯ Yes 1 ◯ No 2
N Injections d Were you offered any injections?	select_one yes_no ◯ Yes 1 ◯ No 2
N IVFluids e Were you offered IV fluids?	select_one yes_no ◯ Yes 1 ◯ No 2
N Inhaler f Were you prescribed/dispensed an inhaler?	select_one yes_no ${SPCase}=1 R ◯ Yes 1 ◯ No 2
N Education g Were you given education about how to control breathing difficulties/asthma attacks?	select_one yes_no ${SPCase}=1 R ◯ Yes 1 ◯ No 2
N OtherTreat h Was any other treatment suggested/offered?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa1 Details of medicine 1
N DispBrand1 a Brand name	text
N DispManu1 b Name of manufacturer	text

N DispCoun1 c Country of manufacturer	text
N DispForm1 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb1 Details of medicine 1
N DispDosOther1 Please specify dosage form	text ${DispForm1}=4 R
N Disp1Gen1 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29

	◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO1 Please specify generic name	text ${Disp1Gen1}=100 R
N Disp1StrTab1 Strength (mg)	decimal ${DispForm1}=1 R
N Disp1StrLiq1 Strength (mg/ml)	decimal ${DispForm1}=2 R
N Disp1StrCre1 Strength (specify units)	decimal ${DispForm1}=4 or ${DispForm1}=3 R
N Disp2Gen1 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10

	◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO1 Please specify generic name	text ${Disp2Gen1}=100 R

N Disp2StrTab1 Strength (mg)	decimal ${DispForm1}=1 R
N Disp2StrLiq1 Strength (mg/ml)	decimal ${DispForm1}=2 R
N Disp2StrCre1 Strength (specify units)	decimal ${DispForm1}=4 or ${DispForm1}=3 R
N Disp3Gen1 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36

	◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO1 Please specify generic name	text ${Disp3Gen1}=100 R
N Disp3StrTab1 Strength (mg)	decimal ${DispForm1}=1 R
N Disp3StrLiq1 Strength (mg/ml)	decimal ${DispForm1}=2 R
N Disp3StrCre1 Strength (specify units)	decimal ${DispForm1}=4 or ${DispForm1}=3 R
N Disp4Gen1 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17

	◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO1 Please specify generic name	text ${Disp4Gen1}=100 R
N Disp4StrTab1 Strength (mg)	decimal ${DispForm1}=1 R
N Disp4StrLiq1 Strength (mg/ml)	decimal ${DispForm1}=2 R
N	decimal

Disp4StrCre1 Strength (specify units)	${DispForm1}=4 or ${DispForm1}=3 R

	N DDc1 Details of medicine 1
N DispNo1 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm1}=1 R
N DispVol1 e Volume to consume (ml)	decimal ${DispForm1}=2 R
N DispSpoon1 e Volume to consume (spoons)	decimal ${DispForm1}=2 R
N DispVolSt1 e What volume of spoon is used for strength?	decimal ${DispForm1}=2 R
N DispFreq1 f Unameza mara ngapi kwa siku	integer
N DispDur1 g Utazitumia kwa siku ngapi?	integer
N DispMore1 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa2 Details of medicine 2
N DispBrand2 a Brand name	text
N DispManu2 b Name of manufacturer	text
N DispCoun2 c Country of manufacturer	text
N DispForm2 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb2

	Details of medicine 2
N DispDosOther2 Please specify dosage form	text ${DispForm2}=4 R
N Disp1Gen2 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40

	◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO2 Please specify generic name	text ${Disp1Gen2}=100 R
N Disp1StrTab2 Strength (mg)	decimal ${DispForm2}=1 R
N Disp1StrLiq2 Strength (mg/ml)	decimal ${DispForm2}=2 R
N Disp1StrCre2 Strength (specify units)	decimal ${DispForm2}=4 or ${DispForm2}=3 R
N Disp2Gen2 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20

	◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO2 Please specify generic name	text ${Disp2Gen2}=100 R
N Disp2StrTab2 Strength (mg)	decimal ${DispForm2}=1 R
N Disp2StrLiq2 Strength (mg/ml)	decimal ${DispForm2}=2 R
N Disp2StrCre2 Strength (specify units)	decimal ${DispForm2}=4 or ${DispForm2}=3 R
N Disp3Gen2	select_one drug_list

Generic name 3	◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47

	◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO2 Please specify generic name	text ${Disp3Gen2}=100 R
N Disp3StrTab2 Strength (mg)	decimal ${DispForm2}=1 R
N Disp3StrLiq2 Strength (mg/ml)	decimal ${DispForm2}=2 R
N Disp3StrCre2 Strength (specify units)	decimal ${DispForm2}=4 or ${DispForm2}=3 R
N Disp4Gen2 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26

	◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO2 Please specify generic name	text ${Disp4Gen2}=100 R
N Disp4StrTab2 Strength (mg)	decimal ${DispForm2}=1 R
N Disp4StrLiq2 Strength (mg/ml)	decimal ${DispForm2}=2 R
N Disp4StrCre2 Strength (specify units)	decimal ${DispForm2}=4 or ${DispForm2}=3 R

	N DDc2 Details of medicine 2
N DispNo2 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm2}=1 R
N DispVol2	decimal ${DispForm2}=2 R

e Volume to consume (ml)	
N DispSpoon2 e Volume to consume (spoons)	decimal ${DispForm2}=2 R
N DispVolSt2 e What volume of spoon is used for strength?	decimal ${DispForm2}=2 R
N DispFreq2 f Unameza mara ngapi kwa siku	integer
N DispDur2 g Utazitumia kwa siku ngapi?	integer
N DispMore2 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa3 Details of medicine 3
N DispBrand3 a Brand name	text
N DispManu3 b Name of manufacturer	text
N DispCoun3 c Country of manufacturer	text
N DispForm3 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb3 Details of medicine 3
N DispDosOther3 Please specify dosage form	text ${DispForm3}=4 R
N Disp1Gen3 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4

	◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51

	◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO3 Please specify generic name	text ${Disp1Gen3}=100 R
N Disp1StrTab3 Strength (mg)	decimal ${DispForm3}=1 R
N Disp1StrLiq3 Strength (mg/ml)	decimal ${DispForm3}=2 R
N Disp1StrCre3 Strength (specify units)	decimal ${DispForm3}=4 or ${DispForm3}=3 R
N Disp2Gen3 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30

	◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO3 Please specify generic name	text ${Disp2Gen3}=100 R
N Disp2StrTab3 Strength (mg)	decimal ${DispForm3}=1 R
N Disp2StrLiq3 Strength (mg/ml)	decimal ${DispForm3}=2 R
N Disp2StrCre3 Strength (specify units)	decimal ${DispForm3}=4 or ${DispForm3}=3 R
N Disp3Gen3 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11

	◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO3 Please specify generic name	text ${Disp3Gen3}=100 R
N	decimal

Disp3StrTab3 Strength (mg)	${DispForm3}=1 R
N Disp3StrLiq3 Strength (mg/ml)	decimal ${DispForm3}=2 R
N Disp3StrCre3 Strength (specify units)	decimal ${DispForm3}=4 or ${DispForm3}=3 R
N Disp4Gen3 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37

	◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO3 Please specify generic name	text ${Disp4Gen3}=100 R
N Disp4StrTab3 Strength (mg)	decimal ${DispForm3}=1 R
N Disp4StrLiq3 Strength (mg/ml)	decimal ${DispForm3}=2 R
N Disp4StrCre3 Strength (specify units)	decimal ${DispForm3}=4 or ${DispForm3}=3 R

	N DDc3 Details of medicine 3
N DispNo3 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm3}=1 R
N DispVol3 e Volume to consume (ml)	decimal ${DispForm3}=2 R
N DispSpoon3 e Volume to consume (spoons)	decimal ${DispForm3}=2 R
N DispVolSt4 e What volume of spoon is used for strength?	decimal ${DispForm3}=2 R
N DispFreq3 f Unameza mara ngapi kwa siku	integer
N	integer

DispDur3 g Utazitumia kwa siku ngapi?	
N DispMore3 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa4 Details of medicine 4
N DispBrand4 a Brand name	text
N DispManu4 b Name of manufacturer	text
N DispCoun4 c Country of manufacturer	text
N DispForm4 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb4 Details of medicine 4
N DispDosOther4 Please specify dosage form	text ${DispForm4}=4 R
N Disp1Gen4 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16

	◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO4 Please specify generic name	text ${Disp1Gen4}=100 R [ ]
N Disp1StrTab4 Strength (mg)	decimal ${DispForm4}=1 R
N Disp1StrLiq4 Strength (mg/ml)	decimal ${DispForm4}=2 R

N Disp1StrCre4 Strength (specify units)	decimal ${DispForm4}=4 or ${DispForm4}=3 R
N Disp2Gen4 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42

	◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO4 Please specify generic name	text ${Disp2Gen4}=100 R
N Disp2StrTab4 Strength (mg)	decimal ${DispForm4}=1 R
N Disp2StrLiq4 Strength (mg/ml)	decimal ${DispForm4}=2 R
N Disp2StrCre4 Strength (specify units)	decimal ${DispForm4}=4 or ${DispForm4}=3 R
N Disp3Gen4 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22

	◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO4 Please specify generic name	text ${Disp3Gen4}=100 R
N Disp3StrTab4 Strength (mg)	decimal ${DispForm4}=1 R
N Disp3StrLiq4 Strength (mg/ml)	decimal ${DispForm4}=2 R
N Disp3StrCre4 Strength (specify units)	decimal ${DispForm4}=4 or ${DispForm4}=3 R
N Disp4Gen4 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1

	◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49

	◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO4 Please specify generic name	text ${Disp4Gen4}=100 R
N Disp4StrTab4 Strength (mg)	decimal ${DispForm4}=1 R
N Disp4StrLiq4 Strength (mg/ml)	decimal ${DispForm4}=2 R
N Disp4StrCre4 Strength (specify units)	decimal ${DispForm4}=4 or ${DispForm4}=3 R

	N DDc4 Details of medicine 4
N DispNo4 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm4}=1 R
N DispVol4 e Volume to consume (ml)	decimal ${DispForm4}=2 R
N DispSpoon4 e Volume to consume (spoons)	decimal ${DispForm4}=2 R
N DispVolSt4 e What volume of spoon is used for strength?	decimal ${DispForm4}=2 R
N DispFreq4 f Unameza mara ngapi kwa siku	integer
N DispDur4 g Utazitumia kwa siku ngapi?	integer
N DispMore4 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa5 Details of medicine 5
N DispBrand5	text

a Brand name	
N DispManu5 b Name of manufacturer	text
N DispCoun5 c Country of manufacturer	text
N DispForm5 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb5 Details of medicine 5
N DispDosOther5 Please specify dosage form	text ${DispForm5}=4 R
N Disp1Gen5 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25

	◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO5 Please specify generic name	text ${Disp1Gen5}=100 R
N Disp1StrTab5 Strength (mg)	decimal ${DispForm5}=1 R
N Disp1StrLiq5 Strength (mg/ml)	decimal ${DispForm5}=2 R
N Disp1StrCre5 Strength (specify units)	decimal ${DispForm5}=4 or ${DispForm5}=3 R
N Disp2Gen5 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5

	◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51

	◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO5 Please specify generic name	text ${Disp2Gen5}=100 R
N Disp2StrTab5 Strength (mg)	decimal ${DispForm5}=1 R
N Disp2StrLiq5 Strength (mg/ml)	decimal ${DispForm5}=2 R
N Disp2StrCre5 Strength (specify units)	decimal ${DispForm5}=4 or ${DispForm5}=3 R
N Disp3Gen5 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30

	◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO5 Please specify generic name	text ${Disp3Gen5}=100 R
N Disp3StrTab5 Strength (mg)	decimal ${DispForm5}=1 R
N Disp3StrLiq5 Strength (mg/ml)	decimal ${DispForm5}=2 R
N Disp3StrCre5 Strength (specify units)	decimal ${DispForm5}=4 or ${DispForm5}=3 R
N Disp4Gen5 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11

	◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO5 Please specify generic name	text ${Disp4Gen5}=100 R
N	decimal

Disp4StrTab5 Strength (mg)	${DispForm5}=1 R
N Disp4StrLiq5 Strength (mg/ml)	decimal ${DispForm5}=2 R
N Disp4StrCre5 Strength (specify units)	decimal ${DispForm5}=4 or ${DispForm5}=3 R

	N DDc5 Details of medicine 5
N DispNo5 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm5}=1 R
N DispVol5 e Volume to consume (ml)	decimal ${DispForm5}=2 R
N DispSpoon5 e Volume to consume (spoons)	decimal ${DispForm5}=2 R
N DispVolSt5 e What volume of spoon is used for strength?	decimal ${DispForm5}=2 R
N DispFreq5 f Unameza mara ngapi kwa siku	integer
N DispDur5 g Utazitumia kwa siku ngapi?	integer
N DispMore5 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa6 Details of medicine 6
N DispBrand6 a Brand name	text
N DispManu6 b Name of manufacturer	text
N DispCoun6 c Country of manufacturer	text
N DispForm6	select_one dosage_list

d Dosage form	◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb6 Details of medicine 6
N DispDosOther6 Please specify dosage form	text ${DispForm6}=4 R
N Disp1Gen6 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33

	◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenOg Please specify generic name	text ${Disp1Gen6}=100 R
N Disp1StrTab6 Strength (mg)	decimal ${DispForm6}=1 R
N Disp1StrLiq6 Strength (mg/ml)	decimal ${DispForm6}=2 R
N Disp1StrCre6 Strength (specify units)	decimal ${DispForm6}=4 or ${DispForm6}=3 R
N Disp2Gen6 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14

	◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO6 Please specify generic name	text ${Disp2Gen6}=100 R
N Disp2StrTab6 Strength (mg)	decimal ${DispForm6}=1 R
N	decimal

Disp2StrLiq6 Strength (mg/ml)	${DispForm6}=2 R
N Disp2StrCre6 Strength (specify units)	decimal ${DispForm6}=4 or ${DispForm6}=3 R
N Disp3Gen6 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40

	◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO6 Please specify generic name	text ${Disp3Gen6}=100 R
N Disp3StrTab6 Strength (mg)	decimal ${DispForm6}=1 R
N Disp3StrLiq6 Strength (mg/ml)	decimal ${DispForm6}=2 R
N Disp3StrCre6 Strength (specify units)	decimal ${DispForm6}=4 or ${DispForm6}=3 R
N Disp4Gen6 Generic name 4	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20

	◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp4GenO6 Please specify generic name	text ${Disp4Gen6}=100 R
N Disp4StrTab6 Strength (mg)	decimal ${DispForm6}=1 R
N Disp4StrLiq6 Strength (mg/ml)	decimal ${DispForm6}=2 R
N Disp4StrCre6 Strength (specify units)	decimal ${DispForm6}=4 or ${DispForm6}=3 R

	N

	DDc6 Details of medicine 6
N DispNo6 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm6}=1 R
N DispVol6 e Volume to consume (ml)	decimal ${DispForm6}=2 R
N DispSpoon6 e Volume to consume (spoons)	decimal ${DispForm6}=2 R
N DispVolSt6 e What volume of spoon is used for strength?	decimal ${DispForm6}=2 R
N DispFreq6 f Unameza mara ngapi kwa siku	integer
N DispDur6 g Utazitumia kwa siku ngapi?	integer
N DispMore6 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa7 Details of medicine 7
N DispBrand7 a Brand name	text
N DispManu7 b Name of manufacturer	text
N DispCoun7 c Country of manufacturer	text
N DispForm7 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb7 Details of medicine 7
N DispDosOther7 Please specify dosage form	text ${DispForm7}=4 R

N Disp1Gen7 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44

	◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO7 Please specify generic name	text ${Disp1Gen7}=100 R
N Disp1StrTab7 Strength (mg)	decimal ${DispForm7}=1 R
N Disp1StrLiq7 Strength (mg/ml)	decimal ${DispForm7}=2 R
N Disp1StrCre7 Strength (specify units)	decimal ${DispForm7}=4 or ${DispForm7}=3 R
N Disp2Gen7 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23

	◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO7 Please specify generic name	text ${Disp2Gen7}=100 R
N Disp2StrTab7 Strength (mg)	decimal ${DispForm7}=1 R
N Disp2StrLiq7 Strength (mg/ml)	decimal ${DispForm7}=2 R
N Disp2StrCre7 Strength (specify units)	decimal ${DispForm7}=4 or ${DispForm7}=3 R
N Disp3Gen7 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3

	◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51

	◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO7 Please specify generic name	text ${Disp3Gen7}=100 R
N Disp3StrTab7 Strength (mg)	decimal ${DispForm7}=1 R
N Disp3StrLiq7 Strength (mg/ml)	decimal ${DispForm7}=2 R
N Disp3StrCre7 Strength (specify units)	decimal ${DispForm7}=4 or ${DispForm7}=3 R

	N DDc7 Details of medicine 7
N DispNo7 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm7}=1 R
N DispVol7 e Volume to consume (ml)	decimal ${DispForm7}=2 R
N DispVolSt7 e What volume of spoon is used for strength?	decimal ${DispForm7}=2 R
N DispFreq7 f Unameza mara ngapi kwa siku	integer
N DispDur7 g Utazitumia kwa siku ngapi?	integer
N DispMore7 h Kuna dawa nyingine ambazo ulipewa?	select_one yes_no ◯ Yes 1 ◯ No 2

	N DDa8 Details of medicine 8
N DispBrand8 a Brand name	text
N DispManu8 b Name of manufacturer	text
N	text

DispCoun8 c Country of manufacturer	
N DispForm8 d Dosage form	select_one dosage_list ◯ Tablet/pill/capsule 1 ◯ Liquid/syrup/drink 2 ◯ Cream/topical preparation 3 ◯ Other, specify 4

	N DDb8 Details of medicine 8
N DispDosOther8 Please specify dosage form	text ${DispForm8}=4 R
N Disp1Gen8 Generic name 1	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30

	◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp1GenO8 Please specify generic name	text ${Disp1Gen8}=100 R
N Disp1StrTab8 Strength (mg)	decimal ${DispForm8}=1 R
N Disp1StrLiq8 Strength (mg/ml)	decimal ${DispForm8}=2 R
N Disp1StrCre8 Strength (specify units)	decimal ${DispForm8}=4 or ${DispForm8}=3 R
N Disp2Gen8 Generic name 2	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11

	◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp2GenO8 Please specify generic name	text ${Disp2Gen8}=100 R
N	decimal

Disp2StrTab8 Strength (mg)	${DispForm8}=1 R
N Disp2StrLiq8 Strength (mg/ml)	decimal ${DispForm8}=2 R
N Disp2StrCre8 Strength (specify units)	decimal ${DispForm8}=4 or ${DispForm8}=3 R
N Disp3Gen8 Generic name 3	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37

	◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Disp3GenO8 Please specify generic name	text ${Disp3Gen8}=100 R
N Disp3StrTab8 Strength (mg)	decimal ${DispForm8}=1 R
N Disp3StrLiq8 Strength (mg/ml)	decimal ${DispForm8}=2 R
N Disp3StrCre8 Strength (specify units)	decimal ${DispForm8}=4 or ${DispForm8}=3 R

	N DDc8 Details of medicine 8
N DispNo8 e Number of pills/tablets/capsules to take at a time	decimal ${DispForm8}=1 R
N DispVol8 e Volume to consume (ml)	decimal ${DispForm8}=2 R
N DispVolSt8 e What volume of spoon is used for strength?	decimal ${DispForm8}=2 R
N DispFreq8 f Unameza mara ngapi kwa siku	integer
N DispDur8 g Utazitumia kwa siku ngapi?	integer

N DispMore8 h Any more medicines dispensed? If yes give details in notes	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres1Detail ${Prescribed}=1 R 46i Please give details of medicines prescribed but not dispensed
N Pres1Name a Name	text
N Pres1Dose b Dosage	text
N Pres1Freq c Frequency	text
N Pres1Dur d Duration	text
N Pres1Reason e Reason not dispensed	text
N Pres1Price f Price if known	integer
N Pres1More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres2Detail ${Pres1More}=1 R 46ii Please give details of medicines prescribed but not dispensed
N Pres2Name a Name	text
N Pres2Dose b Dosage	text
N Pres2Freq c Frequency	text
N Pres2Dur d Duration	text

N Pres2Reason e Reason not dispensed	text
N Pres2Price f Price if known	integer
N Pres2More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres3Detail ${Pres2More}=1 R 46iii Please give details of medicines prescribed but not dispensed
N Pres3Name a Name	text
N Pres3Dose b Dosage	text
N Pres3Freq c Frequency	text
N Pres3Dur d Duration	text
N Pres3Reason e Reason not dispensed	text
N Pres3Price f Price if known	integer
N Pres3More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres4Detail ${Pres3More}=1 R 46iv Please give details of medicines prescribed but not dispensed
N Pres4Name a Name	text
N Pres4Dose b Dosage	text

N Pres4Freq c Frequency	text
N Pres4Dur d Duration	text
N Pres4Reason e Reason not dispensed	text
N Pres4Price f Price if known	integer
N Pres4More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres5Detail ${Pres4More}=1 R 46v Please give details of medicines prescribed but not dispensed
N Pres5Name a Name	text
N Pres5Dose b Dosage	text
N Pres5Freq c Frequency	text
N Pres5Dur d Duration	text
N Pres5Reason e Reason not dispensed	text
N Pres5Price f Price if known	integer
N Pres5More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres6Detail ${Pres5More}=1 R 46vi Please give details of medicines prescribed but not dispensed

N Pres6Name a Name	text
N Pres6Dose b Dosage	text
N Pres6Freq c Frequency	text
N Pres6Dur d Duration	text
N Pres6Reason e Reason not dispensed	text
N Pres6Price f Price if known	integer
N Pres6More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres7Detail ${Pres6More}=1 R 46vii Please give details of medicines prescribed but not dispensed
N Pres7Name a Name	text
N Pres7Dose b Dosage	text
N Pres7Freq c Frequency	text
N Pres7Dur d Duration	text
N Pres7Reason e Reason not dispensed	text
N Pres7Price f Price if known	integer
N Pres7More g Were any more medicines prescribed but not dispensed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Pres8Detail ${Pres7More}=1 R 46viii Please give details of medicines prescribed but not dispensed
N Pres8Name a Name	text
N Pres8Dose b Dosage	text
N Pres8Freq c Frequency	text
N Pres8Dur d Duration	text
N Pres8Reason e Reason not dispensed	text
N Pres8Price f Price if known	integer
N Pres8More g Were any more medicines prescribed but not dispensed? If yes, please add in notes section	select_one yes_no ◯ Yes 1 ◯ No 2

	N Inj1Detail ${Injections}=1 R 47i Please give details of injection prescribed
N Inj1Brand a Brand name	text
N Inj1Gen b Generic name	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11

	◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31 ◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Inj1Other c Please specify generic name	text ${Inj1Gen}=100 R
N	integer

Inj1Price d Price if known	
N Inj1More e Were any more injections prescribed?	select_one yes_no ◯ Yes 1 ◯ No 2

	N Inj2Detail ${Inj1More}=1 R 47ii Please give details of injection prescribed
N Inj2Brand a Brand name	text
N Inj2Gen b Generic name	select_one drug_list ◯ herbal (no need to list herbs) 0 ◯ aceclofenac 1 ◯ albendazole 2 ◯ aminophylline 3 ◯ ammonium chloride 4 ◯ amodiaquine 5 ◯ amoxicillin 6 ◯ ampicillin 7 ◯ artemether 8 ◯ artemisinin 9 ◯ aspirin 10 ◯ azithromycin 11 ◯ benzylpenicillin 12 ◯ bromhexine hydrochloride 13 ◯ cefadroxil 14 ◯ cephalexin 15 ◯ cephalexin monohydrate 16 ◯ cetirizine 17 ◯ cetirizine hydrochloride 18 ◯ chlorpheniramine hydrobromide 19 ◯ chlorpheniramine maleate 20 ◯ ciprofloxacin 21 ◯ clarithromycin 22 ◯ clavulanic acid/clavulanate potassium 23 ◯ cloxacillin 24 ◯ codeine phospohate 25 ◯ dextromethorphan hydrobromide 26 ◯ diclofenac sodium 27 ◯ dihyrdoartemisinin 28 ◯ diphenhydramine 29 ◯ doxycycline 30 ◯ erythromycin 31

	◯ erythromycin stearate 32 ◯ flucloxacillin 33 ◯ gentamicin 34 ◯ guaiphenesin 35 ◯ ibuprofen 36 ◯ loratadine 37 ◯ lumefantrine 38 ◯ metronidazole 39 ◯ paracetamol 40 ◯ penicillin 41 ◯ piperaquine 42 ◯ potassium clavulanate 43 ◯ praziquantel 44 ◯ prednisolone 45 ◯ pyrimethamin 46 ◯ quinine 47 ◯ salbutamol 48 ◯ sulfadoxine 49 ◯ sulfamethoxazole 50 ◯ tarbutaline sulphate 51 ◯ trimethoprim 52 ◯ Other, specify 100
N Inj2Other c Please specify generic name	text ${Inj2Gen}=100 R
N Inj2Price d Price if known	integer
N Inj2More g Were any more injections prescribed? If yes, please give details in notes	select_one yes_no ◯ Yes 1 ◯ No 2

	N InhalerDetail ${Inhaler}=1 R 48 Inhaler
N InhalerBrand a Brand name of inhaler	text
N InhalerGen b Generic name of inhaler	select_one inhaler_list ◯ salbutamol 1 ◯ Other, specify 2
N InhalerOther c Please specify generic name of inhaler	text ${InhalerGen}Sta=2 R
N	text

InhalerAdvice d What advice were you given about taking the inhaler (if any)?	
N OtherDetail 49 Please give details of other treatment(s) suggested/offered	text ${OtherTreat}=1 R
N OwnRDT 50 You have reported a positive test for malaria. Please do an RDT with your supervisor as soon as possible and report the result here	select_one rdt_list selected(${MRDTr}, '2') or selected(${MBSr}, '2') R ◯ Negative 1 ◯ Positive 2 ◯ Test not done as malaria confirmed and treated within last two weeks 3 ◯ Test not done as negative RDT with supervisor yesterday 4
N notes 51 Notes	text
N end END	note

Facility survey tool

N InterviewerCode 1 Interviewer code	integer
N FacilityName 2 Name of facility	text
N FacilityCode 3 Facility code	integer
N DistrictCode 4 District code	integer
N NameInC 5 What is your name?	text
N RoleInC 6 What is your role in the facility?	select_one facility_role ◯ In-charge, clinician 1 ◯ In-charge, non-clinician 2 ◯ Deputy/duty in-charge, clinician 3 ◯ Deputy/duty in-charge, non-clinician 4 ◯ Other, clinician 5 ◯ Other, non-clinician 6
N FacilityType 7 First I'd like to ask some background questions about the facility. Is this facility private commercial, mission or NGO?	select_one facility_type ◯ Private commercial 1 ◯ Mission 2 ◯ NGO 3 ◯ Other 4 ◯ Don't know 99
N TypeOther Please specify how the facility is owned	text ${FacilityType}=4 R
N OtherFacilities 8 Does the owner of this facility own any other dispensaries, health centres or hospitals?	select_one yes_no_dk ${FacilityType}!=3 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N NumberOwned 9 How many?	integer ${OtherFacilities}=1 R
N FBOOwner 10 Which religious denomination owns this facility ?	select_one fbo_list ◯ Christian, catholic 1 ◯ Christian, protestant 2 ◯ Christian, denomination not specified 3 ◯ Muslim 4

	◯ Other religion, specify 5 ◯ Don't know 99
N FBOOther Please specify the religion	text ${FBOOwner}=5 R
N NGOOwner 11 Does the NGO that owns this facility own any other dispensaries, health centres or hospitals?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N NumberOwnedNGO 12 How many?	integer ${NGOOwner}=1 R
N FacilityLevel 13 What is the level of the facility?	select_one levels ◯ Dispensary 1 ◯ Health centre 2 ◯ Hospital 3 ◯ Designated district hospital (DDH) 4 ◯ Other, specify 5 ◯ Don't know 99
N LevelOther Please specify facility level	text ${FacilityLevel}=5 R
N APHFTA 14 Are you part of APHFTA?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N CSSC 15 Are you part of CSSC?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N OpenHours 16 Is the facility open 24 hours a day, 7 days a week?	select_one yes_no ◯ Yes 1 ◯ No 2
N GovStaff 17 Is anyone who works here paid by the government?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N YearFounded 18 In which year was the facility founded here? *If Don't Know enter 9999*	integer
N BRNVisit 19 Has the facility had a visit from BRN/Big Results Now in the last two years?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99

N BRNNum 20 How many visits have you had from BRN in the last two years? *If Don't Know enter 99*	integer
N BRNDate 21 When was the last visit from BRN?	date Month: Year:
N BRNQIP 22 Did you receive a QIP/quality improvement plan from BRN?- can I see it?	select_one seen_list ◯ Yes, seen 1 ◯ Yes, not seen 2 ◯ No 3 ◯ Don't know 99
N MOHVisit 23 Has the facility had a visit from Ministry of Health (MoH) in the last two years, other than for BRN?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N MOHDate 24 When was the last visit from MOH, other than for BRN?	date ${MOHVisit}=1 R Month: Year:
N MOHReason 25 Why did they come?	text ${MOHVisit}=1 R
N FacilitiesNear 26 Are there any other facilities - dispensaries, health centres or hospitals, but not drugstores or referral hospitals - within about 2km of here?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N NumberGov 27 How many of those are of each of the following types…. Government? *If Don't Know enter 99*	integer
N NumberFBO 28 … faith-based or not-for-profit? *If Don't Know enter 99*	integer
N NumberPFP 29 … private for profit? *If Don't Know enter 99*	integer
N NumberDK 30 …another type or don't know the type? *If Don't Know enter 99*	integer

N KaiZen 31 Is the facility part of the following programmes…. Kai Sen / Five S?	select_one yes_no ◯ Yes 1 ◯ No 2
N KaiZenPast 32 Has it been in the past?	select_one yes_no_dk ${KaiZen}=2 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N PSI 33 … Familia/PSI/Population Services International?	select_one yes_no ◯ Yes 1 ◯ No 2
N PSIPast 34 Has it been in the past?	select_one yes_no_dk ${PSI}=2 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N MSI 35 … BlueStar/MSI/Marie Stopes International	select_one yes_no ◯ Yes 1 ◯ No 2
N MSIPast 36 Has it been in the past?	select_one yes_no_dk ${MSI}=2 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N AMF 37 … Afya Microfinance?	select_one yes_no ◯ Yes 1 ◯ No 2
N AMFPast 38 Has it been in the past?	select_one yes_no_dk ${AMF}=2 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N RBF 39 … RBF/Results Based Financing?	select_one yes_no ◯ Yes 1 ◯ No 2
N RBFPast 40 Has it been in the past?	select_one yes_no_dk ${RBF}=2 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N DKT 41 … DKT/Trust?	select_one yes_no ◯ Yes 1 ◯ No 2
N DKTPast	select_one yes_no_dk ${DKT}=2 R

42 Has it been in the past?	◯ Yes 1 ◯ No 2 ◯ Don't know 99
N OtherProgram 43 Is this facility part of any other programmes to improve quality, or increase the scope of services provided?	select_one yes_no ◯ Yes 1 ◯ No 2
N OtherProgramName Which program(s)?	text ${OtherProgram}=1 R
N ControlSCA 44 Have you recieved an assessment by the SafeCare programme?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N ControlQIP 45 Have you received a QIP from SafeCare?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N SeniorClinician 46 What is the qualification of the most senior clinician who is employed here (not a visiting consultant)?	select_one clinician_list ◯ Doctor/Physician/Medical Officer 1 ◯ Assistant Medical Officer/AMO 2 ◯ Clinical Officer/CO 3 ◯ Nurse/midwife 4 ◯ Other, specify 5
N OtherCadre Please specify qualification	text ${SeniorClinician}=5 R
N InCharge 47 Is the most senior clinician (mentioned above) in charge of the management of the facility, or is there an administrative/non-clinical manager who oversees the running of the facility? Or is the responsibility shared by a clinician and non-clinician?	select_one incharge_list ◯ Senior clinician is the in-charge 1 ◯ Other clinican is the in-charge 2 ◯ Administrator/non-clinician is the in-charge 3 ◯ Responsibility shared by clinician and non-clinician 4 ◯ Don't know 99
N Loan1 48 Has the facility received any loans in the last two years?	select_one yes_no_dk ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N LoanSource1 49 What was the source of the loan?	text
N LoanValue1 50 What was the total value of the loan in shillings? *If Don't Know enter 9999*	integer
N	decimal

