Mixed Methods Evaluation of a Médecins sans Frontières Noncommunicable Diseases Programme for Syrian Refugees and the Host Population in Jordan

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Declaration

I, Éimhín Mary Brassil Ansbro, 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.

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The evaluation described in this thesis was carried out in collaboration with the Ministry of Health of Jordan, and with Médecins sans Frontières (MSF) staff from their headquarters in Amsterdam, coordination team in Amman, and project team in Irbid, north Jordan, as well as staff and patients of the MSF noncommunicable disease clinics in Irbid. MSF co-authors, Karla Bil, Tomas Homan, Jamil Qasem, Shoaib Muhammad and Sara Ellithy, and data collectors, including Hashem Tani, made invaluable contributions to study design, data collection and analysis, and many other MSF staff members generously shared their insights during interviews. Drs Lucky Maconick and Sylvia Garry were joint first authors with me on two of the papers included in this thesis, and I am very grateful for their contributions to data analysis and writing.

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Abstract of Analytic Commentary

Introduction: Addressing non-communicable diseases (NCDs) in humanitarian crises is increasingly relevant as the global NCD burden grows in tandem with rising rates of forced displacement. When the Syrian crisis began in 2011, there were gaps in research, tools, and guidelines to support NCD care delivery in crises. This thesis summarises four publications evaluating a Médecins sans Frontières (MSF) NCD programme for Syrian refugee and host populations in Irbid, Jordan. The evaluation sought to support service improvement, knowledge generation and translation to other settings. The objectives of this analytic commentary are to:

1. Summarise and critically appraise the methods and key findings of the evaluation and four related publications.
2. Situate the key findings within the broader policy and operational context and within the relevant literature.
3. Discuss implications of the findings for research on NCDs in humanitarian settings and for my own work.

Methods: A mixed methods study, guided by the RE-AIM implementation framework, comprised routine cohort data analysis, qualitative and descriptive costing studies, clinical audit, medication adherence survey and secondary analysis of an MSF household survey.

Key Findings: This complex, multidisciplinary, vertical MSF NCD programme reached 25% of the target population. It was considered acceptable and accessible to patients, staff, and stakeholders; clinical guidelines were usable. Effectiveness was demonstrated by good clinical control and low defaulter rates. Implementation challenges included Syrian refugees' social suffering and sense of hopelessness, which limited their capacity to engage in self-care, and proved challenging for staff. Programme adaptations included introducing mental health and psychosocial support (MHPSS), humanitarian liaison and home visit services. However, MHPSS service uptake was limited by low patient awareness, doctors' distrust of the service, and mental health stigma. The programme's costs, driven by human resources and medications, rose as its complexity increased. Programme maintenance was hindered

by cost, short-term humanitarian funding and planning cycles, and limited integration within host systems.

Conclusions: NCD programmes in humanitarian crises should be context-adapted and patient-centred, providing a continuum of care, including MHPSS and referral services, and catering for the range of clinical complexity within an NCD patient cohort. They should strive to be cost efficient while affordable and be designed in a participatory way, taking health system strengthening and sustainability perspectives to maintain continuity of care for the patient cohort, where possible. This evaluation built on previous cohort analyses, presented the first micro-costing study and MARS-5 medication adherence study, and added to the sparse published qualitative literature in this area. It contributed methodologically to indicator development, and conceptually to a framework for NCD care models in humanitarian settings. Its findings may support other actors engaged in NCD care in humanitarian crises.

Contents

Tables and Figures

Abbreviations

CFIR	Consolidated Framework for Implementation Research
COPD	Chronic Obstructive Pulmonary Disease
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
eGFR	estimated Glomerular Filtration Rate
ELRHA	Enhancing Learning and Research for Humanitarian Assistance
FBG	Fasting Blood Glucose
FGD	Focus Group Discussion
GP	General Practice/Practitioner
HbA1C	Glycosylated Haemoglobin
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
HTN	Hypertension
HQ	Headquarters
ICRC	International Committee of the Red Cross and Red Crescent
IDP	Internally Displaced Person
(I)NGO	(International) Non-governmental Organisation
IRC	International Rescue Committee
LMIC	Low- and Middle-Income Country
LSHTM	London School of Hygiene & Tropical Medicine
MARS-5	Medication Adherence Report Scale – 5 item
MHPSS	Mental Health and Psychosocial Support
MOH	Ministry of Health
MSF	Médecins sans Frontières
NCD	Noncommunicable Disease

PCI	Primary Care International
PEN	Package of Essential Noncommunicable Disease Interventions
PhD	Doctor of Philosophy
PRISM	Practical, Robust Implementation and Sustainability Model
RE-AIM	Reach, Effectiveness, Adoption, Implementation, Maintenance
(S)BP	(Systolic) Blood Pressure
TB	Tuberculosis
UN	United Nations
UNHCR	United Nations High Commission for Refugees
UNRWA	United Nations Relief and Works Agency
WHO	World Health Organization

SECTION 1: ANALYTICAL COMMENTARY

Preamble

This thesis is being submitted for consideration for a PhD by Prior Publication. It comprises a thematically linked portfolio of four publications and a 15,000-word critical analytic commentary, structured according to the London School of Hygiene's (LSHTM) doctoral college guidance, consisting of a summary of the portfolio of four publications and an analysis of the work in context.

The four submitted publications are drawn from a mixed methods evaluation of a non-communicable disease (NCD) programme for Syrian refugees and the vulnerable Jordanian population, delivered by Médecins sans Frontières (MSF) in Irbid, Jordan. The papers are referred to throughout the text as follows:

1. **Paper 1 (RE-AIM):** MSF experiences of providing multidisciplinary primary level NCD care for Syrian refugees and the host population in Jordan: an implementation study guided by the RE-AIM framework. Ansbro É ; Homan T; Qasem J; Bil K; Rasoul Tarawneh M; Roberts B; Perel P; Jobanputra K. 2021. BMC health services research(1).
2. **Paper 2 (Cohort Analysis):** Clinical outcomes in a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: A cohort analysis using routine data. Ansbro É ; Homan T; Prieto Merino D; Jobanputra K; Qasem J; Muhammad S; Fardous T; Perel P. 2021. PLoS medicine(2).
3. **Paper 3 (Mental Health):** "To die is better for me", social suffering among Syrian refugees at a noncommunicable disease clinic in Jordan: a qualitative study. Maconick L; Ansbro É; Ellithy S; Jobanputra K; Tarawneh M; Roberts B. 2020. Conflict and Health (3).
4. **Paper 4 (Costing):** Delivering a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: a descriptive costing study. Ansbro, Éimhín; Garry, Sylvia; Karir, Veena; Reddy, Amulya; Jobanputra, Kiran; Fardous, Taissir; Sadique, Zia. 2020. Health Policy and Planning (4).

1. Background

1.1. Global noncommunicable diseases burden and response

NCDs, such as cardiovascular disease (CVD), hypertension (HTN) and diabetes (DM) account for almost three quarters (74%) of annual global mortality, and a significant proportion of morbidity and long-term disability (5–7). Low-and-middle income countries (LMICs) are disproportionately affected, suffering 77% of all NCD deaths and over 85% of all premature deaths (those occurring before the age of 70). Premature NCDs deaths are more likely to occur in countries where health systems are poorly equipped to manage NCDs, or among marginalised populations with limited healthcare access, and these premature deaths may bring significant socioeconomic consequences for families, communities and national economies (6,8,9).

Most global NCD deaths are due to cardiovascular disease, and HTN and DM are key CVD risk factors (10). Since 1990, the number of people aged 30-79 years with hypertension has doubled. Of these, 82% (over 1 billion people) live in LMICs (11). Diabetes prevalence is rising rapidly and now affects around 9.3% of adults globally, and up to 12.2% in the Middle East and North Africa (MENA) region (12). The NCD epidemic is due to the growth and ageing of the world's population, and to increasing urbanisation, which is associated with reduced physical activity and increased consumption of unhealthy, highly processed foods, alcohol and tobacco(7,13). To prevent NCDs, cost effective population-level policies and interventions are needed to reduce exposure to NCD risk factors (14). A number of these have been identified by WHO as "best buys", including raising taxes on tobacco products, and alcoholic and sugar-sweetened beverages, and providing drug therapy for people who have had heart attacks or strokes (15).

Over the last decade, NCDs have risen up the global health agenda. The United Nations (UN) General Assembly's High-Level Meeting on NCD in 2011 resulted in the UN Political Declaration on Prevention and Control of Noncommunicable Diseases and the development of a Global Action Plan (NCD GAP) 2013-2020 (16,17). However, this has not been

accompanied by the large-scale funding initiatives seen with diseases such as HIV/AIDS (18,19).

NCDs are generally life-long conditions, and they require continuity of care, which is longitudinal, consistent and coordinated across different levels of health and social care systems (20). Health systems must, therefore, be capable of providing integrated NCD care. WHO defines health service integration as: "The management and delivery of health services such that people receive a continuum of health promotion, disease prevention, diagnosis, treatment, disease-management, rehabilitation and palliative care services, through the different levels and sites of care within the health system, and according to their needs throughout the life course"(21). Integration aims to improve 'person centredness' by building care around the individual, their family and their expressed needs and values (21). Integrating NCD care with care for other conditions is also essential, given most older people live with multiple chronic conditions, and NCDs often co-exist with mental health conditions and chronic communicable disease, such as HIV and TB (22–27).

Traditionally in many LMICs, NCD care has been delivered by specialists at secondary or tertiary hospital level, limiting patient access in terms of availability, physical distance and affordability. However, it is increasingly recognised that care for NCDs should be integrated within a strengthened primary care system, ideally as part of a universal health care (UHC) package (14,20,24). There is also an opportunity to use the differentiated care delivery approach to upscaling HIV treatment as a blueprint to improving NCD care (28). This involves decentralisation of care from hospital level to primary and community levels in a context-adapted way, along with task sharing and community engagement (14,25,29). Key health system inputs also require strengthening to improve access and quality of NCD care, including health information systems, workforce capacity, and medicines and equipment supply chains.

1.2. NCDs in humanitarian settings - burden and response

Over 250 million people are estimated to be affected by humanitarian crises annually, and in 2022, a record 103 million people were forcibly displaced, as internally displaced persons

(IDPs) or refugees (30). Humanitarian crises are defined as events stemming from armed conflicts, natural disasters, or food insecurity that threaten the health and safety of a community. Conflicts and displacement crises have become more protracted, while socio-environmental disasters are increasing in severity and frequency in countries of all income levels, fuelled by the climate crisis (31–33). Crises may require an international response from the humanitarian sector, international non-governmental organisations (INGOs) and UN agencies (34,35).

Most humanitarian crises occur in LMICs and several current crises are taking place in middle-income countries with significant NCD burdens, including Syria, Yemen and Ukraine (30,36–38). People living with NCDs are at risk of experiencing acute exacerbations or complications during such crises (39,40). Their access to essential NCD care and medicines may be limited by insecurity or displacement, by interrupted supply chains and services, by irregular food supplies, and by targeted destruction of health facilities and weakened health systems (41–45).

As humanitarian crises and the growing NCD burden converge, it has become more urgent to include NCDs in humanitarian response. However, the need to address NCDs in humanitarian crises was not acknowledged in global policy until the third UN High Level Meeting on NCDs in 2018 (46). Since then, the impact of the Covid-19 pandemic on people living with NCDs has greatly reinforced the need for the international community to include NCDs in emergency preparedness and response planning and funding (47).

Until a decade ago, humanitarian actors had limited experience of delivering NCD care. NCDs were often "forgotten" or responses tended to be "ad hoc", "disorganised" or delayed (48,49). For example, at the onset of the Syrian crisis in 2011, guidance to support humanitarian agencies to develop effective models of NCD care in crisis contexts was very limited; what guidance did exist was adapted from high-income, stable settings (41–43,50). While the United Nations Relief and Works Agency (UNRWA) had been providing diabetes and hypertension care for Palestinian refugees since the 1990s, other humanitarian actors, such as the United National High Commissioner for Refugees (UNHCR), Médecins sans Frontières (MSF), and the International Committee of the Red Cross (ICRC) had scant internal

guidance and limited NCD medication on their essential medicines lists (41,42,51,52). The Sphere Handbook, which sets out minimum standards for quality in humanitarian response, barely mentioned NCDs in the 2011 edition (53).

While recognising the growing need to address NCDs, emergency medical organisations, such as MSF, internally debated the relevance of NCDs to their mandate of providing life-saving care and relief of suffering in acute crises (41,42). However, the changing global burden of disease and the Syrian crisis catalysed the humanitarian sector to address chronic conditions more formally (42). They adapted humanitarian models of health care, which traditionally provided acute care for communicable diseases, to better address chronic NCDs. Within MSF, for example, an internal discussion document was produced, NCD advisors were gradually appointed from 2012 onwards at headquarters (HQ) level, and pilot stand-alone NCD projects were sanctioned (including one in Jordan that became the full-scale project whose evaluation forms the basis for this PhD). Internal clinical and operational guidelines were developed, which became widely used by MSF and other humanitarian actors (54).

Humanitarian agencies' lack of engagement on NCDs resulted in a lack of experience of NCD programming among their management staff. Similarly, there was a lack of capacity among project level health workers in delivering acute or chronic care for NCDs in crises, because, in their settings, NCD care had typically been delivered at specialist level (48,55). To help address this, in parallel with internal MSF developments, UNHCR partnered with Primary Care International (PCI) in 2014 to develop and deliver clinical guidance and training to health staff from UNHCR, partner organisations, and host country agencies (55).

Humanitarian implementing organisations have continued to call for tools to better understand the NCD burden and needs in acute crises (48). They emphasise the need for rigorous monitoring and evaluation of novel models of care to identify weaknesses and learn lessons, and for the development of tools and guidance to support programming that is appropriate and adaptable to LMIC humanitarian settings, and that takes a person-centred and integrated approach to care (41,48,56).

1.3. NCDs in humanitarian settings - research landscape

The evidence base to support NCD responses in crises was fairly negligible until recently. A 2015 systematic review on effectiveness of NCD interventions in humanitarian settings found only eight relevant studies published since 1985, with half published using UNRWA data from stable Palestinian refugee camps, which are atypical compared to humanitarian settings globally (57). Implementation research is very limited, as is evidence on NCD burden and access to care among crisis-affected populations, and on cost-effective care models (42,49,57,58). There is a key evidence gap on patient and provider experiences and preferences, patient empowerment approaches and on patient costs(48). In addition, evidence on NCD prevention activities in crisis settings, such as alcohol and tobacco control, regulation of the food industry and promotion of health eating and exercise, is almost completely lacking (59,60).

Funding for research in humanitarian crises, including on NCDs, has been extremely limited and short-term, leading to studies of short duration that cannot demonstrate impact on hard clinical outcomes, such as mortality (48,56). Humanitarian project-based funding cycles, which are typically of one to two years, are also a poor fit for chronic disease care and related research (48,49). Commentators have, therefore, called for more high quality research to explore cost-effective models of care for NCDs in humanitarian settings (41–43,48).

1.4. Analytical commentary objectives

Prior to the Syrian Crisis, MSF's limited engagement in NCD care involved several small pilots modelled on HIV programmes. The Syrian crisis, however, drew unprecedented attention to NCDs, since they constituted the greatest unmet health need. In 2014, given their lack of institutional experience, and the need for guidance and evidence on delivering effective models of NCD care in crises, MSF decided to pilot NCD care models in diverse humanitarian settings and to evaluate them, via funding a research fellowship that I undertook at LSHTM. This PhD was built around the evaluation of an MSF NCD programme targeting Syrian refugees and the host population in Irbid, north Jordan. The evaluation was published as four linked

peer-reviewed articles and this analytical commentary aims to summarise and critically appraise the papers' findings. The specific objectives of this analytic commentary are to:

1. Summarise and critically appraise the methods and key findings of the evaluation and four related publications

2. Situate the key findings within the broader policy and operational context and within the relevant literature

3. Discuss implications of the findings for research on NCDs in humanitarian settings and for my own work

2. Methods

2.1. Background to the MSF programme evaluation

To strengthen implementation research evidence on the management of NCDs in humanitarian settings, MSF undertook a mixed methods evaluation of their NCD programme serving the Syrian refugee and host populations in Irbid, north Jordan. The evaluation sought to learn lessons to refine the care model and to generate evidence on its feasibility, acceptability and effectiveness, with a view to informing programming in comparable humanitarian settings.

2.2. Study setting

For over a decade, the war in Syria has devastated the Syrian population and hugely impacted the surrounding countries. It is still the main driver of global displacement (30). Since 2011, over 6.1 million people were internally displaced in Syria, while over 6.8 million fled as refugees into neighbouring Jordan, Lebanon, and Turkey, and beyond (61). NCDs (mainly CVD, cancer, chronic respiratory disease, and diabetes) accounted for around 75% of total mortality in Syria before the war, and this NCD burden has been a key feature of the humanitarian health sector and host country responses to the crisis (62–66).

Jordan borders southern Syria and the two countries have close historical and familial ties. In 2017, at the time of this evaluation, Jordan hosted almost 670,000 UNHCR-registered Syrians (67). Globally, it ranked second only to Lebanon in number of refugees hosted relative to the national population (61). While Jordan set up a number of refugee camps, the majority (79%) of Syrian refugees lived in urban settings dispersed among the host population, and a minority resided in informal tented settlements (68).

Prior to the crisis, Jordan was an upper-middle-income country with a high human development index and a strong public health system, including a well-developed network of primary care facilities (66,69). It was, therefore, a relatively resource-rich and stable crisis-affected setting. During the crisis response, the Jordanian Ministry of Health (MOH) played a

strong leadership role, jointly coordinating with UNHCR the diverse health actors who provided care for Syrian refugees (66).

Figure 1. Map of Jordan

*Source: Nations online project: https://www.nationsonline.org/oneworld/map/jordan_map.htm#

In addressing its own rising NCD burden, Jordan had shifted focus from hospital- and specialist-delivered NCD care to strengthening services at primary care level (66). UNHCR-registered Syrian refugees could access free NCD services at MOH primary care centres until 2014, when co-payments were first introduced and later increased in 2018 (66). NGOs often provided free primary care but patients faced co-payments for laboratory examinations, medications and equipment, while private services were available but expensive (70). Access to public secondary or tertiary care required referral and was only part-funded by UNHCR, if eligibility criteria were met. Over time, growing complexity, which was difficult for both patients and NGOs to navigate, and increasing co-payments reduced Syrian refugees' access

to public services, and, in response, many shifted care-seeking towards NGOs and the private sector (66,71–73).

To support Jordan's response to the Syrian crisis, in December 2014, MSF commenced an NCD programme in Irbid, Jordan's second largest city, which is located just 30 minutes south of the Syrian border. Irbid governorate hosts over 165,000 Syrian refugees, the largest number outside of the Jordanian capital, Amman (72). The NCD programme built on an MSF NCD pilot project in Irbid that I co-developed in early 2014 as MSF project doctor. A first programme site was set up within an MOH primary care facility in December 2014 and a second opened within a local NGO clinic in April 2016. The MSF programme was vertical, operating in parallel to pre-existing activities at each site, rather than integrating with them. The cohort size of patients was capped by MSF at approximately 4,000 for operational and cost reasons (72).

The NCD intervention comprised a multi-disciplinary, primary-level programme, using context-adapted clinical guidelines and medications, based on the MSF and WHO Essential Medicines Lists. It targeted diabetes, hypertension, cardiovascular and chronic respiratory diseases among urban-based Syrian refugees and the vulnerable Jordanian host population. Patients received consultations, medications (low-cost generics) and laboratory testing free-of-charge, in line with MSF policy. The programme evolved from initially providing medical consultation and health education, to later including mental health and psychosocial support (MHPSS), a home visit service for house-bound patients, a humanitarian support service, and physiotherapy services. Care was initially provided by non-specialist doctors with a team of nurses, trained health educators, and pharmacists. Later, family medicine specialists, psychosocial counsellors, physiotherapists, a social worker, and a home care team were added.

2.3. MSF programme evaluation design

Evaluating interventions in humanitarian settings is challenging as the context may be volatile and insecure, populations are acutely vulnerable and may be mobile, there is severely limited

time, capacity and funding for research, and data may be in accessible and of limited quality (34,35,56,74,75). Evaluations of chronic disease care in most settings are challenging because of the complexity of care, which often involves multi-faceted interventions involving (older) patients with multimorbidity(76). It can be difficult to demonstrate the impact and generalisability of such interventions if they are not developed in ways that allow rigorous evaluations to be performed; for example, by developing an intervention using a theoretical underpinning, clearly defining intervention components, and linking them to relevant outcomes (including patient-reported outcomes) (77).