LoanInterest1 51 What is the interest rate of the loan? *If Don't Know enter 99*	
N LoanDate1 52 When did you take out the loan?	date Month: Year:
N LoanYears1 53 What is the period of the loan?... Years *If Zero Years enter 0. If Don't Know enter 99*	integer
N LoanMonths1 54 .. And months? *If Zero Months enter 0. If Don't Know enter 99*	integer
N LoanPurpose1 55 What was the purpose of the loan? *Tick all that apply*	select_multiple purpose_list ☐ Infrastructure/renovations 1 ☐ Medical equipment 2 ☐ Other equipment/assets 3 ☐ Stock of medicines/medical supplies 4 ☐ Other operating expenses 5
N Loan2 56 Has the facility received any other loans in the last two years?	select_one yes_no_dk ${Loan1}=1 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N LoanSource2 57 What was the source of the loan?	text
N LoanValue2 58 What was the total value of the loan in shillings? *If Don't Know enter 9999*	integer
N LoanInterest2 59 What is the interest rate of the loan? *If Don't Know enter 99*	decimal
N LoanDate2 60 When did you take out the loan?	date Month: Year:
N LoanYears2 61 What is the period of the loan?... Years *If Zero Years enter 0. If Don't Know enter 99*	integer
N LoanMonths2	integer

62 .. And months? *If Zero Months enter 0. If Don't Know enter 99*	
N LoanPurpose2 63 What was the purpose of the loan? *Tick all that apply*	select_multiple purpose_list ☐ Infrastructure/renovations 1 ☐ Medical equipment 2 ☐ Other equipment/assets 3 ☐ Stock of medicines/medical supplies 4 ☐ Other operating expenses 5
N Loan3 64 Has the facility received any other loans in the last two years?	select_one yes_no_dk ${Loan2}=1 R ◯ Yes 1 ◯ No 2 ◯ Don't know 99
N LoanSource3 65 What was the source of the loan?	text
N LoanValue3 66 What was the total value of the loan in shillings? *If Don't Know enter 9999*	integer
N LoanInterest3 67 What is the interest rate of the loan? *If Don't Know enter 99*	decimal
N LoanDate3 68 When did you take out the loan?	date Month: Year:
N LoanYears3 69 What is the period of the loan?... Years *If Zero Years enter 0. If Don't Know enter 99*	integer
N LoanMonths3 70 .. And months? *If Zero Months enter 0. If Don't Know enter 99*	integer
N LoanPurpose3 71 What was the purpose of the loan? *Tick all that apply*	select_multiple purpose_list ☐ Infrastructure/renovations 1 ☐ Medical equipment 2 ☐ Other equipment/assets 3 ☐ Stock of medicines/medical supplies 4 ☐ Other operating expenses 5
N Loan4 72 Has the facility received any other loans in the last two years?	select_one yes_no_dk ${Loan3}=1 R

	◯ Yes 1 ◯ No 2 ◯ Don't know 99
N LoanSource4 73 What was the source of the loan?	text
N LoanValue4 74 What was the total value of the loan in shillings? *If Don't Know enter 9999*	integer
N LoanInterest4 75 What is the interest rate of the loan? *If Don't Know enter 99*	decimal
N LoanDate4 76 When did you take out the loan?	date Month: Year:
N LoanYears4 77 What is the period of the loan?... Years *If Zero Years enter 0. If Don't Know enter 99*	integer
N LoanMonths4 78 .. And months? *If Zero Months enter 0. If Don't Know enter 99*	integer
N LoanPurpose4 79 What was the purpose of the loan? *Tick all that apply*	select_multiple purpose_list ☐ Infrastructure/renovations 1 ☐ Medical equipment 2 ☐ Other equipment/assets 3 ☐ Stock of medicines/medical supplies 4 ☐ Other operating expenses 5
N triageask 80 Now I'd like to ask a few questions about the way the facility is run and managed. Does the facility have a triage system – a system in which every patient who enters the facility is assessed (their vitals) whether they need to be seen urgently? Who does this check ?	select_one triage_list ◯ Yes, assessed by health professional (e.g. nurse) 1 ◯ Yes, but assessed by unqualified person (e.g. receptionist) 2 ◯ No triage system 3
N recordsask 81 Do you use patient records? These are files containing the medical history of a patient that do not leave the health facility. Are there patients who you don't create a patient record for? Please explain.	select_one records_list ◯ Patient record for all patients 1 ◯ Patient record for some patients 2 ◯ No patient records system 3
N mtuhaask 82 Do you submit information on patient cases to MTUHA – the government's health management information system?	select_one yes_no ◯ Yes 1 ◯ No 2

N patindsask 83 Do you monitor any patient indicators at this facility other than those submitted to MTUHA By patient indicators, I mean numbers which you measure to tell you something about whether the facility is providing quality services. For example, you might monitor the number of women referred to PMTCT. If you do monitor them, how many do you monitor? Can you give examples?	select_one kpi_no ◯ 1-2 patient indicators 1 ◯ 3-9 patient indicators 2 ◯ 10+ patient indicators 3 ◯ No patient indicators 4
N freqpatindsask 84 Do you regularly produce a report reviewing these patient indicators? By report, I mean a document in which you have tables or graphs to help your team review the performance of this facility. How frequently do you produce these reports?	select_one freq ${patindsask}!=4 R ◯ Yearly 1 ◯ Quarterly 2 ◯ Monthly 3 ◯ Weekly 4 ◯ Never 5
N busindsask 85 Do you monitor any business performance indicators at this facility? For example, you might monitor the income from NHIF or cash patients. These are numbers which tell you about the business performance of the facility. If you do monitor them, how many do you monitor? Can you give examples?	select_one kpibusiness_no ◯ 1-2 business indicators 1 ◯ 3-9 business indicators 2 ◯ 10+ business indicators 3 ◯ No business indicators 4
N freqbusindsask 86 Do you regularly produce a report reviewing these business performance indicators? How frequently do you produce this report?	select_one freq ${busindsask}!=4 R ◯ Yearly 1 ◯ Quarterly 2 ◯ Monthly 3 ◯ Weekly 4 ◯ Never 5
N targetask 87 Do you set targets for this facility to achieve? By targets, I mean specific numerical or quantitative goals which you aim for the facility to reach in the future. What kind of targets do you set – can you give examples? Over what period of time are the targets set?	select_one target_list ${patindsask}!=4 or ${busindsask}!=4 or ${mtuhaask}!=2 R ◯ Main focus is on short term (up to one year) targets 1 ◯ Main focus is on long term (over one year) targets 2 ◯ Combination of short-term and long-term targets 3 ◯ No targets 4
N trainask 88 Do you have a training plan in place to improve the skills of your health workers going forward? How many years does this plan cover?	select_one train_list ◯ Long term plan (more than one year) in place 1 ◯ Short term plan (one year or less) in place 2 ◯ No training plan in place 3
N payask 89 Do healthcare workers in the OPD receive a fixed monthly salary? Or does the salary vary from month to month based on facility or individual performance? If yes, can you explain further?	select_multiple pay_list ☐ Fixed monthly salary 1 ☐ Share of facility revenue 2 ☐ Bonus based on targets of patient

Tick all that apply	numbers 3 ☐ Bonus based on other measures of performance 4
N appraisalask 90 Do you have any formal system to appraise the performance of healthcare workers? For example, in the government sector they use an appraisal system called OPLUS.	select_one appraisal_list ◯ Formal appraisal system exists 1 ◯ No formal and regular appraisal system 2
N inventask 91 Do you keep an inventory of your drug stock? That is, do you physically count how many of each drug you have from time to time? How often do you carry out an inventory of your stock?	select_one invent_freq ◯ Every quarter or more frequently 1 ◯ Every six months 2 ◯ Every year 3 ◯ No inventory 4
N budgetask 92 Do you have an annual budget of the likely costs the health facility will face over the next year?	select_one yes_no ◯ Yes 1 ◯ No 2
N profitask 93 Do you produce an annual statement of the facility revenue and expenditure? *Probe by asking about profit and loss statement*	select_one yes_no ◯ Yes 1 ◯ No 2
N OPD_present 94 Now I'd like to ask about how many patients of different types the facility treats. We are only interested in the number of patients, not the names of patients. If possible, I'd like to copy these numbers from your MTUHA records or original registers, to make sure the numbers are as precise as possible. Firstly do you have the following ... OPD (outpatient department)?	select_one yes_no ◯ Yes 1 ◯ No 2
N IPD_present 95 IPD (inpatient department)	select_one yes_no ◯ Yes 1 ◯ No 2
N CTC_present 96 CTC/HIV clinic	select_one yes_no ◯ Yes 1 ◯ No 2
N TB_present 97 TB clinic	select_one yes_no ◯ Yes 1 ◯ No 2
N ANC_present 98 Antenatal care clinic	select_one yes_no ◯ Yes 1 ◯ No 2
N Del_present 99 Labour room or birth centre	select_one yes_no ◯ Yes 1 ◯ No 2
N Fam_present 100 Family planning clinic	select_one yes_no ◯ Yes 1 ◯ No 2
N	select_one yes_no

Dia_present 101 Diabetes clinic	◯ Yes 1 ◯ No 2
N CTC_visits 102 Are visits in the CTC/HIV clinic recorded separately from OPD visits?	select_one yes_no ${CTC_present}=1 R ◯ Yes 1 ◯ No 2
N TB_visits 103 Are visits in the TB clinic recorded separately from OPD visits?	select_one yes_no ${TB_present}=1 R ◯ Yes 1 ◯ No 2
N Dia_visits 104 Are visits in the diabetes clinic recorded separately from OPD visits?	select_one yes_no ${Dia_present}=1 R ◯ Yes 1 ◯ No 2

	N opdpage1 OPD Month 1
N OPDmonth 105 OPD visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N OPD1 106 How many outpatient visits did you receive in [Month 1]? This number should include children and adults, first visits and revisits *If Don't Know enter 9999*	integer
N OPD1Source 107 (Give source of data)	select_one source_list ${OPD1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N opdpage2 OPD Month 2
N OPD2 108 How many outpatient visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N OPD2Source 109 (Give source of data)	select_one source_list ${OPD2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N opdpage3 OPD Month 3
N OPD3 110 How many outpatient visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N OPD3Source 111 (Give source of data)	select_one source_list ${OPD3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ipdpage1 IPD Month 1
N IPDmonth 112 IPD visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N IPD1 113 How many inpatient visits did you receive in [Month 1]? This number should include children and adults *If Don't Know enter 9999*	integer
N IPD1Source 114 (Give source of data)	select_one source_list ${IPD1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ipdpage2 IPD Month 2
N IPD2 115 How many inpatient visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N IPD2Source 116 (Give source of data)	select_one source_list ${IPD2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ipdpage3 IPD Month 3

N IPD3 117 How many inpatient visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N IPD3Source 118 (Give source of data)	select_one source_list ${IPD3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ctcpage1 CTC Month 1
N CTCmonth 119 CTC / HIV visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N CTC1 120 How many CTC / HIV clinic visits did you receive in [Month 1]? *Include all types of visits such as those for HIV tests and treatment. If Don't Know enter 9999*	integer
N CTC1Source 121 (Give source of data)	select_one source_list ${CTC1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ctcpage2 CTC Month 2
N CTC2 122 How many CTC / HIV clinic visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N CTC2Source 123 (Give source of data)	select_one source_list ${CTC2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ctcpage3 CTC Month 3
N CTC3	integer

124 How many CTC / HIV clinic visits did you receive in [Month 3]? *If Don't Know enter 9999*	
N CTC3Source 125 (Give source of data)	select_one source_list ${CTC3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N tbpage1 TB Month 1
N TB_month 126 TB visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N TB_1 127 How many TB clinic visits did you receive in [Month 1]? *If Don't Know enter 9999*	integer
N TB_1Source 128 (Give source of data)	select_one source_list ${TB_1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N tbpage2 TB Month 2
N TB_2 129 How many TB clinic visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N TB_2Source 130 (Give source of data)	select_one source_list ${TB_2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N tbpage3 TB Month 3
N TB_3 131 How many TB clinic visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N	select_one source_list

TB_3Source 132 (Give source of data)	${TB_3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ancpage1 ANC Month 1
N ANCmonth 133 ANC visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N ANC1 134 How many ANC clinic visits did you receive in [Month 1]? *If Don't Know enter 9999*	integer
N ANC1Source 135 (Give source of data)	select_one source_list ${ANC1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ancpage2 ANC Month 2
N ANC2 136 How many ANC clinic visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N ANC2Source 137 (Give source of data)	select_one source_list ${ANC2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N ancpage3 ANC Month 3
N ANC3 138 How many ANC clinic visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N ANC3Source 139 (Give source of data)	select_one source_list ${ANC3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N delpage1 DEL Month 1
N Delmonth 140 Deliveries [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N Del1 141 How many visits for deliveries did you receive in [Month 1]? *If Don't Know enter 9999*	integer
N Del1Source 142 (Give source of data)	select_one source_list ${Del1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N delpage2 DEL Month 2
N Del2 143 How many visits for deliveries did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N Del2Source 144 (Give source of data)	select_one source_list ${Del2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N delpage3 DEL Month 3
N Del3 145 How many visits for deliveries did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N Del3Source 146 (Give source of data)	select_one source_list ${Del3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

N deliveries_inpatients	select_one yes_no ${IPD_present}=1 R

147 Are these deliveries also included in the inpatient records?	◯ Yes 1 ◯ No 2

	N fppage1 FP Month 1
N Fammonth 148 Family planning visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N Fam1 149 How many family planning clinic visits did you receive in [Month 1]? *If Don't Know enter 9999*	integer
N Fam1Source 150 (Give source of data)	select_one source_list ${Fam1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N fppage2 FP Month 2
N Fam2 151 How many family planning clinic visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N Fam2Source 152 (Give source of data)	select_one source_list ${Fam2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N fppage3 FP Month 3
N Fam3 153 How many family planning clinic visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N Fam3Source 154 (Give source of data)	select_one source_list ${Fam3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N diapage1 Diabetes Month 1
N Diamonth 155 Diabetes visits [Month1]: Which month is the latest complete month with data available?	date Month: Year:
N Dia1 156 How many diabetes clinic visits did you receive in [Month 1]? *If Don't Know enter 9999*	integer
N Dia1Source 157 (Give source of data)	select_one source_list ${Dia1}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N diapage2 Diabetes Month 2
N Dia2 158 How many diabetes clinic visits did you receive in [Month 2]? *If Don't Know enter 9999*	integer
N Dia2Source 159 (Give source of data)	select_one source_list ${Dia2}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N diapage3 Diabetes Month 3
N Dia3 160 How many diabetes clinic visits did you receive in [Month 3]? *If Don't Know enter 9999*	integer
N Dia3Source 161 (Give source of data)	select_one source_list ${Dia3}!=9999 R ◯ Patient register 1 ◯ Monthly report 2 ◯ Provider self-report 3

N Cash_present	select_one yes_no

162 Now I'd like to ask about how much money the facility takes in each month. We want to know this to see if being part of a quality improvement programme increases revenue for health facilities. This information will remain confidential and not be shared outside of the study team. If possible, I'd like to copy these numbers from your original record to make sure the numbers are as precise as possible. Firstly, do you receive revenue from cash patients?	◯ Yes 1 ◯ No 2
N Insurance_present 163 Do you accept patients who are able to pay through health insurance?	select_one yes_no ◯ Yes 1 ◯ No 2
N Govt_present 164 Do you ever receive cash transfers from government?	select_one yes_no ◯ Yes 1 ◯ No 2
N Contract_present 165 Do you have any contracts to provide services to government or private company employees? *This question refers to contracts other than health insurance*	select_one yes_no ◯ Yes 1 ◯ No 2
N Mobile_present 166 Do you have patients who pay by mobile money (e.g. M-pesa, Tigo pesa)?	select_one yes_no ◯ Yes 1 ◯ No 2
N Mobile_record 167 Do you record mobile money payments separately from cash patients?	select_one yes_no ${Mobile_present}=1 R ◯ Yes 1 ◯ No 2

	N cashpage1 Cash Month 1
N Cash1 168 What was your revenue from cash patients in [Month 1]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Cash1Source 169 (Give source of data)	select_one source_list2 ${Cash1}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3
N Cashmonth 170 Which was Month 1, the latest completed month with data available?	date Month: Year:

	N cashpage2 Cash Month 2

N Cash2 171 What was your revenue from cash patients in [Month 2]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Cash2Source 172 (Give source of data)	select_one source_list2 ${Cash2}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N cashpage3 Cash Month 3
N Cash3 173 What was your revenue from cash patients in [Month 3]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Cash3Source 174 (Give source of data)	select_one source_list2 ${Cash3}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N insurancepage1 Health Insurance Month 1
N Ins1 175 How much did you bill/invoice insurance organisations in [Month 1]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Ins1Source 176 (Give source of data)	select_one source_list2 ${Ins1}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3
N Insmonth 177 Which was Month 1, the latest completed month with data available?	date Month: Year:

	N insurancepage2 Health Insurance Month 2
N Ins2 178 How much did you bill/invoice insurance organisations in [Month 2]?	integer

If Don't Know enter 9999. If No Income enter 0	
N Ins2Source 179 (Give source of data)	select_one source_list2 ${Ins2}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N insurancepage3 Health Insurance Month 3
N Ins3 180 How much did you bill/invoice insurance organisations in [Month 3]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Ins3Source 181 (Give source of data)	select_one source_list2 ${Ins3}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N governmentpage1 Government Transfers Month 1
N Gov1 182 How much did you receive in cash tranfsers from the goverment in [Month 1]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Gov1Source 183 (Give source of data)	select_one source_list2 ${Gov1}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3
N Govmonth 184 Which was Month 1, the latest completed month with data available?	date Month: Year:

	N governmentpage2 Government Transfers Month 2
N Gov2 185 How much did you receive in cash tranfsers from the goverment in [Month 2]? *If Don't Know enter 9999. If No Income enter 0*	integer
N	select_one source_list2

Gov2Source 186 (Give source of data)	${Gov2}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N governmentpage3 Government Tranfers Month 3
N Gov3 187 How much did you receive in cash tranfsers from the goverment in [Month 3]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Gov3Source 188 (Give source of data)	select_one source_list2 ${Gov3}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N contractpage1 Contracts Month 1
N Contract1 189 How much did you bill for contracts, for example with government of private companies, in [Month 1]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Contract1Source 190 (Give source of data)	select_one source_list2 ${Contract1}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3
N Contractmonth Which was Month 1, the latest completed month with data available?	date Month: Year:

	N contractpage2 Contracts Month 2
N Contract2 191 How much did you bill for contracts, for example with government of private companies, in [Month 2]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Contract2Source 192 (Give source of data)	select_one source_list2 ${Contract2}!=9999 R

	◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N contractpage3 Contracts Month 3
N Contract3 193 How much did you bill for contracts, for example with government of private companies, in [Month 3]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Contract3Source 194 (Give source of data)	select_one source_list2 ${Contract3}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N mpesapage1 Mpesa Month 1
N Mpesa1 194 How much did you receive from mobile money (e.g. M-pesa, Tigo pesa), if not included in cash payments, in [Month 1]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Mpesa1Source 195 (Give source of data)	select_one source_list2 ${Mpesa1}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3
N Mpesamonth 196 Which was Month 1, the latest completed month with data available?	date Month: Year:

	N mpesapage2 Mpesa Month 2
N Mpesa2 197 How much did you receive from mobile money in [Month 2]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Mpesa2Source 198 (Give source of data)	select_one source_list2 ${Mpesa2}!=9999 R

	◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

	N mpesapage3 Mpesa Month 3
N Mpesa3 199 How much did you receive from mobile money in [Month 3]? *If Don't Know enter 9999. If No Income enter 0*	integer
N Mpesa3Source 200 (Give source of data)	select_one source_list2 ${Mpesa3}!=9999 R ◯ Register 1 ◯ Monthly report 2 ◯ Provider self-report 3

N triageobs 201 [Observe the triage desk. Is triage system in place and staffed?] *Verify through observation*	select_one yes_no ${triageask}!=3 R ◯ Yes 1 ◯ No 2
N recordsobs 202 [Ask to see a recent patient record where they are filed away. Is a recent patient record observed?] *Verify through observation*	select_one yes_no ${recordsask}!=3 R ◯ Yes 1 ◯ No 2
N mtuhaobs 203 [Ask to see an MTUHA monthly report. Is a MTUHA report observed?] *Verify through observation*	select_one yes_no ${mtuhaask}!=2 R ◯ Yes 1 ◯ No 2
N patindsobs 204 [Ask to see reports of patient indicators that are not MTUHA. How many indicators can you see reported?] *Verify through observation*	select_one kpi_no ${patindsask}!=4 R ◯ 1-2 patient indicators 1 ◯ 3-9 patient indicators 2 ◯ 10+ patient indicators 3 ◯ No patient indicators 4
N freqpatindobs 205 [How frequently are they reported?] *Verify through observation*	select_one freq ${patindsobs}!=4 and ${patindsask}!=4 R ◯ Yearly 1 ◯ Quarterly 2 ◯ Monthly 3 ◯ Weekly 4 ◯ Never 5
N busindsobs	select_one kpibusiness_no ${busindsask}!=4 R

206 [Ask to see reports of business indicators. How many indicators can you see reported?] *Verify through observation*	◯ 1-2 business indicators 1 ◯ 3-9 business indicators 2 ◯ 10+ business indicators 3 ◯ No business indicators 4
N freqbusindobs 207 [How frequently are they reported?] *Verify through observation*	select_one freq ${busindsask}!=4 and ${busindsobs}!=4 R ◯ Yearly 1 ◯ Quarterly 2 ◯ Monthly 3 ◯ Weekly 4 ◯ Never 5
N targetobs 208 [Ask to see a record of the targets. Is there a record observed?] *Verify through observation*	select_one yes_no ${targetask}!=4 R ◯ Yes 1 ◯ No 2
N trainobs 209 [Ask to see the training plan. Is it observed?] *Verify through observation*	select_one yes_no ${trainask}!=3 R ◯ Yes 1 ◯ No 2
N appraisalobs 210 [Ask to see a staff appraisal report. Is one observed?] *If OPLUS is used, ask to see an OPLUS form. Verify through observation*	select_one yes_no ${appraisalask}!=4 R ◯ Yes 1 ◯ No 2
N inventobs 211 [Ask to see a drug stock inventory report. Is one observed?] *Verify through observation*	select_one yes_no ${inventask}!=4 R ◯ Yes 1 ◯ No 2
N budgetobs 212 [Ask to see the facility annual budget document for this year. Is one observed?] *Verify through observation*	select_one yes_no ${budgetask}!=2 R ◯ Yes 1 ◯ No 2
N profitobs 213 [Ask to see the annual statement of the facility revenue and expenditure for last year. Is it observed?] *Verify through observation. Probe by asking about profit and loss statement*	select_one yes_no ${profitask}!=2 R ◯ Yes 1 ◯ No 2
N notes 214 Notes	text
N supcheck Form has been checked by supervisor	select_one yes_no ◯ Yes 1 ◯ No 2
N supcode Supervisor code	integer ${supcheck}=1 R

N end END OF HEALTH FACILITY SURVEY	note

Standardised patient detection survey tool

N InterviewerCode 1 Code of data enterer	select_one interviewer_list [Names redacted] ◯ Other, specify 33
N OtherInterviewer 2 Please specify	text ${InterviewerCode} =33 R
N FacilityName 3 Name of facility	select_one facility_list [Names redacted] ◯ Other, specify 238
N Otherfacility 4 Please specify	text ${FacilityName}=238 R
N anysus 5 Any suspicious patients reported?	select_one yes_no ◯ Yes 1 ◯ No 2
N num_suspatient 6 How many?	integer ${anysus}=1 R

N repeat Patient details	
N date_visit What date was the visit? If not known, choose 1st January 2018	date Day: Month: Year:
N time_visit What time of day was the visit?	select_one time_of_day ◯ Morning 1 ◯ Afternoon 2 ◯ Evening 3 ◯ Don't know 4
N patient_age How old was the patient, approximately? If not known, enter 99	integer
N patient_gender Was the patient male or female?	select_one gender

	◯ Male 1 ◯ Female 2 ◯ Don't know 3
N patient_name What was the patient's name? If not known, enter 99	text
N patient_condition Please can you give me details of the patient's condition/complaint (why they were visiting the facility)?	text
N reason_sus What made you/your colleagues suspect this person was a standardised patient?	text
N confront_sus Did you confront the patient/ask them if they were a standardised patient?	select_one yes_no ◯ Yes 1 ◯ No 2
N treat_sus Did you treat the patient differently due to your suspicions?	select_one yes_no ◯ Yes 1 ◯ No 2
N treat_how How/in what way did you treat them differently? [probe- e.g. sent away, didn't prescibe medicines]	text ${treat_sus}1 R
N other_comment Do you have any other comments about this patient?	text
N notes Notes	text
N end END SP FOLLOW-UP CALL	note

Appendix 6: Information and consent form for health facility survey and SP visits

UNDERSTANDING AND ENHANCING APPROACHES TO QUALITY IMPROVEMENT IN SMALL AND MEDIUM SIZED PRIVATE FACILITIES IN SUB-SAHARAN AFRICA

A STUDY TO EVALUATE THE EFFECTIVENESS OF THE "SAFECARE" APPROACH IN TANZANIA

[INFORMATION AND CONSENT FOR HEALTH PROVIDERS PARTICIPATING IN THE STUDY]

INFORMATION

Introduction

Hello, my name is ---------- and I am working with the Ifakara Health Institute. I am here because your facility is taking part in a study of the SafeCare approach.

Why is this study being done?

This study is being conducted by the Ifakara Health Institute and the London School of Hygiene and Tropical Medicine, in partnership with PharmAccess, APHFTA and CSSC. Over the last 18 months or two years, you have had quality improvement support from APHFTA/CSSC using the SafeCare approach. This facility is participating in the study, and we are very grateful for your cooperation so far. Now, we would like to assess the extent to which SafeCare improves the quality of care and performance of health facilities, and to investigate the advantages and challenges of the approach.

What will happen?

We would like to collect information about your facility in a number of different ways:

1) We would like to interview you [provider/owner] and ask you questions about the facility, how you operate and your experience with SafeCare. The interview will last approximately 40 minutes.

2) We would like to observe you [and your staff] working in the consultation room[s], injection room and laboratory. We will not intrude on your work but will ask to attach stickers to staff and patients for easy observation. We will ask individual staff and patients to consent to being observed before beginning, and will watch for up to two hours.

3) We would like to take photographs of at the facility today as a record of our activities. They may be used in presentations and reports about our work

4) We would like to do a short interview with 8 of your outpatients as they leave the facility.

5) We would like other members of our team to return to your facility in the next three months as 'standardised patients'. This means they will not reveal their role as researchers, but will pose as patients seeking healthcare in your facility. They will act as normal patients and pay all fees as any patient would be expected to do. One month after the 'standardised patients' visit, we will contact you by telephone or email to inform you it has taken place, and to ask you whether you detected any standardised patients.

Taking part in the research is your choice. You can decide to stop participating in the research at any time.

All information gathered will be treated as confidential, and will be stored securely. The data may be made publicly available in a completely anonymised format. Your name and the names of your facility, staff and patients will not be used in any of our reports.

What risks can I expect from being in the study?

We do not anticipate any risks for you in participation in this study. Participation will take up some of your time.

Are there benefits to taking part in the study?

Your facility will not be paid for taking part in this study, but you will receive feedback which may benefit your health facility and your patients. More broadly, the study will help researchers and policy-makers understand how to improve the quality of care in private health facilities.

Do you have any questions?

Who if I have further questions about the study?

You can talk to the researchers about any questions or concerns you have about this study. Contact Christina Makungu (+255 788 721256) from the Ifakara Health Institute. If you still have concerns, you may contact Dr Mwifadhi Mrisho (+255 788766676) from the Institutional Review Board

(leave a copy of the information sheet with the facility)

A STUDY TO EVALUATE THE EFFECTIVENESS OF THE "SAFECARE" MODEL IN TANZANIA

CONSENT FORM

RESPONDENT AGREES TO INTERVIEW yes / no

RESPONDENT AGREES TO OBSERVATIONS yes / no

RESPONDENT AGREES TO PHOTOGRAPHS yes / no

RESPONDENT AGREES TO PATIENT EXIT INTERVIEWS yes / no

RESPONDENT AGREES TO STANDARDISED PATIENTS yes / no

"I have understood the explanation concerning this study and have been given the opportunity to ask questions. I agree to take part in this study."

Date: _____

Name: _____

Signature: _____

Facility Name: _____

Facility Code: _____

District: _____

Name of person giving information: _____

Signature of person giving information: _____

Appendix 7: Ethical approvals

The following approval letters are attached:

LSHTM

i. Initial approval (10493)
ii. Amendment (10493-1)

IHI

i. Initial approval (IHI/IRB/No: 04-2016)
ii. Extension 1 (IHI/IRB/EXT/12-2017)
iii. Extension 2 (IHI/IRB/EXT/No:001-2018)
iv. Amendment (IHI/IRB/AMM/No:009-2017)

NIMR

i. Initial approval (NIMR/HQ/R.8a/Vol. IX/2415)
ii. Extension 1 (NIMR/HQ/R.8c/Vol. II/914)
iii. Amendment (NIMR/HQ/R.8c/Vol. I/543)

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Observational / Interventions Research Ethics Committee

Dr Catherine Goodman
Reader in Health Economics and Policy
Department of Global Health and Development (GHD)
LSHTM

5 January 2016

Dear Dr Catherine Goodman ,

Study Title: Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in sub-Saharan Africa

LSHTM ethics ref: 10493

Thank you for your application for the above research, which has now been considered by the Interventions Committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Protocol / Proposal	PharmAccess study protocol 27Nov15	27/11/2015	1
Protocol / Proposal	SafeCare Basic Assessment Tool	27/11/2015	1
Investigator CV	LEO_CV template_C.G(2014)-cg	27/11/2015	1
Investigator CV	Tim P-J CV	27/11/2015	1
Information Sheet	SafeCare_Information and Consent_27Nov15	27/11/2015	1
Protocol / Proposal	Cover letter for LSHTM ethics application	27/11/2015	1
Sponsor Letter	QA756_Sponsor Confirmation_301115	30/11/2015	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: http://leo.lshtm.ac.uk

Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerel

[redacted]

Professor John DH Porter
Chair

London School of Hygiene & Tropical Medicine
Keppel Street, London WC1E 7HT
United Kingdom
Switchboard: +44 (0)20 7636 8636

www.lshtm.ac.uk

Observational / Interventions Research Ethics Committee

Dr Catherine Goodman
Reader in Health Economics and Policy
Department of Global Health and Development (GHD)
LSHTM

13 September 2017

Dear Catherine,

Study Title: Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in sub-Saharan Africa

LSHTM Ethics Ref: 10493 - 1

Thank you for your application for the above amendment to the existing ethically approved study and submitting revised documentation. The amendment application has been considered by the Interventions Committee.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above amendment to research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval for the amendment having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Other	IHI ethics approval 9Mar16	16/03/2016	1
Other	NIMR ethics approval 2017	17/01/2017	1
Other	Extension approval June 2017 (1)	03/07/2017	1
Other	PharmAcccess_EXIT INTERVIEW_Eng_24022016 - Copy	27/07/2017	1
Other	PharmAcccess_EXIT INTERVIEW_SWH_ 24022016	27/07/2017	1
Other	PharmAccess_Facility Questionnaire_ENG_24022016 - Copy	27/07/2017	1
Other	PharmAccess_Facility Questionnaire_SWH_24022016	27/07/2017	1
Other	PharmAccess-IDI Facility staff-Eng-24022016 - Copy	27/07/2017	1
Other	PharmAccess-IDI Facility staff-SWH-24022016	27/07/2017	1
Other	PharmAccess-IDI Implementing staff-Eng-24022016	27/07/2017	1
Other	PharmAccess-IDI Implementing staff-SWH_ 24022016	27/07/2017	1
Other	PharmAccess-KII-Eng-24022016	27/07/2017	1
Other	PharmAccess-KII-SWH-24022016	27/07/2017	1
Other	PharmAccess_IPC_Tool_ENG_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_Asthma_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_Asthma_SWH_06072017 copy	27/07/2017	1
Other	PharmAccess_SP_Script_Malaria_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_Malaria_SWH_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_TB_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_TB_SWH_06072017 copy	27/07/2017	1
Other	PharmAccess_SP_Script_URTI_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Script_URTI_SWH_06072017	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_Asthma_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_Asthma_SWH_06072017	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_Malaria_Eng_06072017	27/07/2017	1

Other	PharmAccess_SP_Questionnaire_Malaria_SWH_06072017 copy	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_TB_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_TB_SWH_06072017 copy	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_URTI_Eng_06072017	27/07/2017	1
Other	PharmAccess_SP_Questionnaire_URTI_SWH_06072017 docx	27/07/2017	1
Other	ICF_ ENG_Exit _13012017	27/07/2017	1
Other	ICF_ SWH_Exit_13012017	27/07/2017	1
Other	ICF_ENG_SP+survey+IPC+exit_06072017	27/07/2017	1
Other	ICF_SWH_SP+survey+IPC+exit_06072017	27/07/2017	1
Other	ICF_ ENG_IDI facility staff_13012017	27/07/2017	1
Other	ICF_ SWH_IDI facility staff_13012017	27/07/2017	1
Other	ICF_ ENG_IDI Implementing staff_13012017	27/07/2017	1
Other	ICF_ SWH_IDI Implementing staff_13012017	27/07/2017	1
Other	ICF_ ENG_KII _13012017	27/07/2017	1
Other	ICF_ SWH_KII _13012017	27/07/2017	1
Other	PharmAccess study protocol 27Jul17	27/07/2017	2
Other	PharmAccess SP protocol 270717	27/07/2017	1
Other	PharmAccess_IPC_Tool_SWH_06072017 (1)	27/07/2017	1

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

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Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,

Professor John DH Porter
Chair

ethics@lshtm.ac.uk
http://www.lshtm.ac.uk/ethics/

Improving health worldwide

IFAKARA HEALTH INSTITUTE
research | training | services

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9th March, 2016

National Institute for Medical Research
P O Box 9653
Dar Es Salaam
Email; headquarters@nimr.or.tz

Mary Mwangome
Ifakara Health Institute
P O Box 53
Ifakara

IHI/IRB/No: 04-2016

INSTITUTIONAL CLEARANCE CERTIFICATE FOR CONDUCTING HEALTH RESEARCH

On 26th February, 2015, the Ifakara Health Institute Review Board (IHI-IRB) reviewed from study titled: ***"Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in sub-Saharan Africa"*** **submitted by P.I Mary Mwangome.**

The following documents were reviewed:

1. Protocol
2. Informed Consent Forms
3. Budget
4. Data collection tools
5. LSHTM ethical approval
6. CVs

The study has been approved for implementation after IRB consensus. This certificate thus indicates that; the above- mentioned study has been granted an Institutional Ethics Clearance to conduct the above named study in Tanzania (facilities in all districts across Northern, Southern, Southern Highlands and Eastern MOH Zones) and Kenya (national level).