2.4. RE-AIM Implementation Framework

This MSF programme evaluation design was guided by the RE-AIM Implementation Framework. RE-AIM is one of the most cited implementation research frameworks and it has been successfully used to plan and evaluate interventions in both high-income and LMIC settings (78). The framework aims to assess complex programmes under five key domains: reach, effectiveness, adoption, implementation, and maintenance (discussed further below). It seeks to improve the reporting of implementation factors, that is, key elements for successful programme implementation at both individual- and organisational-levels, which may support learning, scale-up or translation to other settings (78–82).

MSF's aim to learn lessons applicable to other settings was well served by RE-AIM's facilitation of contextualised learning. While colleagues and I had limited experience of its use, to the best of my knowledge, this was the first comprehensive use of RE-AIM to evaluate a humanitarian NCD intervention (83).

2.5. Overall study approach

The study design sought to address the RE-AIM domains, using methods that were pragmatic and feasible to undertake in a humanitarian setting. I designed a mixed methods evaluation that comprised: secondary analysis of data from a pre-existing cross-sectional household survey (72); retrospective analysis of routine cohort data; a descriptive costing study; a clinical audit; a self-administered medication adherence survey; and qualitative research. The

evaluation took place in late 2017 and covered the study period December 2014 to December 2017.

For this evaluation, the RE-AIM domains were defined with reference to the relevant literature, with some adaptations, as follows (78–81):

Reach was defined as coverage of the NCD service and its components to the intended target population, and included a focus on MHPSS services, as MSF was interested in exploring integrating MHPSS care with physical NCD services.

Effectiveness was determined by examining: 1) trends in intermediate clinical outcomes [control of systolic blood pressure (SBP) and blood sugar (fasting blood glucose – FBG – and glycosylated haemoglobin – HbA1c)] and treatment delay, 2) quality of care indicators, and 3) behavioural outcomes (smoking, exercise and diet).

Adoption/acceptance were explored in relation to the organisation, setting, staff and patients (including medication adherence) and included changes to behaviour and practice. The Adoption domain is usually a "setting-level" outcome, defined in the literature in terms of absolute number, proportion, and representativeness of settings and intervention agents who are willing to initiate a programme. Since there was no choice for staff or settings to take part in the MSF programme, I adapted this domain to cover patient and staff adoption of the programme, including participation, access and acceptability. Access was defined in line with Penchansky and Thomas's elements of access: availability, accommodation, affordability, physical accessibility and acceptability (84). I also explored barriers to access.

Implementation of the NCD service was explored in relation to each programme component (medical consultation, health education, MHPSS, social work). Fidelity is usually used to determine adherence to an intervention across different implementation sites. This sub-domain was adapted to examine the fidelity of guideline implementation (using process indicators) and its usability. This domain also covered the adaptation of structures, processes and tools, and the costs of implementation.

Maintenance referred to the continued implementation of the NCD service over time by patients and the programme team, at individual and organisational levels.

The specific indicators and methodologies used to operationalize these definitions are listed in Annex 1. Findings from the different methods were integrated using a convergent approach, and synthetized using the RE-AIM framework (85).

In Paper 1 (RE-AIM), the evaluation's overarching findings were presented according to the RE-AIM framework domains (1). Paper 2 (Cohort Analysis) examined *Effectiveness* via cohort data analysis(2) Paper 3 (Mental Health) considered the RE-AIM domains *Adoption*, *Implementation* and *Maintenance* and addressed themes around mental health, social suffering and hope, and their influence on NCDs (3). These themes arose inductively from the qualitative analysis, and additional analysis was undertaken given their prominence in the data (3). Paper 4 (Costing) focussed on the descriptive costing analysis, and was also linked to the *Adoption*, *Implementation* and *Maintenance* framework domains (4).

2.6. Individual method data sources and analysis

The study methods are summarised here and more detail is available in the four thesis papers and their annexes (Section 2). I led the study design and analysis, and the Irbid MSF team, LSHTM staff and MSc students supported data collection and analysis. They are included as co-authors of the published papers, along with my supervisors, and their initials are included in the relevant sections below.

2.6.1 Household survey

To explore *Reach*, I conducted secondary analysis of a Household Access and Utilisation Survey, performed by MSF in Irbid governorate in 2016 to inform health service planning for the refugee population. MSF estimated the prevalence of NCDs and NCD multi-morbidity and determined factors associated with high NCD prevalence. Data collection and analysis are described in detail elsewhere (72).

2.6.2 Retrospective cohort study

To explore *Reach, Effectiveness, Adoption/acceptance* (specifically access) and *Implementation,* data from all patients who ever attended an enrolment visit in MSF's NCD clinics from December 2014 to December 2017 were analysed retrospectively. Routine paper-based clinical data were collected by an MSF data clerk and entered into a bespoke password-protected Microsoft Excel software database. Cohort data from both clinical sites were aggregated and analysed using R v1.0.136 (R, Boston, MA 02210, USA).

The MSF epidemiologist (TH) undertook descriptive statistical analysis to examine patient demographics, NCD prevalence, and process indicators, including service use. A senior LSHTM statistician (DPM) explored trends in the control of intermediate clinical outcomes [blood pressure (SBP < 140 mmHg) and glycaemia (FBG ≤ 180 mg/dL or HbA1c < 8%] and treatment delay or interruption from programme and patient perspectives, and the factors associated with these trends, among a subset of patients 18 years or older with HTN/DM type II (DM II)(2). Monthly means for each outcome (SBP, FBG, HbA1c or treatment delay/interruption) were plotted and the proportion of monthly visits at which targets were achieved was calculated. Generalised Linear Mixed-Effects Models were used to explore factors associated with each outcome.

2.6.3 Costing study

To explore components of *Implementation* and *Maintenance*, a descriptive costing analysis from the provider perspective calculated the programme's annual total, per patient and per consultation costs for the period 2015-2017. I used a combination of step-down and ingredients-based approaches, previously used in economic evaluations of health interventions in LMIC settings (86–89). Data collection was supported by the MSF epidemiologist (TH) and an MSc student (SG), using Excel sheets I designed. I undertook the descriptive analysis, supported by SG. Endpoint costs were expressed as cost per patient active at the end of each year, and cost per consultation per year. I performed multifactorial scenario analyses around drug and personnel costs, the key drivers of total cost, to explore areas where greater cost efficiency might be gained.

2.6.4 Clinical audit

To examine elements of *Effectiveness* and *Implementation,* the clinical audit aimed to explore programme quality and the fidelity of guideline implementation. A random selection of paper files from patients enrolled at least 12 months in the programme was analysed. Data were extracted in August 2017 by MSF medical staff using a paper-based checklist I had designed, and entered into a purpose-designed Excel spread-sheet. I analysed the data using descriptive statistics.

2.6.5 Medication adherence survey

To explore patient *Adoption/acceptance* (including medication adherence), a convenience sample of 300 consenting patients aged 18 or over, attending MSF clinics over two weeks in September 2017 was selected. I designed the 17-item survey, which included demographic information and a pre-existing self-reported medication adherence tool: the Medication Adherence Report Scale-5 item (MARS-5) (90–93). I trained two data collectors who took written informed consent, and supported patients to self-fill the survey in Arabic, assisting those with limited literacy. Analysis was undertaken by an LSHTM statistician (DPM), and included descriptive statistics and multivariate logistic regression.

2.6.6 Qualitative study

A qualitative study was included to explore each of the RE-AIM domains. It involved two focus group discussions (FGDs), with Syrian patients, and 40 individual semi-structured interviews: 16 with Syrian and Jordanian patients, 18 with MSF staff, and seven with key stakeholders. Patients were stratified by NCD diagnosis, then randomly selected for invitation to participate in an interview or FGD. MSF staff were purposively selected to represent a range of cadres. Key stakeholders included representatives of the Syrian community, the Jordanian MOH, and NGOs involved in delivering NCD care. Two trained Arabic speaking MSF staff (SE) and I collected data face-to-face, in Arabic or English, during a three-week study visit in August 2017. Two online interviews were undertaken with international MSF staff who had left the project. I coded the transcripts with an LSHTM MSc student (LM), and performed thematic analysis, based on the RE-AIM framework, using a combination of inductive and deductive

approaches. LM undertook additional analysis focussing on the mental health themes that arose inductively from the initial analysis for her MSc research project, which I supervised.

2.7. Ethics

The study protocol was approved by the MSF Ethics Review Board and LSHTM Ethics Committee. Written authorisation to implement the study was obtained from the Ministry of Health of Jordan. Further details on ethical procedures are provided in the individual papers.

2.8. Positionality Statement

From a socio-cultural perspective, I am a white, cisgender, Irish woman, a native English speaker from a high-income country, who has lived and worked in LMICs. Professionally, I am medically trained, specialising in General Practice (GP; primary care and family medicine), a public health researcher and former project doctor with MSF. I co-authored the MSF NCD clinical guidelines and co-designed the Irbid NCD pilot, which became the project I evaluated and present in this thesis. The evaluation design was influenced by my own and my supervisors' professional backgrounds. My MSF supervisor was an operational researcher with experience in HIV care, and a trained GP, and my academic supervisors' research focussed on humanitarian programming, health systems, MHPSS, NCD care and NCD risk factors (alcohol and tobacco) in LMIC and humanitarian settings. Certain process and outcomes indicators were, therefore, emphasised, for example, prescribing of cardiovascular secondary prevention medication and referral for MHPSS services.

Medical training tends to take a naïve realism ontological approach, heavily influenced by "evidence-based medicine" (94,95). General practice training tempers this, emphasising the biopsychosocial model and need to adapt evidence-based practice to individuals and their social context. During my MSc, I encountered the critical realist perspective, which posits that reliable knowledge and progress in understanding can be developed, while acknowledging that knowledge is socially constructed (94,96). My ontological position when designing this study reflects my personal transition from a more positivist approach to a critical realist approach.

My epistemological position is a combination of objectivism and constructionism and, while the evaluation's theoretical perspective was interpretivist, the design was clearly influenced by a positivist medical approach. For example, including quantitatively determined indicators of effectiveness and quality reflects the positivist approach of the natural sciences, while the combination of deductive and inductive coding of qualitative data facilitated both an exploration of pre-specified themes and of patients' and providers' world views and experiences. The final RE-AIM-guided synthesis took a critical realist perspective, acknowledging that the lessons learned could be generalizable but that the context and the individual's experiences played a key role in implementation (94). The analysis of mental health-related findings applied a bounded relativism approach, proposing that one shared reality could exist for Syrian refugee patients, which differed from the reality experienced by Jordanian patients (94).

I was both an insider (within MSF and the medical fraternity) and an outsider (socio-culturally with Syrian refugees and Jordanians, and as researcher from a university tasked with evaluating the programme) (97). The implications of my dual insider/outsider status are discussed further in section 4.2.

3. Results

This section summarises the evaluation's key findings, which were included in the four linked papers submitted as part of this thesis. They are presented according to the RE-AIM framework domains. When indicators relating to a single theme (for example, medication adherence) were included under several RE-AIM domains (Annex 1), findings were consolidated and presented under a single domain. Detailed results, including supportive quotes from the qualitative findings, and their discussion are available in the four thesis papers. Where limited detail was included in the published papers, due to space limitations, I added additional analysis extracted from the longer evaluation report.

Overall, the evaluation found that a humanitarian actor could deliver primary level NCD care that was effective and acceptable to patients and staff, in a crisis-affected setting. However, these findings must be interpreted in the light of the programme's characteristics and the broader context. MSF learned three key implementation lessons, and adapted the

programme iteratively to respond to them. First, crisis-affected populations with NCDs have multiple needs, especially MHPSS, which benefit from a person-centred, multidisciplinary approach to care. Second, NCD care encompasses a broad range of patient complexity, from asymptomatic hypertensive patients, to frail, elderly patients with advanced disease and multi-morbidity. It is, therefore, important to design a service that is flexible and adaptable to this range of complexity, and that provides a continuum of care, including relevant referral pathways. Third, to encourage sustainable NCD care and long-term health system strengthening, local health system assessment, meaningful engagement and joint planning with government and other health actors are required, where possible.

As the MSF NCD programme evolved it became more complex and more costly, and therefore, potentially less sustainable for MSF, and less replicable by other actors. To improve efficiency, MSF introduced less frequent medical review for stable patients and task sharing to nurses. These implementation lessons are potentially transferable and, along with insight gained from other chronic care models in LMICs (such as HIV care), they may inform the design of NCD care models for other settings and systems. Further implementation research, including cost effectiveness studies, is needed to evaluate such adapted models.

3.1 Reach

The cohort's demographics and NCD prevalence are available in Paper 1 (RE-AIM) along with the numbers eligible for the programme, numbers reached and their representativeness (1). The number of adult Syrian refugees enrolled (3531) equated to reaching almost one quarter (23%) of the estimated 15,102 target adult Syrian adult population with NCDs residing in Irbid governorate (1). However, this was based on the MSF household survey's self-reported HTN prevalence of 14%. Other sources estimate hypertension prevalence as 20% to 30%, and thus the programme's true reach may have been lower (98).

Enrolled Syrian and Jordanian patients' NCD risk factor levels (obesity, smoking rates) and disease prevalence reflected regional norms (99–101). Many patients were older, multi-morbid and frail; almost 10% classified themselves as mobility-impaired. Approximately 7.5% of Syrians were aged over 80, a group particularly vulnerable to disability, psychological

distress, social isolation and exclusion from services and decision making (102). MSF gradually implemented adaptations to increase the reach and reduce exclusion of older people – introducing the home visit service (discussed under 3.4.3), providing assistive devices, and informally enlisting family support (102).

Reach was limited by MSF capping the cohort for operational and cost reasons. The Irbid model provided complex care within a standalone, vertical service, that was not integrated with the public health system, despite MSF's efforts to work with the Jordanian MOH. To my knowledge, the reach of other NCD programmes in humanitarian settings has not been discussed in the literature. For example, UNRWA, which, unlike most humanitarian agencies, operates an e-health system that supports cohort monitoring, reports only NCD prevalence among clinic attendees, but not coverage within their broader target population (103,104).

3.2 Effectiveness

The full analysis of clinical outcome and quality indicators, and perceived *Effectiveness* are presented in Papers 1 and 2 (1,2).

3.2.1 Clinical outcome indicators

Findings on clinical effectiveness are presented in Paper 2 (Cohort analysis) (2). A subset of 4044 adult patients met the cohort analysis inclusion criteria. Most (72.0%) had HTN, 63.0% had DM II, and over a third had both diagnoses [1530 (37.8%)].

Intermediate clinical outcomes (SBP, FBG) improved among individuals within six months of entering the cohort. Mean SBP decreased by 6.6 mmHg among hypertensive patients within the first 6 months, from a relatively well controlled mean of 137.9 mmHg (95% CI 137.1 to 138.7) to 131.3 mmHg (95% CI 130.3 to 132.3). Individuals' FBG levels improved by 1.43 mmol/l within 6 months of cohort entry/new diagnosis, from a mean of 10.40 mmol/l (95% CI 10.19 to 10.62), to 8.97 mmol/l (95% CI 8.67 to 9.26). Clinical outcomes also improved at cohort level as the programme matured.

Most patients had pre-existing diagnoses on enrolment and the clinical improvements probably reflected receiving regular consultations and a consistent supply of medication,

which contrasted to their previous experiences of NCD care in Jordan. The SBP improvement is clinically significant, as each 2 mm Hg decrease in systolic blood pressure has been shown to decrease stroke and cardiovascular mortality (105).

The mean monthly days of delay following the next planned appointment fell from 43 (95% CI 20 to 66) to 14 days (95% CI 10 to 18) within the programme's first 12 months, and the chance of treatment interruption declined with time and duration of patient stay. These findings likely reflect the bedding-in of the patient appointment, reminder and recall systems introduced by MSF. In addition, the cohort cap was reached within several months of the programme starting, so most patients attending in 2017 had been retained in the cohort for several years.

The positive intermediate clinical outcome findings reflect those reported by MSF and UNRWA in similar humanitarian settings (106–108). However, the evaluation could not measure "hard" outcomes, related to major complications, such as stroke, ischaemic heart disease and death. Complications are difficult to diagnose at primary care level, requiring equipment and trained personnel, and there was limited affordable specialist investigations or management available to these patients in Jordan (66,109).

Retention in care is discussed under *Maintenance* (section 3.5.1). In terms of mortality, 2.6% of the cohort reportedly died during the study period, but this is likely underestimated. Most deaths occurred in hospitals or in the community and were not documented by MSF. Where MSF did record a death, cause of death was usually unknown. A loss-to-follow-up tracing system was introduced after the evaluation and further study of loss-to-follow-up, death rates and cause of death is warranted in future studies. This would require a longer follow-up period, which is not currently supported by funders interested in this area.

3.2.2 Quality (process) indicators

These findings were reported in Paper 1 (RE-AIM) (1). A number of behaviour change indicators could not be determined since exercise and smoking levels were not quantified, rather patients self-reported their level in relation their previous visit (e.g., smoking was reported as unchanged, reduced or increased). Lessons learned included the need to co-

develop indicators with implementers when using routine programmatic data, and to quantify behaviour change in future studies.

Process indicators showed that some processes were under-performed by providers, such as statin prescribing, CVD risk scoring and annual urinary protein testing in diabetic patients. The low statin prescribing rates persisted despite MSF making changes following similar findings from previous studies (110,111). Since statins are a proven, effective strategy to reduce mortality, the evaluation recommended MSF re-staff and undertake further audits.

Chronic respiratory disease diagnoses were recorded in surprisingly few patients (n=352; 7% of total cohort with asthma; 1.4% with chronic obstructive pulmonary disease) despite the high smoking rates among male patients, which reflected smoking rates in the region (101). There is little available evidence on chronic respiratory disease prevalence or risks among crisis affected populations, although stress, increased pollution exposure and poor access to care have been suggested as potential triggers of asthma and COPD exacerbations (112–114).

3.2.3 Perceived effectiveness

Paper 1 (RE-AIM) findings confirmed that staff and patients perceived the programme as effective (1). Patients reported feeling physically and psychologically better after being enrolled, with consistent access to affordable medication and consultations providing them financial and emotional relief. Perceived effectiveness may have been linked to patients' expressed trust in the service and their longitudinal relationship with care providers (115). Providers saw themselves as offering effective, supportive care and they perceived most programme adaptations, such as the home visit service, as necessary and useful. However, attitudes towards the MHPSS service varied, with most doctors expressing distrust (see section 3.4).

3.3 Adoption, Access and Acceptance

3.3.1 Adoption

Within this domain, I explored staff's experiences of delivering the programme, and its effect on their wellbeing and ways of working. Clinical staff were mainly Jordanian medical and paramedical university graduates with previous NGO experience. Most were committed to working for MSF, valued their new-found knowledge and experience, and felt well-supported by supervisors.

3.3.2 Access

Patients reported that MSF services were accessible in terms of distance, location, transport and convenience. However, steps limited physical access for frailer patients at both clinic sites. Staff also reported that women's access, and ability to discuss issues such as gender-based violence, was limited by the required presence of a male family member at appointments.

Despite MSF offering a free-of-charge service, indirect costs (transport and lost income) limited its affordability. Syrians were reported to carefully weigh up expenditure, often prioritising medical consultation over other services, such as MHPSS. (71)

There were limited available or affordable alternative NCD services, which is consistent with the literature on NCD care access in Jordan (66,71,99). Most private and NGO providers required co-payments and, over time, the MOH introduced varying co-payments for Syrian refugees, diminishing access to primary level NCD care and increasing demand on the NGO sector (71). By contrast, most enrolled Jordanians had insurance-based access to public health services. Staff reported that, in a drive to recruit Jordanians to meet government requirements, MSF failed to enrol the vulnerable, uninsured Jordanian population who "would benefit (most)" (116).

Poor access to NCD medicines was a key source of distress for Syrian refugees and their families, as reported by patients and providers, echoing similar findings in the literature (71). Enrolling with MSF improved patients' medication access but 60% of adherence survey participants continued to purchase medications from private pharmacies. Staff believed this reflected patients' preference for the more expensive, branded medication they were used to in pre-war Syria, and their distrust of MSF's generic medications. Further research could

identify ways to build trust in generic medications, thereby reducing patients' out-of-pocket spending.

The lack of specialist care referral pathways for NCD complications, previously described in the literature, was a source of frustration for MSF staff (66,117). Existing referral pathways, including the UNHCR-funded humanitarian pathway (via the Jordan Health Aid Society), and pathways involving other NGOs, were complex, inconsistent and burdensome for patients. MSF brokered some short-term agreements with other NGOs to provide free specialist investigations, but did not directly fund specialist referral care. UNRWA did likewise for Palestinian refugees in Jordan by funding private specialist services (48).