The Principal Investigator of the study must ensure that, the following conditions are fulfilled during or after the implementation of the study:

1. PI should submit a six month progress report and the final report at the end of the project
2. Any amendment, which will be done after the approval of the protocol, must be communicated as soon as possible to the IRB for another approval
3. All research must stop after the project expiration date, unless there is prior information and justification to the IRB.
4. There should be plans to give feedback to the community on the findings
5. Any publication needs to pass through the IRB
6. The approval is valid until 8th March, 2017

The IRB re[redacted] right to undertake field inspections to check on the protocol compliance

Deputy Chairperson
Dr Saidi Mpendu

IRB Secretary
Be[redacted]

INSTITUTIONAL REVIEW BOARD
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03rd July, 2017

National Institute for Medical Research
P O Box 9653
Dar Es Salaam
Email; headquarters@nimr.or.tz

Dr Mary Mwangome
Ifakara Health Institute,
P O Box 53,
Ifakara.

IHI/IRB/EXT/12 - 2017

EXTENSION APPROVAL

On 30th June, 2017, the Ifakara Health Institute Review Board (IHI-IRB) renewed Annual Extension application to a study titled: ***"Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in Sub-Saharan African"*** submitted by Christina Makungu**.** The Annual Extension extends from 9th March 2017 to 8th March 2018. The above-named study had a previous approval number IHI/IRB/No: 04 - 2016 dated 9th March 2016.

The IRB reserves the right to undertake field inspections to check on the protocol compliance.

Deputy IRB Secretary

[redacted]

Dr. Mwifadhi Mrisho

IFAKARA HEALTH INSTITUTE
research | training | services

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15th January, 2018

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Christina Makungu,
Ifakara Health Institute,
P O Box 78373,
Dar Es Salaam.

IHI/IRB/EXT/No: 001 - 2018

EXTENSION APPROVAL

On 11th January, 2018, the Ifakara Health Institute Review Board (IHI-IRB) renewed Annual Extension application to a study titled: ***"Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in sub Saharan Africa"*** Submitted by the P.I Christina Makungu. The Annual Extension extends from 8th March, 2018 to 8th March 2019. The above-named study had a previous approval number IHI/IRB/No: 04 - 2016.

The IRB reserves the right to undertake field inspections to check on the protocol compliance.

IHI - IRB Secretary

[redacted]

Dr. Mwifadhi Mrisho

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31st July, 2017

Christina Makungu
Ifakara Health Institute
P O Box 78373
Dar es Salaam

Ref: IHI/IRB/AMM/ No: 09-2017

AMMENDMENT APPROVAL

On 28th July 2017, The Ifakara Health Institute Review Board (IHI-IRB) reviewed and approved the study titled ***"Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in sub-saharan Africa"***, submitted by Principal Investigator Christina Makungu. This study had a previous approval number IHI/IRB/No: 04-2016 of 9th March 2016

Amendment include:

1. Addition of Christina Makungu from Ifakara Health Institute as a Principal investigator in the study. Ms Makungu replaces Dr. Mary Mwangome who left the study as she re-located from Tanzania.

2. Additional of other staff: Jessica King and Abdallah have joined the study as new investigators. Other changes are highlighted in the protocol.

3. Private facilities will be included within the Northern, Eastern, Central, Southern and Southern Highlands zones, including the following districts: Arusha DC, Arusha Municipal, Babati DC, Bagamoyo, Bahi, Chamwino, Chunya, Dodoma, Dodoma Urban, Gairo, Hai, Hanang, Handeni, Ikungi, Ilala, Ileje, Iringa Rural, Karatu, Kibaha, Kibaigwa, Kilakala, Kilimahewa, Kilindi, Kilolo, Kilombero, Kilosa, Kilwa Masoko, Kinondoni, Kisarawe, Kiteto, Kitunda, Kondoa, Kongwa, Korogwe, Kyela, Lindi Rural, Liuli, Longido, Ludewa, Lushoto, Mahenge, Makambako, Makete, Manyara, Masasi, Mbeya Rural, Mbinga, Mbozi, Mbulu, Meru, Mjini Magharibi, Mkinga, Mkuranga, Mlandizi, Monduli, Morogoro Rural, Moshi Rural, Moshi Urban, Mpanda, Mpwapwa, Mufindi, Muheza, Mvomero, Mwanga, Nachingwea, Ngorongoro, Njombe, Nkasi, Nyasa, Rombo, Rufiji, Rungwe, Same, Simanjiro, Songea, Sumbawanga, Tanga, Temeke, Tunduru, Ulanga, Arumeru, Mbarali, Momba, Mtwara, Namtumbo, Siha, Singida,Tandahimba and Wanging'ombe.

The IRB reserves the right to undertake field inspections to check on the protocol compliance

[redacted]

IRB Secretary

Dr Mwifadhi Mrisho

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NIMR/HQ/R.8a/Vol. IX/2415

17th February 2017

Mary Mwangome
Ifakara Health Institute
P.O. Box 53
Ifakara

CLEARANCE CERTIFICATE FOR CONDUCTING MEDICAL RESEARCH IN TANZANIA

This is to certify that the research entitled: Understanding and enhancing approaches to quality improvement in small and medium sized private facilities in Sub-Saharan Africa (Mwangome M. *et al)*, has been granted ethical clearance to be conducted in Tanzania.

The principal investigator of the study must ensure that the following conditions are fulfilled:

1. Progress report is submitted to the Ministry of Health, Community Development, Gender, Elderly & Children, the National Institute for Medical Research, Regional and District Medical Officers after every six months.
2. Permission to publish the results is obtained from the National Institute for Medical Research.
3. Copies of final publications are made available to the Ministry of Health, Community Development, Gender, Elderly & Children and the National Institute for Medical Research.
4. Any researcher, who contravenes or fails to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine. NIMR Act No. 23 of 1979, PART III Section 10(2).
5. Sites: Northern, Eastern, Central, Southern, and Southern highlands zones.

Approval is for one year: 17th February 2017 to 16th February 2018.

Name: Prof. Yunus Daud Mgaya

[redacted]

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Prof. Muhammad Bakari Kambi

[redacted]

Signature
CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, COMMUNITY DEVELOPMENT, GENDER, ELDERLY & CHILDREN

CC: RMOs of selected regions
DMOs/DEDs of selected districts

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Faculty of Arts and Social Sciences
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40478 Dodoma

NIMR/HQ/R.8c/Vol. II /914

29th December 2017

Ms Christina Makunga
Ifakara Health Institute
P.O. Box 53
Ifakara

RE: APPROVAL FOR EXTENSION OF ETHICAL CLEARANCE

This letter is to confirm that your application for extension on the already approved protocol entitled: Understanding and Enhancing Approaches to Quality Improvement in Small and Medium Sized Private Facilities in Sub-Saharan Africa (Makungu C *et al*) has been approved.

The extension approval is based on the progress report dated 15th December 2017 on the project with Ref. NIMR/HQ/R.8a/Vol. IX/2415 dated 17th February 2017. Extension approval is valid from 17th February 2018- 16th February 2019.

The Principal Investigator must ensure that other conditions of approval remain as per ethical clearance letter. The PI should ensure that progress and final reports are submitted in a timely manner.

Name: Prof. Yunus Daud Mgaya

[redacted]

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Prof. Muhammad Bakari Kambi

[redacted]

Signature
CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, COMMUNITY DEVELOPMENT, GENDER, ELDERLY & CHILDREN

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NIMR/HQ/R.8c/Vol. I/ 543

22nd November 2017

Christina Makungu
Ifakara Health Institute
P.O. Box 53
Ifakara

RE: ETHICAL APPROVAL FOR PROTOCOL AMENDMENT

This letter is to confirm that your application for Amendment on the study entitled: Understanding and enhancing approaches to qualify improvement in small and medium sized private facilities in Sub-Saharan Africa (Mkungu C. *et al.)* (Ref. NIMR/HQ/R.8a/Vol. IX/2415 dated 17th February 2017) has been granted ethical clearance to be conducted in Tanzania.

The Principal Investigator of the study must ensure that the approval is for the following amendments:

1. Change of a Principal Investigator (PI), Dr. Mary Mwangome is replaced by Christina Makungu.
2. Direct observation of infection control will be applied instead of role playing vignettes.
3. Standardized patient scenarios now include cases of suspected malaria and URTI, replacing unstable angina.
4. Addition of quality management component.

Approval is valid until 16th February 2018.

Name: Prof. Yunus Daud Mgaya

[redacted]

Signature
CHAIRPERSON
MEDICAL RESEARCH
COORDINATING COMMITTEE

Name: Prof. Muhammad Bakari Kambi

[redacted]

Signature
CHIEF MEDICAL OFFICER
MINISTRY OF HEALTH, COMMUNITY DEVELOPMENT, GENDER, ELDERLY & CHILDREN

Appendix 8: NIMR permissions to publish

Permission letters from NIMR are attached for the publication of the following papers, which use data collected in Tanzania:

Chapter 5 in thesis: King JJ, Powell-Jackson T, Makungu C, Hargreaves J, Goodman C. How much healthcare is wasted? A cross-sectional study of outpatient overprovision in private-for-profit and faith-based health facilities in Tanzania. Health policy and planning. 2021 ;36(5):695-706.

Chapter 6 in thesis: King J, Powell-Jackson T, Hargreaves J, Makungu C, Goodman C. Pushy Patients Or Pushy Providers? Effect Of Patient Knowledge On Antibiotic Prescribing In Tanzania: Effect of patient knowledge on antibiotic prescribing in Tanzania. Health Affairs. 2022;41(6):911-20.

NATIONAL INSTITUTE FOR MEDICAL RESEARCH
HEADQUARTERS

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3 Barack Obama Drive
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Tanzania

Your Ref:
Our Ref: NIMR/HQ/P.12 VOL XXXI/111

5th November 2020

Dr Honorati Masanja
Ifakara Health Institute
Plot 463, Kiko Avenue, Mikocheni,
P.O. Box 78373,
DAR ES SALAAM.

Dear Dr Masanja,

RE: PERMISSION TO PUBLISH

Reference is made to your request for permission to publish.

2. Permission has been granted to publish a manuscript titled: "**How much healthcare is wasted? A cross-sectional study of outpatient overprovision in private-for-profit and faith-based health facilities in Tanzania**" by authors: Jessica King, Timothy Powell Jackson, Christina Makungu, James Hargreaves and Catherine Goodman.

3. Please submit an electronic copy of the published manuscript to the National Institute for Medical Research through email publications@nimr.or.tz.

[redacted]

Dr. Ndekya Maria Oriyo
DIRECTOR OF RESEARCH INFORMATION, TECHNOLOGY AND COMMUNICATION

UNITED REPUBLIC OF TANZANIA

MINISTRY OF HEALTH, COMMUNITY DEVELOPMENT, GENDER, ELDERLY AND CHILDREN

NATIONAL INSTITUTE FOR MEDICAL RESEARCH

In reply please quote:

Ref. No: NIMR/HQ/P.12 VOL XXXIII/77 Date: 18th October 2021

Dr Honorati Masanja
Plot 463, Kiko Avenue, Mikocheni
P.o. Box 78,373
DAR ES SALAAM.

Dear Dr Masanja,

RE: PERMISSION TO PUBLISH

Reference is made to your request to publish data dated 13th October 2021 with reference number IHI/CED/DSM/2021/3207 from a study with ethical clearance number NIMR/HQ/R.8a/Vol. IX/1856.

2. Permission has been granted to publish a manuscript titled: "**Pushy patients or pushy providers? A randomised control trial to explore the role of patient knowledge on antibiotic prescribing practices in the Tanzanian private health sector**" by authors: Jessica King, Timothy Powell-Jackson, James Hargreaves, Christina Makungu and Catherine Goodman.

3. Please submit an electronic copy of the published manuscript to the National Institute for Medical Research through email publications@nimr.or.tz.

[redacted]

Dr. Ndekya Maria Oriyo

DIRECTOR OF RESEARCH INFORMATION, TECHNOLOGY AND COMMUNICATION

Appendix 9: Harm minimisation protocol

All fieldwork contains inherent risks, but SP studies expose fieldworkers to additional risks by asking them to pose as real patients. SP cases and training must be designed to minimise these risks. The major risks identified by the study team and MAQARI SP manual, and steps taken to reduce them, are detailed below.

1. Exposure to airborne pathogens in facility. There is little that can be done to reduce exposure of SPs to respiratory pathogens when waiting inside a facility. More serious respiratory infections, such as TB, are not treated in small clinics, and are treated in separate outdoor clinics in larger facilities. It is therefore thought that the risk of an SP contracting a serious respiratory infection from this work is minimal.

2. Exposure to surface pathogens in facility. During training, SPs will be educated about the pathogens that remain on surfaces inside facilities. They will be informed of the importance of hand hygiene after the end of the facility visit, and supplied with alcohol hand gel.

3. Exposure to pathogens on thermometers. SPs will be trained to avoid having temperature taken with an unsterilized oral thermometer. Training will include:
    a. Recognition of when thermometer may not have been sterilized
    b. Asking provider whether thermometer has been sterilized
    c. Asking provider to use sterilized thermometer/sterilize thermometer before use
    d. Refusing to have temperature taken orally if thermometer not sterile
    e. Revealing identity as SP if refusal not accepted

4. Exposure to pathogens through injections. SPs will be trained to avoid all injections, IV fluids and other parenteral administration of medications. Training will include:
    a. Recognition of terms provider may use to indicate they plan to give SP injection
    b. Recognition of provider actions which indicate imminent injection (e.g. preparing needle)
    c. Refusal of injections on grounds of extreme needle phobia “I cannot have injections, the last time I received an injection I lost consciousness”
    d. Refusal of injections on grounds of cost “I do not have the money to pay for an injection with me today, I don’t want it”
    e. Refusal of injections on grounds of fasting “I am fasting so I may not have an injection”
    f. Revealing identity as SP if refusal not accepted

5. Exposure to pathogens through blood draws. SP cases have been chosen to minimise likelihood of blood tests, with the exception of the malaria case, which requires a finger-prick blood sample. SPs will be trained to avoid having blood drawn except from the fingertip with a single-use, sterile lancet which is part of a malaria RDT. Training will include:
    a. Asking provider whether a diagnostic test requires blood to be taken
    b. Asking provider where blood will be taken from
    c. Recognising a single-use sterile lancet
    d. Refusal of blood draw on grounds of extreme needle phobia “I cannot have injections, the last time I received an injection I lost consciousness”

e. Refusal of diagnostic tests on grounds of cost "I cannot do these tests; I can't pay for them"
f. Refusal of diagnostic tests on grounds of inconvenience "I cannot stay and have these tests, I have to meet with someone soon"
g. Leaving the facility and paying fees without having diagnostic tests if refusal not accepted
h. Revealing identity as SP if refusal not accepted

6. Unnecessary exposure to ionising radiation. SPs will be trained to avoid all X-rays. X-rays are only likely to be offered to TB SPs, and only 37 of 237 study facilities can offer X-ray imaging, so this risk will exist in a small number of cases. If offered, SPs will refuse on grounds of cost.