3.3.3 Acceptance

Interview data presented in Paper 1 (RE-AIM) showed that patients, staff and stakeholders found the programme acceptable (1). Stakeholders valued MSF alleviating burden from the MOH and several called on MSF to further expand the programme's coverage and scope (for example, by financing specialist referral care). Interviewed patients felt they received trusted, good quality, consistent care in a caring and respectful environment. Patients highly valued the provision of free-of-charge medications, laboratory and vital sign testing, which required co-payments at other available NCD services (see 3.3.2, above). This study and subsequent work found that consistent access to medications is fundamental to patients maintaining trust in an NCD service in crisis settings (48). The MSF service reportedly compared favourably to most others, where patients experienced long waits, short consultation times and cronyism. MSF's introduction of an appointment system, uncommon in Jordan or Syria, and their high staffing levels contributed to this improved patient flow.

Interviewed patients were accepting of most programme components, such as health education, but were unfamiliar with the humanitarian liaison service and the MHPSS service (see 3.4.2 below). Patients' and providers' main sources of dissatisfaction were the narrow range of services offered by MSF (primary level NCD-focussed, rather than offering comprehensive primary care or specialist referral services) and the use of generic medicines.

3.4 Implementation

In Paper 1 (RE-AIM), under the *Implementation* domain, the following sub-themes were explored: fidelity of programme delivery; implementation challenges and facilitators; adaptations; and costs of programme delivery (1).

3.4.1 Fidelity of programme delivery

Fidelity of programme delivery was determined using *Implementation* indicators explored via routine cohort data analysis and clinical audit. The *Implementation* indicators were closely related to the *Effectiveness* quality *(*process*)* indicators (Annex 1) as they addressed clinical quality and effectiveness, but they focussed on patient monitoring and referral processes, and included activities relevant to nurses health educator and MHPSS staff.

Findings indicated that laboratory investigations were well performed (e.g. annual albumin creatinine ratio was checked in 83.8% of diabetic patients) but processes requiring external referral (e.g. retinopathy screening) were less well performed (50%). While health education sessions consistently took place, interview data suggested that they were not delivered as intended. Rather, staff delivered health education in a *"didactic", "harsh"* and "*combative*" way, using a knowledge-based approach that was unlikely to change behaviour. Supervisory staff suggested that a more solution-focussed approach, utilising patients' own strengths, skills and intrinsic motivation would be preferable (118).

3.4.2 Implementation challenges and facilitators

The principal *Implementation* challenge faced by Syrian patients was the profound impact war and the refugee experience had on their lives and capacity to engage in NCD care. Themes around "social suffering" and "hope" arose inductively from patient and provider accounts and are explored in detail in Paper 3 (Mental Health) (3). Social suffering links physical ill health with social problems, and links individual experience with collective experiences (119,120). Social hope links resilience and wellbeing to the social context and to resource access, at individual and community levels (120).

Syrian and Jordanian patients consistently described their health in terms of interconnected physical, psychological and social dimensions. Both nationalities tended to attribute the onset or worsening of physical NCDs to psychological distress. For Syrians, poverty and social disadvantage may also have directly impacted their physical NCDs. The literature demonstrates, for example, that depression and diabetes intersect more frequently in low-income populations because of the strong relationship between depression and poverty (121).

Both nationalities linked their physical and mental health with their social suffering. For Jordanians this involved their individual social circumstances, while for Syrians it involved their community's collective experience of psychological and physical suffering . Staff reported that Jordanians engaged well with healthy living advice . By contrast, Syrians' engagement with behaviour change advice was limited by their psychological distress, lack of agency and lack of hope. Jordanian's greater levels of hope were likely linked to their relative wealth and their rootedness. Syrian refugees, however, were in a state of "entrapment", the enemy of social hope, due to structural barriers they experienced in Jordan and their state of flux (122).

MSF introduced the MHPSS service to address the high levels of mental-ill health they encountered and the lack of adequate referral options (see section 3.4.3). Notably, no patient interviewees were aware of the MHPSS services and MSF clinics were not seen as an appropriate place to seek psychological support. Patients and doctors did not perceive psychological distress as a health problem. They viewed MHPSS services as stigmatising, aimed at people who were "*abnormal*". Stigma has previously been noted as a barrier for both Syrians and Jordanians seeking psychological support (123,124). Staff with a psychology background believed that psychosocial issues had to be addressed alongside patients' physical problems. Other staff felt ill-equipped to deal with the intensity of Syrians' war-related trauma.

Other implementation challenges were described in Paper 1 (RE-AIM) (1). From a provider perspective, these included patients' tendency to visit multiple providers and purchase medication privately, and their initial reluctance to adhere to the appointment system. Contextual and cultural factors, such as diet and exercise norms (high fat, high salt diet and

limited exercise for health or leisure), high smoking rates (especially in men), and limited exercise infrastructure impeded behaviour change.

Facilitators to *Implementation* from a staff perspective included the introduction of the MSF NCD guideline, and the excellent patient-staff rapport, strong supervision and training, and good teamwork they experienced. The NCD guideline was largely adopted by clinicians, who found it acceptable, "*useful*" and adaptable. Some were uncomfortable with the level of care offered, describing it as below the usual standard in Jordan. Others highlighted gaps in the guideline, which did not cover care of complex multimorbid patients or provide the programmatic guidance necessary to define a primary level NCD package or predict referral needs. Patient level facilitators included support from family and community members, religion and the "*encouragement*" given by MSF staff.

3.4.3 Programme adaptations

Programme adaptations, described in Paper 1 (RE-AIM), were made in response to patients' physical, mental health and psychosocial needs, and to programmatic and contextual challenges (1).

The MHPSS service evolved to respond to initial low uptake/utilisation among staff and patients. Individual counselling sessions were later supplemented with ad hoc psycho-education sessions in waiting rooms, peer-support groups and a targeted 'living well' group programme, combining health education and psychosocial support. To boost referral rates, the MHPSS team provided staff training and extended referral rights to nurses. Depression screening was introduced but later paused as the numbers screening positive overwhelmed the service's capacity. To address the ongoing gap in referral services, MSF planned to provide additional psychiatric training to one family medicine specialist.

Other adaptations improved the person-centredness of care, including introducing the humanitarian liaison officer role, adapting health education messages to patients' circumstances, and involving family members as informal treatment supporters. A home visit service was introduced in 2015 to improve access for elderly, housebound and frail

patients and both team and catchment area were later expanded. Clearer admission criteria relating to patient vulnerability were introduced in 2017.

Additional adaptations aimed to improve the programme's cost-efficiency. These included the introduction of an appointment system and of task sharing the care of stable patients to nurses. Several barriers limited the introduction of task sharing, including a lack of eligibility criteria for nurse-led care, reported resistance from patients and medical staff, and national regulations limiting nurses' roles (125). The appointment and dispensing intervals for stable patients were increased from one to three months and, finally, family medicine specialists were employed to manage more complex patients.

3.4.4 Implementation costs

The costing results are reported in detail in Paper 4 (Costing) (4). The total annual financial cost of the NCD programme from the provider perspective increased annually in parallel with greater patient volume, greater service complexity and with the addition of specialist staff. It increased by 52% from INT$ 4,206,481 in 2015 to INT$ 6,400,611 in 2016 and by a further 5% to INT$ 6,739,438 in 2017. Per-patient-per-year (PPPY) costs increased 23% from INT$ 1424 (2015) to 1751 (2016), and by 9% to 1904 (2017), while cost per consultation increased from INT$ 209 to 253 (2015–2017). There are limited available published data to compare endpoint costs of primary-level NCD care delivery in humanitarian settings, and none from the Middle East region. MSF data report incremental PPPY costs of INT$222 (2015) and INT$441 (2016), respectively, associated with adding diabetes care to pre-existing services in a chronic conflict setting in Mweso, Democratic Republic of Congo and with integrating NCD care with HIV and general outpatient services in Swaziland. However, comparisons must be made cautiously, since these figures do not include costs of the pre-existing services, and due to different programme, procurement and HR structures and costs.

The major cost drivers of the Irbid programme were human resources (accounting for 38.9–42.6% of total annual costs) and medications (34.8–43.2%), with insulin and related supplies one of the costliest items. This is echoed both in the MSF studies and in studies from stable LIMC settings (83,126,127).

3.5 Maintenance

The challenges and facilitators related to programme *Maintenance* at the individual and organisational level are discussed in this section.

3.5.1 Individual level

In Paper 1 (RE-AIM), retention in care, medication burden, and the challenges and supports around medication adherence and behaviour change were explored from patient and provider perspectives (1). Routine cohort data analysis showed the majority of patients enrolled during the study period (N = 5045) were retained in care for over 6 months; 85% attended a follow-up appointment six-months (+/− 30 days) after enrolment. By study completion, one-third of enrolled patients had exited, including 12.5% cumulative loss-to-follow-up, planned exits or deaths.

Over half of adherence survey participants (N = 300; 74.4%) were prescribed four or more MSF-provided medications. The majority (60.4%) also obtained medications from another source. Total self-reported adherence rates were high (approximately 90%) and were similar across age, gender, and civil status groups. However, during patient interviews, both nationalities described taking medications intermittently, when experiencing symptoms, such as headache. This high self-reported adherence rate may reflect social desirability bias. However, while higher than rates reported from some other contexts, it reflects similar self-reported adherence rates among Syrian refugees in Lebanon (103,128–131). Patients reported that their adherence was facilitated by receiving consistent, free-of-charge medications and by MSF staff and family support, while staff noted the negative impact Syrians' psychosocial suffering had on their adherence.

To support adherence, clinical staff educated patients and their families, and pharmacy staff used labelling adapted for those with low literacy. Further work is needed to develop adherence measurement and support tools in this population, but joint decision making with patients, and formally involving treatment supporters may prove valuable, as has been found in other contexts (132,133).

3.5.2 Organisational level

In Paper 1 (RE-AIM), facilitators and challenges to maintaining or sustaining the programme from an organisational perspective were discussed. Facilitators of programme *Maintenance* included the availability of highly qualified Jordanian professional staff. Most were committed to MSF, with the exception of junior medical doctors, who regularly departed for other training opportunities. Failure of health workforce retention is universal in LMICs, and is particularly challenging for continuity of NCD care (134–136).