7. Administration of unnecessary/harmful medications. SPs will be trained to avoid all medications:
    a. Parenteral administration will be avoided as outlined above (4)
    b. SPs will be trained to give all dispensed medications to supervisor as soon as reasonably possible, and that they must not under any circumstances take medications. The medications will then be stored and returned to study team for quality control testing
    c. If provider offers oral medication in facility, SP will be trained to refuse on grounds of fasting, and say that they can take it in the evening.
    d. If fasting will not be believed, refuse on grounds of cost
    e. SPs must reveal identity rather than take any medication

8. Invasive physical examinations. SP cases have been chosen to minimise the likelihood of invasive physical exams. SPs will be trained to refuse pelvic/genital exams and any other examination or procedure they do not feel comfortable with, and to reveal their identity as an SP as a last resort if necessary.

9. Admission to facility. SPs will be trained to avoid being admitted to the facility as an inpatient. They will refuse to be admitted on grounds of inconvenience, saying they need to return to where they live and will seek medical attention there. If this explanation is not accepted, they will reveal their identity as an SP.

10. Diagnosis of previously undetected condition. There is a risk that SPs may be diagnosed with a genuine medical condition during the course of their work, as a direct result of investigations carried out in study facilities. SP cases have been designed to minimise this risk. SPs will only be recruited if they self-report good health and do not report any underlying conditions. Specific scenarios are outlined below:

    a. HIV: No SP will be diagnosed as blood cannot be taken except for finger-prick samples for malaria.
    b. Malaria: If SP tests positive for malaria, they must report this to the supervisor and take a second RDT. If this is also positive the SP/supervisor should purchase AL for treatment.
    c. Hypertension: SPs are likely to have blood pressure measured frequently during the study period and may be informed they are hypertensive.

11. Abuse/harassment at facility due to detection of SP. During the first (overt) round of field work, facilities will be informed of the use of SPs in the study and asked to give their consent. SPs will only be sent to facilities where consent has been given for the use of SPs. The facility will be asked to ensure that the manager, duty manager or supervisor has been informed of SPs. A letter will be given to facilities explaining the use of SPs, to be put on file in the facility along with a copy of the ethical approval. If the identity of an SP is revealed, or the SP needs to reveal their identity to avoid harm they will;
    a. Explain that they are a fieldworker from the SafeCare/LSHTM/IHI study
    b. Thank the provider for their time, pay any outstanding fees and leave the facility
    c. If challenged, show copies of letter and ethical approval, and tell provider the facility should also have them on file
    d. Provide the contact details of a member of the study team if the provider has further queries

Appendix 10: Supplementary material for Chapter 5 (as published)

Selection of study facilities

Data were collected as part of a randomised controlled trial of the SafeCare quality improvement programme. SafeCare was implemented by the NGO PharmAccess, in partnership with the Association of Private Health Facilities in Tanzania (APHFTA) which represents mainly for-profit facilities), and the Christian Social Services Commission (CSSC) which represents most mission facilities). Eligible facilities were dispensaries and health centres which are members of APHFTA, and dispensaries, health centres and hospitals which were members of CSSC. Facilities were ineligible if they refused consent, provided specific services only (e.g. mental health or maternity), or were tertiary hospitals. Facilities were recruited from the Northern, Eastern, Central, Southern and Southern Highlands zones of Tanzania (Lake Zone was excluded because SafeCare had been rolled out there prior to study commencement).

The selection of study facilities was based on a sampling frame of 975 potentially eligible private health facilities. With the implementing partners APHFTA and CSSC, we selected a list of 280 potentially eligible facilities for participation in the study. For the CSSC facilities, we selected a random sample of 124 health facilities, stratified by facility type (dispensary, health centre, hospital). For the APHFTA facilities, we were given a list of 156 health facilities that included dispensaries and health centres. Because of the sampling strategy, we do not claim that the study sample is representative of the broader population of health facilities in the study zones. The study facilities are, however, widely dispersed across both urban and rural areas, in 18 of mainland Tanzania's 22 regions.

The partner organisations approached the 280 potentially eligible facilities to confirm eligibility, carry out sensitisation and obtain written informed consent to participate. Of these, 43 declined to participate in the study or were found to be ineligible, such that 237 facilities were recruited at baseline. Study facilities were recruited from Mar 7, 2016, to Nov 30, 2016. Standardised patients were conducted at endline, at which point nine facilities had closed down. Specifically, seven were closed permanently, one was undergoing renovations, one was open but operating illegally without a license so we could not visit, and one facility owned by a private company served only their employees so SPs could not visit undercover. Our sample thus comprises 227 health facilities.

Using an endline sample from a quality-improvement programme evaluation raises the question of whether these facilities had different patterns of overprovision to what might normally be expected. However, the SafeCare programme did not have the specific aim of tackling overprovision, nor is reducing overprovision part of the SafeCare standards. Overprovision was very similar between intervention and control groups at endline, with no significant difference between the two groups (the results of the randomised controlled trial will be reported elsewhere).

Standardized patients

SP survey

Standardised patients (SPs) are healthy people, who covertly pose as real patients and respond to the clinician's actions as a real patient would. We used the SPs to measure process quality of care. We developed four SP cases: asthma, non-malarial febrile illness, tuberculosis, and upper respiratory tract infection. Each facility received the four SP cases. Facilities and implementing partners for the quality improvement intervention were blinded to the four cases chosen. The SPs

themselves were blinded to information about the health facilities, including whether the facilities were in the intervention or control arm of the quality improvement trial.

The tools and protocols were developed through a number of steps. First, a systematic literature review was carried out in November-December 2016. The review identified published examples of the use of covert standardized patients to evaluate all aspects of clinical care. These were drawn upon as guidance for what was feasible and ethical in SP studies. Second, we organized a workshop in Dar es Salaam in January 2017. The workshop was attended by the study team, representatives of PharmAccess International and PharmAccess Tanzania, implementing partners for the SafeCare intervention (APHFTA and CSSC), and clinical specialists from an author's institution. The workshop identified the aspects of process quality of care which were most likely to be affected by SafeCare, and the best ways of measuring these. Third, the study team reviewed the tools and protocols available for two SP studies carried out in India, one examining TB care, the other asthma, angina and childhood diarrhoea. Fourth, the study team consulted with an advisory group with experience in the SP methodology and reviewed the national treatment guidelines for Tanzania.

Case choice rationale

A shortlist of conditions was drawn up based on (i) a literature review of use of standardized patients in LMICs, and (ii) conditions reported to be frequently treated in facilities in Tanzania. Each condition on the shortlist was then assessed for inclusion on the basis of six criteria:

7. Evidence for treatment: is there clinical evidence (preferably national standard treatment guidelines) by which to define correct treatment or management? This was a prerequisite for consideration.
8. Clinical and public health significance: does recognition and correct treatment of the condition have an important public health role, or is it a serious clinical emergency?
9. Frequency in study facilities: is the condition commonly enough seen in study facilities that correct recognition and treatment is feasible, and it will not arouse suspicion?
10. Risk to fieldwork and ethical considerations: will the case necessitate practices which expose the fieldworker to health facility-acquired infection, invasive examinations or a life-changing diagnosis?
11. Falsifiability of symptom and ease of diagnoses: can the symptoms be easily falsified by fieldworkers and will the provider be able to make a diagnosis on the basis of those symptoms during a single consultation with limited laboratory testing?
12. Universal applicability: can the condition be diagnosed or treated, or an appropriate referral made, at all facilities in the study?

The assessment by the study team is summarised in Table A1, which was used to select the four SP cases used in the study.

SP scripts and background stories

The SP fieldworkers were trained over a two week period. The main purpose of the SP training was to teach SPs about the case they are meant to portray, and how they should go about doing this. For each case we developed an SP script, which provided the basis for each fieldworker to learn their role. The full SP scripts are given at the end of this appendix. Specifically, SPs were told about the conditions they were acting, and the symptoms the patient would and would not have. SPs were trained to only give information that was asked for by the care provider, and not to deliberately give more information to 'help' the provider along the way to a diagnosis. SPs

practised coming up with answers for unexpected questions, so that they were prepared to give an answer if a provider asks about a symptom or lifestyle factor that the study team did not anticipate.

Time during training was dedicated to developing background stories for the SP characters. SPs were trained to portray people from a lower middle class demographic group, and to match the type of clients expected at small private providers. SPs were also trained to dress according to this character, and to adapt their dress to different areas of the country where necessary. SPs were given examples of how to explain their attendance at a facility where they are not recognised, and trained to respond to questions about where they are staying and where they are from. The basic backstory, which was adapted according to SP and setting, was that the SP is visiting a relative who has recently been posted to the area for work (for example, the SP's uncle is a teacher who has been posted to the school). This allowed SPs to explain why they were in the area without requiring them to have local knowledge. SPs worked in groups to develop the 'personality' of their SP, working out how their character would respond to different behaviours from providers. This reduced heterogeneity in the portrayal of SP cases across different fieldworkers.

SP fieldworkers were not screened for HIV and HIV status was not used as a recruitment criterion. When asked about HIV status by a provider, SPs were trained to respond that they did not know their status and to decline an HIV test as they wished to be tested alongside their partner. Female SPs told the provider that they did not have any children, as it would be expected that women who had accessed antenatal care services would have been tested for HIV and would know their status.

Procedures: consent, data collection, follow-up

We obtained informed consent from health facilities in our sample to receive SPs. They were told that an SP would be visiting their facility unannounced at some point over the next three months but they were given no further details. We sent the four SP cases to each health facility in the sample, randomly allocating fieldworkers to health facilities within each region. SP visits were carried out between 3rd May 2018 and 12th June 2018 in the 227 facilities. A total of 909 SP visits were done (one facility had two malaria visits by two different SPs).

At the end of each interaction, SPs completed a debriefing questionnaire on a smartphone using ODK Collect v.1.12.1 immediately after the visit, and fieldwork supervisors verified the information with the SP the same day. The debriefing questionnaire gathered information on the questions, examinations and diagnostic tests completed by the provider as well as the results of these tests, diagnoses offered, and treatment given. The debriefing questionnaires for each SP case are available on request. SPs paid the fees charged and retained medicines and test results to verify information recorded. Using a structured questionnaire, we telephoned health facilities four weeks after the SP visits, completing interviews with 225 facilities that represented 901 SP visits. A visit was coded as a confirmed detection if the facility reported receiving an SP visit and gave the name used by the SP. Possible detection was coded if the facility gave details which matched the visit (symptoms, gender, approximate age or date) but not the name. Visits were categorised as not detected if the facility did not report any suspicion of having an SP visit, or reported suspicions which did not match the details of the actual SP visits. Results of the detection survey are given in Table A4. Results excluding detected SPs are given in Table A5.

Harm minimisation

All fieldwork contains inherent risks, but SP studies expose fieldworkers to additional risks by asking them to pose as real patients. SP cases and training must be designed to minimise these risks. The major risks identified by the study team, and steps taken to reduce them, are detailed below.

12. Exposure to airborne pathogens in facility. There is little that could be done to reduce exposure of SPs to respiratory pathogens when waiting inside a facility. More serious respiratory infections, such as TB, are not treated in small clinics, and are treated in separate clinics in larger facilities. It was therefore anticipated that the risk of an SP contracting a serious respiratory infection from this work was minimal. Note that data collection was completed in 2018, well before the COVID-19 pandemic.
13. Exposure to surface pathogens in facility. During training, SPs were educated about the pathogens that remain on surfaces inside facilities. They were informed of the importance of hand hygiene after the end of the facility visit, and supplied with alcohol hand gel.
14. Exposure to pathogens on thermometers. SPs were trained to avoid having temperature taken orally with an unsterilized oral thermometer.
15. Exposure to pathogens through injections. SPs were trained to avoid all injections, IV fluids and other parenteral administration of medications.
16. Exposure to pathogens through blood draws. SP cases were chosen to minimise likelihood of blood tests, with the exception of the malaria case, which requires a finger-prick blood sample. SPs were trained to avoid having blood drawn except from the fingertip with a single-use, sterile lancet.
17. Unnecessary exposure to ionising radiation. SPs were trained to avoid all X-rays. X-rays were only likely to be offered to TB SPs, and only 37 of 237 study facilities could offer X-ray imaging, so this risk was present only in a small number of cases. If offered, SPs were trained to refuse on grounds of cost.
18. Administration of unnecessary/harmful medications. SPs were trained to avoid ingesting all medications.
19. Invasive physical examinations. SP cases were chosen to minimise the likelihood of invasive physical exams. SPs were trained to refuse pelvic/genital exams and any other examination or procedure they did not feel comfortable with, and to reveal their identity as an SP as a last resort if necessary.
20. Admission to facility. SPs were trained to avoid being admitted to the facility as an inpatient. They were told to refuse to be admitted on grounds of inconvenience, saying they needed to return to where they live and seek medical attention there.
21. Diagnosis of previously undetected condition. There was a risk that SPs may be diagnosed with a genuine medical condition during the course of their work, as a direct result of investigations carried out in study facilities. SP cases were designed to minimise this risk. SPs were only recruited if they self-reported good health and did not report any underlying conditions.
22. Abuse or harassment at a facility due to detection of SP. During a prior visit, facilities were informed of the use of SPs in the study and asked to give their consent. A letter was given to facilities explaining the use of SPs, to be put on file in the facility along with a copy of the ethical approval. SPs also carried a copy of this letter with them.

Definition of unnecessary care

All tests and drugs ordered for SPs were categorised by an expert panel as required, palliative/appropriate, economically harmful, harmful to public health and clinically harmful. A full list of all tests and drugs ordered is given in Table A2.

Table A1. SP case choice criteria

Case/condition	Clinical and public health significance	Frequency in study facilities[1]	Risk to fieldworker and ethical considerations	Falsifiability of symptoms and ease of diagnosis	Universal applicability
Included:					
Asthma	Some (not infectious, can be life-threatening)	Low (40/234)	Low- blood tests only to exclude other conditions	Good- can report distinctive breathing difficulties	Yes
Non-malarial febrile illness	High (life-threatening, infectious, resistance)	High (221/234)	Some- reduced risk with fingerprick testing with single-use lancets	Good- cyclic pattern of fever means no fever required at consultation	Yes
TB	High (underdiagnosed, infectious)	Low (assumed)	Low- X-ray required but not in facility	Good- history of cough and weight-loss, cough need not produce blood	Yes
Upper respiratory tract infection	High (antimicrobial stewardship)	High (178/234)	Low- blood tests only to exclude other conditions	Good- generic symptoms of headache, coughing and running nose	Yes
Excluded:					
Angina	Limited (life-threatening, not infectious)	Low (assumed)	Low- blood tests only to exclude other conditions	Limited- angina patients typically appear seriously unwell	Yes
Child (any condition, absent)	High (often infectious, significant morbidity)	High (assumed)	Low- child is absent	Poor- attending health facility without child abnormal	Yes
Child (any condition, present)			High- child SPs cannot give consent to study participation	Limited- would need to train children	Yes
Depression	High (significant morbidity, underdiagnosed)	Low (assumed)	Low- blood tests unlikely	Limited- unlikely to be recognised in non-specialist facilities	Yes
Diabetes	High (significant morbidity, underdiagnosed)	Low (65/234)	Some- blood glucose test requires fingerprick	Limited – symptoms can be falsified but not blood glucose levels	Yes
Diarrhoea	High (significant morbidity, infectious)	High (188/234)	Low- blood tests only to exclude other conditions	Poor- can't provide stool sample	Yes
Family planning client	High	Variable (up to 480 visits per month)[2]	Some- pelvic exam can be refused	Good- no symptoms needed	No[2]
HIV testing	High (significant morbidity, infectious)	Medium (85/234)	High -could be mitigated by testing fieldworkers before study	Good- no symptoms needed	Yes
Hypertension	High (significant morbidity)	Medium (100/234)	Low-blood tests only to exclude other conditions	Poor- cannot falsify high blood pressure	Yes
Injuries and accidents	High (significant morbidity)	Medium (81/234)	Low- blood tests unlikely	Poor- difficult to falsify injuries	Yes

Case/condition	Clinical and public health significance	Frequency in study facilities[1]	Risk to fieldworker and ethical considerations	Falsifiability of symptoms and ease of diagnosis	Universal applicability
Pregnancy testing	Limited (interest in antenatal care, not pregnancy testing)	High (191/234)	Low- blood tests unlikely	Limited- symptoms easily falsifiable but urinalysis will be negative	Yes
Skin diseases	Limited	High (123/234)	Low- blood tests unlikely	Poor- difficult to falsify skin complaints	Yes
Sexually transmitted illness	High (significant burden, infectious)	High (147/234)	Some- pelvic/genital exam, difficult to refuse	Limited- can report pain and discharge but can't falsify visible symptoms	Yes
Urinary tract infection	Limited	High (227/234)	Low- blood tests unlikely	Good- painful and frequent urination	Yes
Worms	High (significant burden)	High (147/234)	Low- blood tests unlikely	Poor- can't provide stool sample	Yes

[1]Based on data collected by PharmAccess Tanzania. Facilities could choose up to ten conditions from a predefined list as the ones most commonly diagnosed or treated. Frequencies listed are the number of facilities which list a given condition as one of their 'top ten'. Data are available for 234 of 237 study facilities.
[2]92 facilities reported a non-zero number of family planning clients per month (averaged over the last six months). 60 reported zero clients, and 83 that the question was not applicable. Data are available for 235 of 237 study facilities.