Maintenance challenges included the cost to MSF, the lack of reliable and affordable referral pathways, the highly-regulated Jordanian environment, and the lack of viable hand-over plan, threatening the programme's sustainability. The costing data supported interviewees' impression that this was an expensive programme. However, the model's potential cost-effectiveness, in relation to delayed or prevented complications and deaths, could not be determined. Scenario analyses exploring potential cost reductions showed that importing drugs could cut costs by a third and that pooled local procurement saved 20%. UNRWA has also demonstrated the potential savings that pooled procurement could bring (137). Salary costs were more sensitive to the frequency of patient review rather than to switching from doctor- to nurse-led consultations, and incrementally greater cost efficiencies were achievable when more patients were categorised as stable, therefore, requiring less frequent review. Reducing review frequency to 6-monthly could, therefore, result in further cost savings.

Referral pathways were limited by cost, inconsistent availability and bureaucracy. Since international funding of MOH services was limited and dwindling, stakeholders suggested that international NGOs should be encouraged to fund and implement referral services. In general, commentators agree that major donors need to devote greater focus and financing to strengthening NCD care within national health systems in humanitarian settings (18,138). For example, a recent review of health overseas development aid for IDPs in LMICs highlighted that spending on NCDs accounted for only 0.5% of the total health spend on IDPs, and there was little more for refugees (18).

For MSF, operating in a middle-income country with well-established systems and policies, which tightly regulated humanitarian actors' activities, proved challenging. Humanitarian policies required that medications were locally purchased (increasing costs compared to MSF's traditional importation model); there was no government focal point or set of regulations governing NGOs; there were significant bureaucratic delays, and Jordan had strict regulations around prescribing of psychotropic medications, nurse-prescribing and Syrian clinicians' right to practice in Jordan. These strong legislative frameworks obliged MSF to adapt the approaches they previously used in contexts with weaker governance, and this was uncomfortable for MSF at times. However, MSF also recognised the need to work closely with Jordanian authorities to plan for an eventual hand over of the NCD cohort.

The theme of sustainability arose inductively from several interviews with MSF staff. It was not emphasised in the published papers because senior MSF staff felt that, since MSF have not historically aimed for sustainability or cost-effectiveness, they should not be assessed on these criteria. In Irbid, staff placed great importance on providing a good quality service that fulfilled MSF's humanitarian remit. Yet, there was a perceived tension between their desire to continually improve the programme and its long-term sustainability. When crises are protracted, MSF tends to identify partners for eventual hand over of their programmes. MSF international staff noted the lack of potential handover partner, especially given the gulf between the complex MSF NCD care model and MOH models. The programme's immediate sustainability was also threatened by MSF's ongoing internal debate around the appropriateness of a humanitarian emergency medical NGO engaging in costly chronic NCD care. Headquarter-level MSF staff recognised that the high-income context of Jordan differed from the more resource-constrained settings where MSF often works, but explained their rationale for maintaining the vertical programme in Irbid was to understand the essential components of an NCD care model, and "learn by doing".

A key finding of the evaluation, therefore, was that developing a siloed NCD service delivered by a single humanitarian actor may contribute to the fragmentation of health care delivery and is not sustainable. Siloed ways of working and vertical programming have been repeatedly cited as barriers to good health system governance in conflict-affected settings (139,140) .

Reflecting on lessons for the design of more context-adapted, sustainable and scalable NCD programmes, MSF staff suggested that MSF could build on their HIV service model, by differentiating care – adapting it to different health systems and patient characteristics – maximising task sharing and decentralising aspects of care to community level, as they had previously done in a HIV/NCD integration project in Kenya (141,142). They recommended that MSF engage more closely with host country health systems in designing future NCD interventions.

The evaluation concluded that NCD programmes should be designed and developed following a health system assessment, and using a health system strengthening and sustainability lens. The health system assessment should take into account pre-existing health sector NCD policy and programming, current health system structure and state of health system reform (e.g., primary care level and workforce capacity to manage NCDs, inclusion in a UHC package). Health strengthening activities could involve, for example, engaging in health workforce capacity building, supporting the implementation of national policy and programming, and strengthening national procurement practices and supply chains.

Health system strengthening is especially relevant for chronic conditions and, as crises have become more complex and prolonged, humanitarian actors recognise that they need to engage more in health system strengthening, while preserving their capacity to provide timely emergency response. In 2016, the World Humanitarian Summit agreed the New Ways of Working, which proposed that emergency, development and peacebuilding actors align their activity through a multi-annual, coordinated approach, sharing planning and implementation processes, while promoting local and national ownership and capacity (139). While WHO guidance on operationalising this "humanitarian-development-peace nexus" for health now exists, there is a lack of evidence on putting these recommendations into practice and also on health system governance in crises, both key areas requiring further study (140,143).

3.6 Key Recommendations

The evaluation's key recommendations are presented in in Table 1. These are adapted from Paper 1 (RE-AIM) (1).

Table 1 Ten Key Recommendations

1. Perform rapid assessments of NCD needs	Develop tools to rapidly assess NCD needs and predicted intervention requirements in the acute phase of crises, including medication, equipment needs and referral pathways
2. Perform a comprehensive health system assessment and engage in health system strengthening	Before embarking on an NCD intervention, perform a comprehensive analysis of the pre-existing health system readiness to manage NCDs and resilience in the face of crisis, including existing NCD policy and health system structure, especially care at community and primary levels, referral pathways and services, supply chains and procurement, data systems and human resource availability and capacity to manage NCDs. Engage with stakeholders, especially Ministries of Health, UN agencies, Health Cluster members, development actors and funders on the needs, scope and goals of the intervention, aligning with pre-existing health system reform. Maximise collaboration between health actors involved in NCD care to minimise fragmentation and support continuity of care. Integrate with and strengthen host health systems, to ensure sustainability and facilitate movement of patients from private to state health systems when humanitarian actors disengage, where possible and appropriate in the local context.
3. Co-design NCD programmes with people living with NCDs, and improve person-centredness of care	Adopt a contextualised, patient-centred approach to NCD care, where possible. For example, deliver care at community level, support patients and families to self-manage and provide holistic, “one-stop-shop” care at facility visits. Elicit and respond to patient priorities. For example, in the work presented here, patients prioritised obtaining consistent, affordable medication and encountering respectful and caring staff.
4. Support provision of complex, yet efficient care	There is a broad range of patient complexity involved in NCD care, from asymptomatic hypertensive patients, to frail, elderly patients with complex disease, multi-morbidity and polypharmacy. The holistic approach needed to respond to this complexity and heterogeneity must be considered when drafting guidelines and designing services. Consultations are time consuming and patients may require frequent review. Where appropriate, a context-adapted, algorithm-driven approach may facilitate task sharing to nurses or community health workers of stable, less complex patients. Introducing fixed dose combination pills, for example, may reduce pill burden, ease adherence, and reduce workload in relevant settings. Context-adapted, cost-efficient, acceptable means of delivering remote care, for example via community workers, telephone or e-health, should be explored.
5. Strengthen the continuum of care, including access to referral services	NCDs require a continuum of care involving primary prevention, diagnosis and treatment, prevention and management of complications, psychosocial support, rehabilitation and palliation. A multi-disciplinary team would ideally deliver this package of care, where available. It may be difficult to secure essential referral pathways (e.g. ophthalmology, cardiology, nephrology) that are acceptable, accessible and affordable for patients. Therefore, it is essential to maximise the quality of primary NCD care to prevent, identify and effectively manage complications.
6. Include mental health and psychosocial support	MHPSS should be included as an integral part of primary level NCD services in humanitarian settings. This may be integrated or provided by partner organisations. Provide a tiered approach to MHPSS according to need: 1. Basic support available to all, 2. Psychosocial or peer support groups for specific patient groups (such as teenagers with diabetes), and 3. Individualised counselling and medical intervention. Staff and patients need to be adequately sensitised to the service to ensure uptake.
7. Adapt healthy living advice to the context	Adapt advice to patients’ constrained circumstances and test and adapt behaviour change techniques proven in other settings, such as solution-focussed counselling and motivational interviewing.
8. Remain low cost for patients yet cost-efficient for providers	The ideal way to ensure access is to provide free-of-charge care to patients, where possible. The model of NCD care presented here was relatively costly from the provider perspective, especially in terms of HR and drugs. Savings could be made by reducing the frequency of facility-based contact and by introducing context-adapted, improved procurement practices, for example using pooled procurement.
9. Adapt monitoring and evaluation to chronic care delivery	Implement more broadly the structures, reporting mechanisms and indicators developed within the MSF Irbid programme to reflect the needs of a chronic disease programme. Start with routine capture of clinical measurements; record complication rates and mortality where possible .
10. Engage in high- quality, participatory programme design and research	Engage patients and stakeholders in the design and evaluation of new models of NCD care in humanitarian settings. These may involve simplification, greater use of task sharing, decentralisation of care to the community level, and use of technology for patient and provider support.

4. Discussion

4.1 Overall study design, participation and implementation

To the best of my knowledge, the four papers included in this thesis present the first published evaluation of an NCD programme in a humanitarian setting and the first comprehensive use of the RE-AIM implementation framework in the humanitarian literature (133,144). This was a "real world" mixed methods evaluation, adapted to a complex and dynamic operational environment.

MSF staff at HQ, country and project levels participated at each stage of the evaluation (145). Many of the challenges and power inequities previously documented in academic and humanitarian NGO research partnerships were considered when designing this study, and much of the power was retained within MSF (146,147). For example, MSF developed the idea for the fellowship, controlled the funding, and managed the timeline. The protocol was co-developed with LSHTM and MSF supervisors, with repeated input from MSF HQ and Jordan teams.

However, I did not seek to engage patients, their caregivers or the wider Syrian or Jordanian communities in the evaluation's design, in a collaborative or co-productive way (146). To date, patient, family and community input has been notably lacking in the design, implementation and evaluation of NCD programming in crises, and participatory and person-centred programme and evaluation design is a key area for future development (48).

4.2 Reflection on positionality

My role both in the design of the pilot and evaluation of the full-scale MSF programme must be a key consideration when reflecting on my positionality, since it is likely to have limited my objectivity. To mitigate this, I endeavoured to identify my biases and maintain awareness of how they influenced my interactions with the MSF team. I used open-ended questions in the qualitative topic guides, worked with a co-analyst for some of the analysis and regularly shared findings with my supervisors.

My dual roles as insider and outsider in relation to the MSF programme conferred both advantages and disadvantages, and I consciously shifted my position on the insider/outsider continuum, depending on the interviewee's characteristics (148). My insider status facilitated access to participants, rapport building and understanding of medical and humanitarian epistemologies (148). However, it may also have introduced social desirability bias in relation to MSF local staff, who were largely uncritical of the programme. By contrast, my outsider status as an academic researcher may have facilitated key stakeholders and MSF international staff to critique it. However, it was also manifested in HQ staff's initial reluctance to share programme data and their questioning of the need for an outsider to undertake the evaluation.

To mitigate language and cultural barriers with patients, I trained two Arabic speaking current and former MSF project staff as interviewers. Both were still cultural outsiders in relation to Syrian refugees, as one was Egyptian and the other was Jordanian. Patients may have perceived all three of us as insiders with influence on the programme's future, which may have further introduced social desirability bias.

4.3 Use of the RE-AIM implementation framework

The RE-AIM framework was a useful tool to evaluate an NCD intervention in a humanitarian setting, to glean implementation lessons to strengthen the care model, support its translation to other settings, and to inform MSF's internal debate on their role in NCD care in crises. NCD care is complex by its nature, and this complexity is magnified in crisis settings (34,83). The LSHTM research team had previously seen the value of RE-AIM in evaluating an MSF Diabetes programme in the complex humanitarian setting of Mweso, Democratic Republic of Congo (83,133). The evaluation presented here built on that experience and made more comprehensive use of the framework. It helped delineate some of the complexity, by identifying the determining factors (i.e. facilitators and barriers) that influenced the programme, and it allowed for the exploration of implementation outcomes that are not widely covered in the humanitarian NCD literature, such as acceptability, adoption, feasibility and sustainability (149).

Literature reviews examining RE-AIM's application to date have shown that qualitative and costing methods have been infrequently employed and that certain domains are underreported or misreported (78,150,151). Bearing this in mind, I designed multiple indicators for each RE-AIM domain and employed a range of data collection approaches, including qualitative and costing methods.

However, including such an array of methods and indicators hindered concise reporting against the RE-AIM framework, and meant that some analysis was excluded from the published papers. For example, indicators related to the MSF guideline were included under several RE-AIM domains, but were reported together under the Maintenance domain to facilitate a coherent narrative. Patients' beliefs about medicines were explored through the adherence survey, but these findings, along with some qualitative findings, could not be included in Paper 1 (RE-AIM) due to space restrictions (1). My experience in using RE-AIM reflects that of other authors, where a lack of precision in defining and operationalising implementation outcomes led to some confusion in reporting them (152). In future, I would streamline the number of indicators designed for each RE-AIM domain, and minimise overlap.

If repeating this evaluation, I would also place more emphasis on context. In subsequent work, I have found the Consolidated Framework for Implementation Research (CFIR) useful and intuitive in the way it supports examining context at facility, organisational and broader system levels (or "inner" and "outer" settings) (153–155). RE-AIM was recently revised as RE-AIM PRISM (Practical Robust Implementation and Sustainability Model), placing greater emphasis on context and incorporating concepts from the quality improvement and innovation diffusion literatures (156,157). In this evaluation, I explored some of the PRISM constructs, including intervention characteristics and stakeholders' perspectives at individual and setting level, but I focussed less on other important concepts, such as implementation and sustainability infrastructure and the external environment. Building on my experience using RE-AIM and CFIR, I am currently using both RE-AIM and RE-AIM PRISM in evaluations of humanitarian NCD care, discussed under 5.6, below.

4.4 Approach to mixed methods

Mixed methods studies are becoming more common in evaluating the effectiveness and implementation of complex public health interventions (158). While I did not pre-specify how the methods would be integrated, I essentially used a convergent design (158,159). Each dataset was analysed separately and the findings were then integrated during a second round of analysis, guided by the RE-AIM framework. During the integration process, the qualitative findings served two functions: *complementarity*, exploring outcomes or domains not covered by the quantitative methods (for example, patients' experience of war) and *expansion,* answering questions raised by other methods (for example, understanding patients' high self-reported medication adherence). The findings were then combined via *connection,* that is, one data set built on others to gain a richer understanding of key themes, such as adherence (160). Having gained a better understanding of mixed method study design, in future, I would reflect on how to integrate the methods during the study design phase, to maximise the utility of each.

4.5 Qualitative methods

The topic guide focussed on experiences of the MSF NCD programme rather than on patient's experiences of living with an NCD or as a refugee. However, since I used a semi-structured interview approach and iteratively adapted the topic guide, I was able to explore themes that arose inductively during interviews, including Syrian patients' psychosocial suffering, their coping strategies and their MHPSS needs (3).

I initially envisaged two rounds of qualitative data collection: 1) exploratory interviews to serve a development function, learning lessons to support programme adaptations, and 2) explanatory interviews to serve *explanatory* and *development* functions in relation to the quantitative and costing findings (160). However, time and capacity limited me to a single data collection visit, during which qualitative, costing, audit and adherence survey data were all collected. An alternative study design could have involved conducting the qualitative data collection visit after the quantitative data had been analysed, thereby allowing the qualitative methods to be used in a more *complementary*, *development* and *expansionist* way (160).

Social desirability bias may have been introduced by patients' dependence on MSF for NCD care, since there were limited affordable alternatives, especially for Syrian refugees, and by the data collectors' status as current or former MSF employees. Focus group discussions were held with Syrians only, since MSF advised Syrians would be more comfortable than if mixed with Jordanians, and I may have lost some richness by not undertaking FGDs with Jordanian patients and with MSF staff, due to time pressures.

FGDs participants and moderators were divided by gender, as this was considered culturally appropriate and would facilitate women to speak more openly. However, the study did not explicitly focus on gender or explore whether there were differences in clinical intermediate outcomes, adherence or overall access for women. Interestingly, the qualitative findings that related to gender were offered by international staff members, who were from different cultural backgrounds to Syrian and Jordanian populations. Future evaluations would benefit from engaging with feminist and decolonising theory during all stages of research development, implementation and dissemination (161,162).

4.6 Cohort study methods

The evaluation benefited from MSF's comprehensive routine data collection system that had been set up during the pilot phase. A retrospective analysis was a pragmatic choice, given time pressures and the MSF project team's limited capacity to undertake additional data collection. This study maximised the use of rich per visit data and used both closed and open-cohort approaches. However, this approach was more complex than the clinical audit approach (using one-off or repeated cross-sectional designs) typically used in NCD cohort studies in humanitarian crises and in other examples of primary care NCD cohort monitoring, and may not be feasible for use in routine quality monitoring (107,108,163).

In terms of limitations, routine clinical data are likely to contain data capture and transfer errors; there were some missing data and analysis was limited to routinely collected variables. Data on deaths, types and rates of complications, such as heart attacks, or hospitalisations, were not routinely collected and, thus, the prevalence or incidence of NCD complications could not be documented. This would have required follow up of hospital referrals, access to hospital reports, and more robust tracking of non-attenders to document cause of death. This

key gap is echoed in the literature and reflects the difficulty in diagnosing complications in resource-limited settings (due to lack of training, equipment and referral services) and weak or absent referral systems linking hospital-based episodes of care back to routine primary care (111). For example, UNRWA reports an annual aggregate late-stage complications rate. However, despite having an electronic medical record, they still report difficulties with consistent data capture (104).

The three-year study period was too short to demonstrate impact on longer term "hard" outcomes, such as mortality and severe complications (had these variables been collected). The study involved a single clinic-based cohort without a comparison site, so demonstrating causality was not possible. As other authors have highlighted, there is a paucity of experimental or quasi-experimental studies in humanitarian settings, for logistical and ethical reasons, and establishing comparison sites is challenging (56,147).

Some of the quantitative indicators I devised were perhaps not intuitive and the MSF epidemiologist who undertook the initial quantitative analysis interpreted them differently to how I would have expected. For example, in calculating the number of hypertensive patients receiving care and number achieving targets annually, the number of hypertension visits per annum was used as the denominator, rather than number of hypertensive patients active during that period. The information generated was useful to monitor workload but not to monitor reach or quality of patient care. This approach may reflect that fact that humanitarian actors traditionally report on individual treatment encounters for acute conditions rather than on chronic care. UNHCR encountered similar issues with their reporting system, which was designed to monitor single encounters rather than following individual or cohort-level patient outcomes over time (48).

In future, I would use a prospective study design to evaluate a novel model of care at several study sites (where possible), with a clear start date and a longer study duration, to evaluate impact more robustly on intermediate as well as long term clinical outcomes, including complications and mortality. This would necessitate better recording and/or measurement of complications, via guided clinical history taking and examination, and would ideally be supported by point of care clinical investigation, for example, mobile phone-supported electrocardiogram and retinal screening.

4.7 Use of medication adherence survey

I felt it was important to understand medication adherence among a distressed population living a complex, unstable setting. Adherence is key to achieving good clinical outcomes, it may be impacted by mental ill-health and it is challenging to maintain, even in high income, stable settings (130,164). I selected the MARS-5 medication adherence report scale, since it is pragmatic, widely used, previously validated in Jordanian Arabic, and free-of-charge, unlike the more widely published Morisky Adherence Scale. The very high positive response rate was unexpected and may reflect social desirability bias, exacerbated by the fact that the data collectors administered the survey to most patients.

A 5-item self-report survey is clearly limited in what it can elucidate about the complex theme of medication adherence. The current gold standards for monitoring medication adherence, direct observation or electronic monitoring, are time consuming, expensive, intrusive and not feasible in a complex humanitarian environment (165). Identifying a better alternative or complement to the MARS-5 is an area that warrants further exploration.

4.8 Use of clinical audit

While the clinical audit provided useful findings that complemented the analysis of the electronic database, the design could be significantly improved. Some of the questions were overly complex and poorly framed. For example, the question: "Was CVD risk score correct as per WHO/ISH CVD risk prediction charts" was a multistage question that involved performing a calculation. Other indicators could not be calculated because the steps required (e.g. calculate estimated glomerular filtration rate (eGFR) if creatinine is above a certain threshold, flag if eGFR is elevated, adjust medications appropriately) were neither prompted by nor well captured in the patient file. In future, a simplified version of the audit could prove useful as part of a quality monitoring cycle.

4.9 Costing study methods

Paper 4 (Costing) is the first comprehensive, descriptive micro-costing study of an NCD programme delivered by a humanitarian actor and it provided insight into the costs of NCD care from the provider perspective (4). A cost-effectiveness study was not possible, given

that this was a complex intervention with multiple components, with many programmatic and contextual changes occurring during the study period, and it was not possible to involve a comparison group. Future studies should consider including assessments of patient-level costs and of cost-effectiveness, although, as mentioned in section 4.6, attributing causality is difficult in dynamic and complex humanitarian contexts.