Table A2 Categorisation of harms of all drugs prescribed and tests ordered by SP case

	Asthma	NMFI	TB	URTI
Drugs				
Required	Inhaled β-2 antagonists and steroids	-	-	-
Palliative	Other β-2 antagonists and steroids, antihistamines, xanthines	Cold and flu combinations, cough syrups, NSAIDs, paracetamol	Cold and flu combinations, cough syrups, NSAIDs, paracetamol	Cold and flu combinations, cough syrups, NSAIDs, paracetamol
Unnecessary (economic harm)	ace inhibitors, antifungals, anthelmintics, antimuscarinics, calcium channel blockers, cough syrups, iron supplements, loop diuretics, paracetamol, ORS, proton pump inhibitors, statins, thiazides, vitamins	ace inhibitors, antifungals, antihistamines, anthelmintics, antimuscarinics, calcium channel blockers, iron supplements, loop diuretics, ORS, proton pump inhibitors, selective beta 2 antagonists, statins, steroids, thiazides, vasoconstrictor sympathomimetics/xanthines, vitamins, xathines	ace inhibitors, antifungals, antihistamines, anthelmintics, antimuscarinics, calcium channel blockers, iron supplements, loop diuretics, ORS, proton pump inhibitors, selective beta 2 antagonists, statins, thiazides, vasoconstrictor sympathomimetics/xanthines, vitamins, xathines	ace inhibitors, antifungals, antihistamines, anthelmintics, antimuscarinics, calcium channel blockers, iron supplements, loop diuretics, ORS, proton pump inhibitors, selective beta 2 antagonists, statins, steroids, thiazides, vasoconstrictor sympathomimetics/xanthines, vitamins, xathines
Public health and economic harm	Antibiotics, antimalarials	Antibiotics, antimalarials	Antibiotics (except fluoroquinolones), antimalarials	Antibiotics, antimalarials
Clinical and economic harm	NSAIDs, benzodiazepines, opioids	Benzodiazepines, opioids	Steroids, benzodiazepines, opioids	Benzodiazepines, opioids
Clinical, public health and economic harm	-	-	Fluoroquinolones	-
Tests				
Required	-	Malaria	AFB sputum	-
Appropriate	Allergy tests, electrocardiogram, HIV, X-ray	Complete blood count, HIV	Complete blood count, HIV, malaria, X-ray, Widal	HIV, malaria

Unnecessary (economic harm)	AFB, blood glucose, brucella, cholesterol, complete blood count, creatinine, erythrocyte sedimentation rate, H. pylori, urinalysis, VDRL, Widal, worms	AFB, allergy tests, blood glucose, brucella, cholesterol, creatinine, electrocardiogram, erythrocyte sedimentation rate, H. pylori, urinalysis, VDRL, Widal, worms, X-ray	Allergy tests, blood glucose, brucella, cholesterol, creatinine, electrocardiogram, erythrocyte sedimentation rate, H. pylori, urinalysis, VDRL, worms	AFB, allergy tests, blood glucose, brucella, cholesterol, complete blood count, creatinine, electrocardiogram, erythrocyte sedimentation rate, H. pylori, urinalysis, VDRL, Widal, worms, X-ray
Public health and economic harm	-	-	-	-
Clinical and economic harm	-	-	-	-
Clinical, public health and economic harm	-	-	-	-

Table A3: Pooled univariate and multivariate results for health centres and dispensaries

		Economic (any unnecessary care)					Clinical (any harmful care)					Public health (any antibiotic or antimalarial)				
			Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis	
		%	OR	P value	OR	P value	%	OR	P value	OR	P value	%	OR	P value	OR	P value
Profit status	Not-for profit	80.7			-		4.4					64.1				
	For-profit	83.9	1.25 (0.85- 1.85)	0.261	1.15 (0.66 – 2.03)	0.620	7.8	1.92 (0.97 – 3.80)	0.060	3.15 (1.24 – 8.00)	0.016	73.8	1.64 (1.13 – 2.37)	0.009	1.64 (0.89 – 2.99)	0.111
Location	Rural	80.7	-		-		7.1			-		65.5			-	
	Peri-Urban	85.4	1.40 (0.85 – 2.31)	0.186	1.35 (0.72 – 2.53)	0.352	6.6	0.93 (0.43 – 2.03)	0.859	0.49 (0.19 - 1.25)	0.134	72.2	1.40 (0.88 – 2.23)	0.152	1.12 (0.58 – 2.17)	0.739
	Urban	81.7	1.07 (0.68 – 1.68)	0.770	1.06 (0.58 – 1.93)	0.851	4.7	0.63 (0.29 – 1.41)	0.264	0.36 (0.13 – 0.97)	0.043	70.8	1.31 (0.85 – 2.03)	0.224	1.09 (0.58 – 2.08)	0.784
Facility level	Dispensary	83.6	-		-		6.6	-		-		72.4	-		-	
	Health centre	80.0	0.78 (0.52 – 1.17)	0.230	0.77 (0.47– 1.26)	0.301	5.3	0.78 (0.38 – 1.58)	0.483	0.93 (0.43 – 2.03)	0.853	63.0	0.63 (0.43 – 0.92)	0.017	0.62 (0.36- 1.05)	0.078

Univariate and multivariate models use mixed effect logistic regression. Univariate models adjust only for stated variable (fixed effects) and clustering at facility level (random effects). Multivariate models adjust for all three variables shown and SP actor (fixed effects) and facility (random effects). All 36 hospitals were excluded from this analysis as all were not-for-profit

Table A4: Detection survey

		Number of SP visits	No detection	Possible detection	Confirmed detection
	All facilities	901	853 (94.7%)	9 (1.0%)	39 (4.3%)
Profit status	Not-for profit	508	462 (90.9%)	7 (1.4%)	39 (7.7%)
	For-profit	393	391 (99.5%)	2 (0.5%)	0 (0.0%)
Location	Rural[1]	376	334 (88.8%)	6 (1.6%)	36 (9.6%)
	Peri-Urban	244	240 (98.4%)	1 (0.4%)	3 (1.2%)
	Urban	281	279 (99.3%)	2 (0.7%)	0 (0.0%)
Facility level	Dispensary	496	470 (94.8%)	4 (0.8%)	22 (4.4%)
	Health centre	261	240 (92.0%)	4 (1.5%)	17 (6.5%)
	Hospital	144	143 (99.3%)	1 (0.7%)	0 (0.0%)

[1]It appears that detection was most likely in rural health facilities. Based on discussions with our field staff, this was likely to be because they had fewer patients, and because the presence of an outsider or visitor to the area was much more notable and memorable in a rural area, even though SPs gave stories to try to explain their presence

Table A5 Results with confirmed and possible detections excluded

		Economic (any unnecessary care)					Clinical (any harmful care)					Public health (any antibiotic or antimalarial)				
			Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis			Univariate analysis		Multivariate analysis	
		%	OR	P value	OR	P value	%	OR	P value	OR	P value	%	OR	P value	OR	P value
Profit status	Not-for profit	81.7					5.0					65.0				
	For-profit	83.8	1.16 (0.77- 1.75)	0.466	1.02 (0.57- 1.81)	0.944	7.9	1.67 (0.85 – 3.29)	0.134	2.72 (1.10 – 6.72)	0.030	73.7	1.58 (1.07 – 2.33)	0.021	1.49 (0.79- 2.82)	0.214
Location	Rural	81.6	-				8.2					66.7				
	Peri-Urban	86.1	1.41 (0.83 – 2.37)	0.203	1.41 (0.77 – 2.70)	0.300	6.7	0.81 (0.38 – 1.73)	0.578	0.46 (0.18 – 1.16)	0.099	72.6	1.38 (0.85 – 2.26)	0.197	1.13 (0.56 – 2.27)	0.741
	Urban	81.6	1.00 (0.63 – 1.60)	0.985	1.04 (0.56 – 1.91)	0.906	4.7	0.54 (0.25 – 1.19)	0.128	0.35 (0.13 – 0.90)	0.030	70.6	1.24 (0.78 – 1.97)	0.356	1.06 (0.54 – 2.08)	0.870
Facility level	Dispensary	84.2					7.0	-				73.4	-			
	Health centre	80.3	0.77 (0.50– 1.16)	0.212	0.72 (0.43 – 1.21)	0.211	5.7	0.80 (0.40 – 1.62)	0.538	0.92 (0.42 – 1.99)	0.832	62.7	0.59 (0.39 – 0.87)	0.008	0.53 (0.28 – 0.94)	0.030

Univariate and multivariate models use mixed effect logistic regression. Univariate models adjust only for stated variable (fixed effects) and clustering at facility level (random effects). Multivariate models adjust for all three variables shown and SP actor (fixed effects) and facility (random effects)

Appendix 11: Supplementary material for Chapter 6 (as published)

Sample selection for SafeCare evaulation

Eligible facilities were dispensaries and health centres which are members of APHFTA (the Association of Private Health Facilities in Tanzania which represents mainly for-profit facilities), and dispensaries, health centres and hospitals which were members of CSSC (the Christian Social Services Commission which represents most mission facilities). Facilities were ineligible if they refused consent, provided specific services only (e.g. mental health or maternity), or were tertiary hospitals. Facilities were recruited from the Northern, Eastern, Central, Southern and Southern Highlands zones of Tanzania (Lake Zone was excluded because SafeCare had been rolled out there prior to study commencement).

The selection of study facilities was based on an initial long list of 975 private health facilities provided by the implementing partners (462 APHFTA member facilities and 513 CSSC member facilities). We then worked with the implementing partners to select a sampling frame of 280 facilities that potentially met study eligibility criteria. For the CSSC facilities, we selected a random sample of 124 health facilities, stratified by facility type (dispensary, health centre, hospital). For the APHFTA facilities, we were given a list of 156 health facilities that included dispensaries and health centres. Because of the sampling strategy, we do not claim that the study sample is representative of the broader population of health facilities in the study zones.

The partner organisations approached the 280 potentially eligible facilities to confirm eligibility, carry out sensitisation and obtain written informed consent to participate. Of these, 43 declined to participate in the study or were found to be ineligible, such that 237 facilities were recruited at baseline. Facilities were informed at sensitisation that there would be an endline assessment as well as other data collection for both intervention and control arms in order to measure the impact of the SafeCare package. 228 facilities were open and operating at the time of data collection.

Figure A1

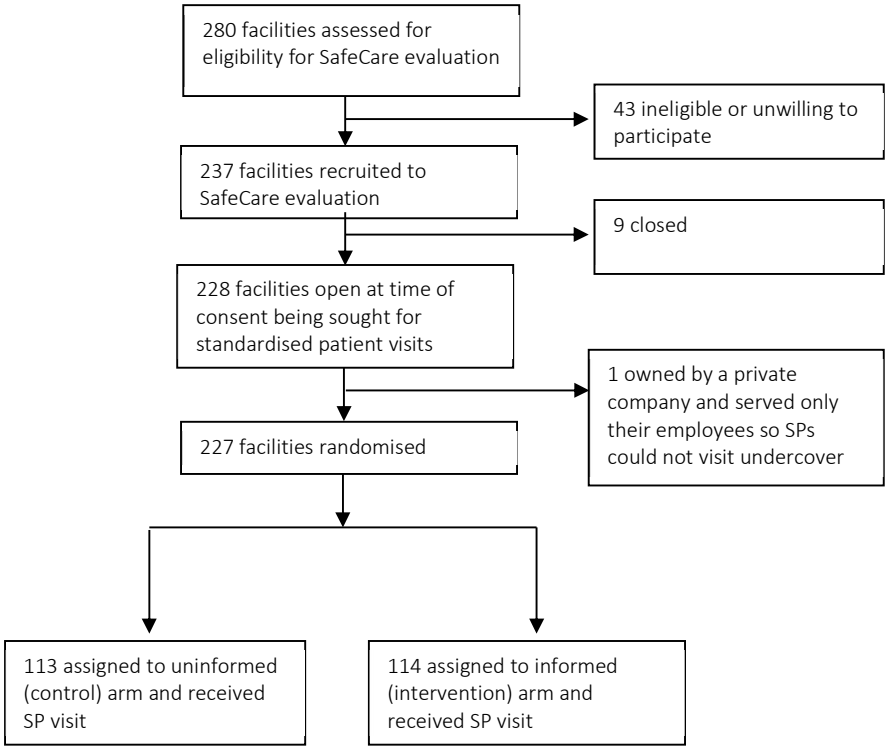


Table A1: Provider effort checklist

Table A1: Provider effort checklist

History taking	***% completed (informed)***	***% completed (uninformed)***	***Odds ratio***	***p***
Age (including during registration/triage)	100.0	96.5	0.13 (0.01 – 2.38)[1]	0.167
Occupation (including during registration/triage)	24.8	25.4	0.98 (0.52 – 1.84)	0.957
Time of day of symptoms	6.2	19.3	3.54 (1.43 – 8.76)	0.006
Duration of symptoms/symptom onset	84.1	86.0	1.20 (0.57– 2.53)	0.625
Productive cough	57.5	58.8	1.11 (0.65 – 1.91)	0.698
Coughing blood	1.8	3.5	1.89 (0.33 – 10.8)	0.473
Any fevers	68.1	67.5	0.93 (0.53 – 1.65)	0.809
Any wheezing	0.9	0.0	-	
Any breathing difficulty/shortness of breath	7.1	15.8	2.51 (10.3 – 6.14)	0.043
Any chest pain	38.6	32.7	1.35 (0.77 – 2.35)	0.296
Loss of appetite	14.0	9.7	1.45 (0.63 – 3.32)	0.380
Other health seeking	35.4	55.3	2.26 (1.31 – 3.90)	0.003
History of TB	0.0	0.0	-	
History of allergies	2.7	2.6	1.24 (0.27 – 5.68)[1]	0.779
Smoker	99.1	95.6	0.16 (0.02 – 1.45)	0.103
Physical examinations				
Takes pulse	28.3	22.8	0.78 (0.43 – 1.44)	0.436
Takes blood pressure	37.2	36.0	0.95 (0.55 – 1.65)	0.856
Takes temperature with thermometer	23.0	29.0	1.31 (0.72 – 2.41)	0.376

Examines throat	19.5	22.8	1.21 (0.63 – 2.33)	0.571
Listens to chest with stethoscope	20.4	30.7	1.61 (0.87 – 3.01)	0.132
Odds ratios are estimated from logistic regression models controlling for study strata. [1] indicates *firthlogit* (penalised maximum likelihood logistic regression) used to deal with separation				

Table A2: Experimental outcomes controlling for SP fixed effects

	Difference	**p**
Prescriptions		
Prescribed any antibiotic	-7.1% (-15.8% - 1.6%)	0.109
Prescribed any drug **(using *firthlogit* to deal with separation)**	12.9% (166.2% - 192.0%)	0.887
Prescribed WHO Watch antibiotic	6.4% (-2.5% - 15.2%)	0.154
Prescribed drug other than antibiotic	1.6% (-4.5% - 7.7%)	0.600
Intensity of care		
Mean total expenditure (USD)	0.14 (-0.78 – 1.06)	0.763
Mean tests ordered	-0.16 (-0.41 – 0.10)	0.211
Mean drugs prescribed	0.04 (-0.21 – 0.30)	0.718
Antibiotics	-0.06 (-0.18 – 0.05)	0.243
Non-antibiotics	0.11 (-0.12– 0.34)	0.339
Mean checklist items completed (/20)	0.56 (-0.12 – 1.24)	0.101

Full regressions for Exhibit 2

Outcome= Prescribed any antibiotic			
Logistic regression		Number of obs=	227
		LR chi2(4)=	4.16
		Prob > chi2=	0.3842
	Log likelihood = -72.368694	Pseudo R2=	0.0280
	Odds Ratio	SE	
Informed	0.417089	0.2002089	
Strata=2	1.208472	0.7596945	
Strata=3	1.347645	0.8448462	
Strata=4	1.173936	0.6997053	
Constant	30.47546	28.49313	
Predictive margins	dy/dx	SE	
Informed	-0.0781868	0.0437852	

Outcome= Prescribed any drug			
Logistic regression		Number of obs=	227
		LR chi2(4)=	0.01
		Prob > chi2=	1.0000
	Log likelihood = -20.116164	Pseudo R2=	0.0001
	Odds Ratio	SE	
Informed	1.01173	1.035193	
Strata=2	.9656746	1.389851	
Strata=3	1.075112	1.547988	
Strata=4	1.018726	1.454403	
Constant	53.97964	104.0177	
Predictive margins	dy/dx	SE	
Informed	-0.0002019	0.0177141	

Outcome= Prescribed WHO Watch antibiotic			
Logistic regression		Number of obs=	227
		LR chi2(4)=	4.40
		Prob > chi2=	0.3540
	Log likelihood = -78.58665	Pseudo R2=	0.0273
	Odds Ratio	SE	
Informed	1.933838	.8559833	

Strata=2	.4655335	.2981658	
Strata=3	.7770407	.4278804	
Strata=4	.6289321	.3569554	
Constant	.0640939	.0539074	
Predictive margins	dy/dx	SE	
Informed	.065576	.0443387	

Outcome= Prescribed drug other than antibiotic			
Logistic regression		Number of obs=	227
		LR chi2(4)=	2.31
		Prob > chi2=	0.6798
	Log likelihood = -45.80495	Pseudo R2=	0.0245
	Odds Ratio	SE	
Informed	1.510203	.9237177	
Strata=2	1.037256	1.063379	
Strata=3	.7604037	.7147016	
Strata=4	.3918024	.3369874	
Constant	14.18943	16.64527	
Predictive margins	dy/dx	SE	
Informed	.0204119	.0306143	

Outcome= Mean total expenditure (USD)			
Linear regression		Number of obs=	227
		F(4, 222) =	6.73
		Prob > F =	0.0000
		R-squared=	0.1082
		Adj R-squared=	0.0921
		Root MSE=	3.4246
	Coefficient	SE	
Informed	0.178052	0.461027	
Strata=2	0.354046	0.658482	
Strata=3	-2.33315	0.642349	
Strata=4	-1.94611	0.644696	
Constant	6.369899	0.870872	

Outcome= Mean tests ordered			

Linear regression		Number of obs=	227
		F(4, 222) =	1.20
		Prob > F =	0.3130
		R-squared=	0.0211
		Adj R-squared=	0.0035
		Root MSE=	.95734
	Coefficient	SE	
Informed	-0.14162	0.128878	
Strata=2	0.293781	0.184075	
Strata=3	0.081359	0.179565	
Strata=4	0.228172	0.180221	
Constant	0.852599	0.243447	

Outcome= Mean drugs prescribed			
Linear regression		Number of obs=	227
		F(4, 222) =	1.21
		Prob > F =	0.3085
		R-squared=	0.0213
		Adj R-squared=	0.0037
		Root MSE=	.92009
	Coefficient	SE	
Informed	0.02435	0.123863	
Strata=2	0.106926	0.176913	
Strata=3	-0.11322	0.172578	
Strata=4	-0.25797	0.173209	
Constant	2.728723	0.233975	

Outcome= Mean antibiotics			
Linear regression		Number of obs=	227
		F(4, 222) =	0.70
		Prob > F =	0.5952
		R-squared=	0.0124
		Adj R-squared=	-0.0054
		Root MSE=	.40278
	Coefficient	SE	
Informed	-0.07894	0.054222	
Strata=2	0.0386042	0.0774453	

Strata=3	-0.0102749	0.0755478	
Strata=4	0.03273	0.0758238	
Constant	1.055444	0.102425	

Outcome= Mean non-antibiotics			
Linear regression		Number of obs=	227
		F(4, 222) =	1.64
		Prob > F =	0.1661
		R-squared=	0.0286
		Adj R-squared=	0.0111
		Root MSE=	.83456
	Coefficient	SE	
Informed	0.103294	0.11235	
Strata=2	0.068322	0.160468	
Strata=3	-0.10294	0.156536	
Strata=4	-0.2907	0.157108	
Constant	1.673278	0.212226	

Outcome= Mean checklist items completed			
Linear regression		Number of obs=	227
		F(4, 222) =	2.18
		Prob > F =	0.0719
		R-squared=	0.0378
		Adj R-squared=	0.0205
		Root MSE=	2.5218
	Coefficient	SE	
Informed	.6026192	.3394929	
Strata=2	.517935	.4848955	
Strata=3	-.5709297	.4730149	
Strata=4	.009393	.4747434	
Constant	5.067219	.641296	

Full regressions for Exhibit 4

Outcome= Prescribed an antimalarial			
Logistic regression		Number of obs=	227
		LR chi2(4)=	8.04
		Prob > chi2=	0.0901
	Log likelihood = -58.869275	Pseudo R2=	0.0639
	Odds Ratio	SE	
No antibiotic prescribed	2.954611	1.862145	
Strata=2	1.093514	0.67672	
Strata=3	0.802477	0.516026	
Strata=4	0.150185	0.165397	
Constant	0.099034	0.045645	

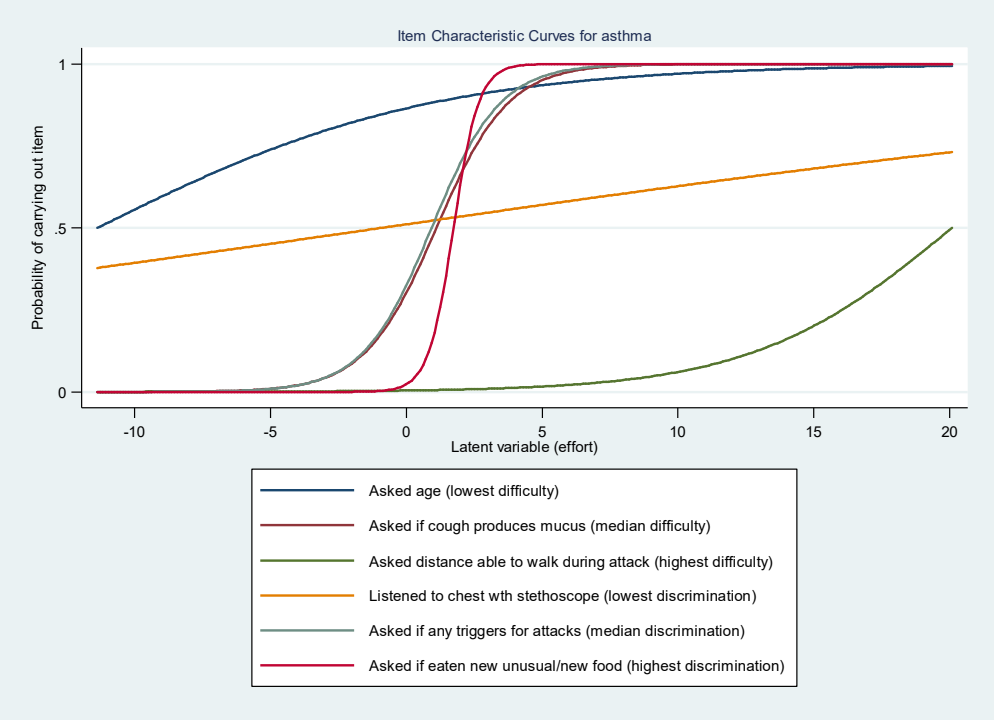
Outcome= Prescribed an antihistamine			
Logistic regression		Number of obs=	227
		LR chi2(4)=	7.56
		Prob > chi2=	0.1091
	Log likelihood = -121.91171	Pseudo R2=	0.0301
	Odds Ratio	SE	
No antibiotic prescribed	2.772178	1.270952	
Strata=2	0.864385	0.418627	
Strata=3	1.292869	0.579254	
Strata=4	1.757758	0.772195	
Constant	0.232833	0.079281	

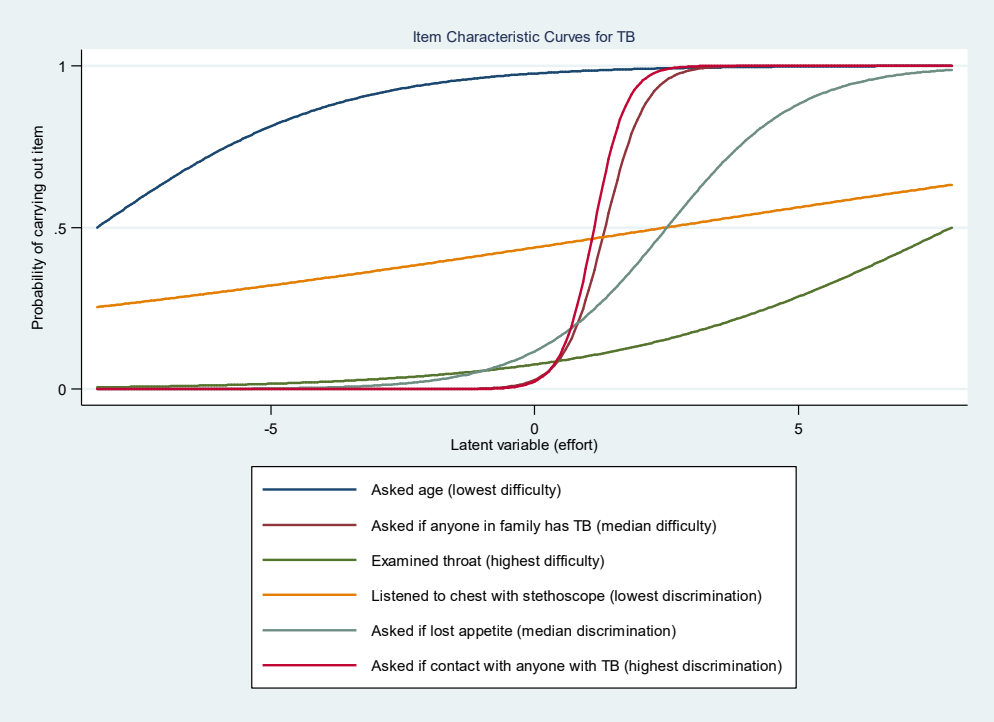
Outcome= Prescribed any symptomatic treatment			
Logistic regression		Number of obs=	227
		LR chi2(4)=	2.53
		Prob > chi2=	0.6393
	Log likelihood = -68.721284	Pseudo R2=	0.0181
	Odds Ratio	SE	
No antibiotic prescribed	0.434156	0.264233	
Strata=2	1.185284	0.833498	

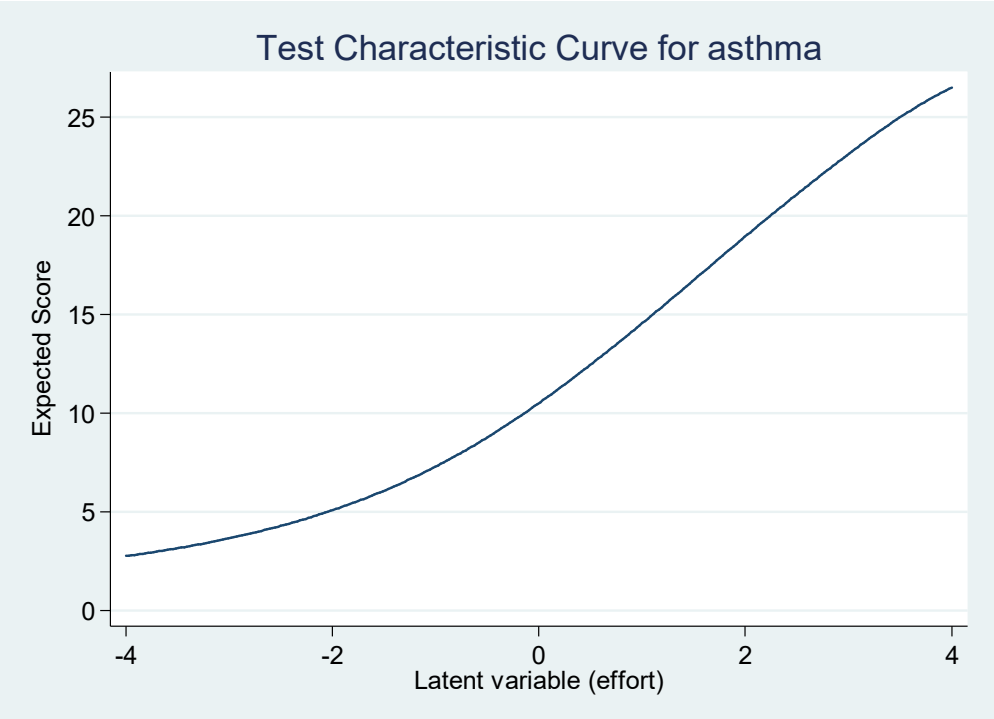
Strata=3	1.031536	0.686648	
Strata=4	0.683196	0.425073	
Constant	11.72506	5.727408	

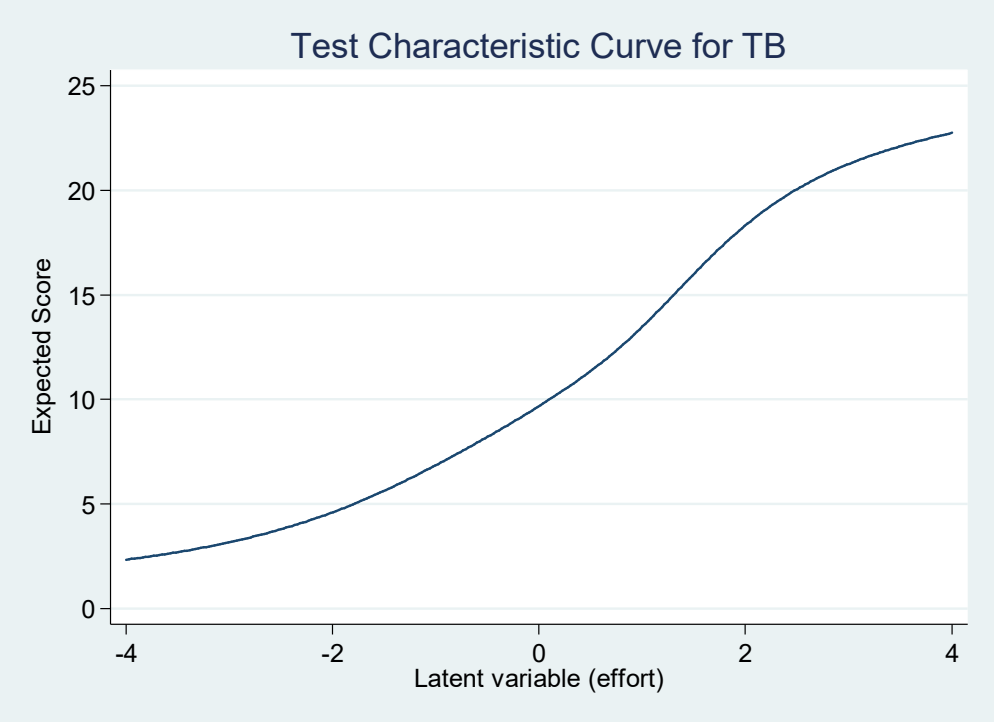
Appendix 12: Provider effort score

For both asthma and TB, graphs showing the item characteristic curves for the items with the lowest, median and highest difficulty and discrimination are given, along with the test characteristic curves showing the relationship between IRT score and number of items completed.




Item Characteristic Curves for TB
Probability of carrying out item
1
.5
0
-5
0
5
Latent variable (effort)
Asked age (lowest difficulty)
Asked if anyone in family has TB (median difficulty)
Examined throat (highest difficulty)
Listened to chest with stethoscope (lowest discrimination)
Asked if lost appetite (median discrimination)
Asked if contact with anyone with TB (highest discrimination)


Test Characteristic Curve for asthma
Expected Score
25
20
15
10
5
0
-4
-2
0
2
4
Latent variable (effort)


Test Characteristic Curve for TB
Expected Score
25
20
15
10
5
0
-4
-2
0
2
4
Latent variable (effort)