4.10 Generalizability

It is notable that this evaluation's positive results around NCD risk factor (BP and FBG) control were achieved in a complex programme that was developed and delivered in a vertical way (despite MSF's efforts to work with the MOH). It was funded by MSF, and used MSF guidelines and medications purchased from local suppliers, which had undergone MSF's strict quality control processes that may be more stringent than national systems' processes. While the programme was acceptable from patient, provider and stakeholder perspectives, the care model was unlikely to be scalable in the more resource-constrained Jordanian public sector.

While many lessons learned from this experience may be widely relevant in humanitarian settings, it must be borne in mind that this programme was delivered in a stable, higher-middle income context, with availability of a highly skilled workforce, established public emergency and referral services and a well-developed private system, albeit with significant access constraints for Syrian refugees and vulnerable Jordanians (166). Implementing a primary level NCD service in a more resource-constrained or volatile LMIC humanitarian setting would require significant adaptations to the model. For example, where there are fewer doctors, it may be more feasible to design a model around task sharing to nurses, community health workers, lay volunteers and peer support groups, mirroring the HIV care model used in many LMIC settings. Indeed, there is growing evidence for CHWs' role in NCD care in LMICs and there are clear examples of CHWs successfully maintaining care and providing emergency relief interventions in crisis contexts (70,167). A well-resourced and trained CHW network could be especially useful where access to health facilities is cut off during active conflict or when people are hard to reach. Experience during the COVID-19 response and recent conflicts has shown that, in acute emergencies, patient registries, buffer stocks of medications, modified dispensing (longer dispensing intervals, less frequent clinical contact and community-based dispensing/delivery – both implemented by MSF in Jordan),

and remote means of disease monitoring, consulting and support for patients to self-manage are all essential (48,144,153,168). How these interventions are implemented inevitably depends on the local sociocultural context, data systems and communications infrastructure as well as on the health system's pre-existing structures, capacity to manage NCDs and its preparedness for crises.

5. Current context, impact and future application

Since this evaluation took place, NCDs have gained greater priority on the global health agenda. Global health policy and operational experience, guidance and tools and the research evidence base on managing NCDs in humanitarian crises, have all developed during the intervening years.

5.1 Policy and operational contexts

Progress was made at the 74th World Health Assembly in 2021, when a resolution on strengthening WHO preparedness and response to health emergencies explicitly included non-communicable diseases (169). Momentum at global policy level has also increased with development of the Global Diabetes, Global NCD and Global Migration Compacts (170–172). WHO is currently developing an operational guideline on emergency preparedness and response for NCDs in crises.

Since the Irbid programme was developed, WHO published the HEARTS package for the management of cardiovascular disease in 2018 and for diabetes in 2019 and revised the NCD Best Buys, adopted in 2023 (173–175). In 2020, the PEN package was updated and a version for humanitarian settings (PEN-H) was published (176,177). WHO also developed an Interagency Emergency Kit for NCDs, released in 2018 and recently updated, which was designed to fulfil the NCD needs of a population of 10,000 for three months in an acute crisis (178,179). In terms of health work force training, UNHCR has continued to partner with PCI to deliver NCD primary level care training to their teams and partners in many

settings, and PCI, MSF, ICRC and the International Rescue Committee (IRC) have developed their own NCD training platforms and modules.

5.2 Research context

Before this evaluation, most relevant publications were either opinion pieces setting out the need for greater focus, funding and experience on NCD care, or descriptive studies of specific care models (42,43,106,108,180). An LSHTM 2021 literature review of NCD care models in LMIC crises highlighted that models are still diverse, ranging from poorly planned responses in acute disasters, to more complex models of care in protracted conflict or refugee situations, or innovative e-health models undertaken as part of short-term intervention studies (49). Recent systematic reviews of NCD access, burden and interventions in LMIC humanitarian settings have shown that the number of relevant publications is increasing year-on-year (58,181–183) However, they are largely limited to observational studies, covering epidemiology or burden, and the majority are drawn from the Eastern Mediterranean region.

The importance of developing the NCDs in humanitarian settings research agenda has also gained greater recognition. In 2015 and again in 2021, ELRHA, an independent British funding body, funded evidence reviews of intervention research in humanitarian settings, highlighting the growing, though still limited, body of evidence on NCDs (183). In 2022, ELRHA then commissioned a research prioritisation exercise on NCDs in humanitarian crises and WHO commissioned both a landscaping review of their work on NCDs in Emergencies at country, regional and HQ level and a literature review on NCDs in Emergencies.

5.3 Empirical contribution

This study demonstrated that it is feasible to undertake mixed methods research, guided by an implementation framework, in a rapidly changing humanitarian context. It was the first, to my knowledge, to comprehensively use a framework to guide the design, analysis and reporting of a mixed methods evaluation of NCD care in a humanitarian setting. It, therefore, went beyond pre-existing studies, to capture implementation factors that may be relevant to other actors in Jordan and beyond.

This study added to the sparse qualitative literature on NCDs in humanitarian settings, highlighting the patient voice (133,142). It drew attention to the convergence between chronic physical and mental health conditions in populations affected by humanitarian crises, demonstrating the high levels of mental health comorbidity and the impact this had, both on the patients' ability to engage with the programme, and on the staff working with a distressed population. The evaluation was the first to describe the development of comprehensive, integrated mental health and physical NCD care in a humanitarian context. Key findings included the need to formally screen patients for symptoms of depression and anxiety, using a brief, validated tool, to have a range of culturally-relevant MHPSS services in place, and to adequately sensitise and train staff to ensure uptake. This baton was taken up by the International Federation of Red Cross and Red Crescent Societies, and the findings from this study were included in their scoping report on integrating MHPSS into NCD prevention and care in humanitarian response (3,184). Further empirical work is needed to improve our understanding of approaches to integrating MHPSS services with care for physical NCDs across different emergency settings, including during active conflict and in more resource-constrained settings, exploring complexity and using process and implementation outcomes. The evaluation was also the first in the NCDs in humanitarian literature to explore medication adherence using quantitative and qualitative approaches and my subsequent work has drawn on this experience (see section 5.6, below) (185).

While integrated care provided by multidisciplinary teams is particularly suited to the complex care needs of people with NCDs in crises, and there are repeated calls for integration of NCD care in humanitarian settings, there has been a lack of detail on "how to do it" (42,48). Establishing multidisciplinary care in humanitarian settings in LMICs is challenging due to limited available health care professionals, and a lack of experience, guidance or policy to support this approach to care. This study documented one such experience of providing a model of integrated, multidisciplinary NCD care, including implementing a home care team, albeit in a well-resourced, stable crisis-affected country with ready availability of highly trained health workers. More research is needed on adapting multidisciplinary NCD care in settings with fewer and less skilled healthcare professionals (28,186).

Other useful examples of multidisciplinary home visit teams, age-friendly community hubs and the role of community health workers in NCD care in LMIC crisis settings have since been described in the literature (48,153). These models often use task sharing to nurses and community health workers, and, in Jordan, the team had started to engage in task sharing certain elements of care to nurses. The model could be adapted to more resource-constrained contexts by identifying key elements of care (such as MHPSS, medication delivery, disease monitoring, adherence support and diabetic foot care) that could be task shared to other health worker cadres, including community health workers or peer supporters, as discussed under 4.9 above. However, such approaches would need to be adequately resourced and evaluated. Moreover, while this study highlighted the cost-saving potential, it also identified policy and legal implementation barriers to task sharing in the Jordanian context, which may be relevant to explore in other settings.

Finally, the work also touched on the potentially complex dynamics between international humanitarian actors and host country governments that must be navigated during a humanitarian response. While in Jordan, I observed the Jordanian authorities' confidence in their capacity to manage the Syrian refugee response and their caution towards humanitarian agencies, whom they associated with operations in more fragile states. This dynamic, Jordanian bureaucracy, and MSF's slow adaptation to the operating environment, were crucial in shaping MSF's ability to integrate with the Jordanian health system and to hand over their patient cohort to the MOH. Further research is needed to better understand the facilitators and barriers to effective collaboration on NCD response in crises. This would support the development of more effective strategies for humanitarian actors' engagement with governments, development actors and funders, to promote alignment around response and rebuilding activities and support longer term health reform (140).

5.4 Methodological and conceptual contribution

From a methodological perspective, the cohort analysis demonstrated an approach to using data from repeat visits that allowed for the exploration of individual-level and cohort-level outcomes over time, accounting for repeated measures. This went beyond the cross-sectional

approach to measuring chronic disease control used in most previous studies in the literature. The approach also allowed for the identification of a well-described seasonal trend in blood pressure control, previously unreported in the humanitarian literature (187).

Responding to the increasing focus on quality of healthcare in LMICs and the evidence that the vulnerable populations, including forcibly displaced people, are more likely to receive low quality care, I included quality outcome measures in the evaluation design (48,188). The experience of operationalising these indicators has fed into the informal interagency working group on NCDs in humanitarian settings' process of indicator development.

While our LSHTM team had previously published an incremental costing analysis of adding diabetes care to an MSF hospital outpatient programme, this was the first time, to my knowledge, that a micro-costing approach was applied to NCD care in humanitarian settings (83). Since its publication, I have noted only one other descriptive NCD costing study from the provider perspective (for IRC delivering diabetes care for Somalian refugees) (189). In addition, there is a notable lack of full economic evaluations, linking costs to outcomes such as cost-effectiveness or cost-benefit analyses, and a recent systematic review of economic evaluations in LMIC humanitarian health programmes found none focussing on NCDs (190). There is also a major gap in costing studies from the patient perspective.

While the theories of social suffering and social hope are not new, this study makes a theoretical contribution to the literature by applying them specifically to the experience of Syrian refugees in Jordan and in the context of a programme for physical NCDs delivered by a humanitarian actor.

Conceptually, this work influenced the development of a framework of a high quality model of care for NCDs in humanitarian settings and a rapid assessment tool to assess the provision of NCD care in primary care centres. The conceptual framework drew on this evaluation, on work done by LSHTM colleagues on MHPSS in humanitarian crises, and on the quality of care literature (48,191). It has since guided the Partnering for Change research project (see section 5.6, below).

5.5 Programmatic contribution

The evaluation made a programmatic contribution to NCD care in humanitarian settings, as it served MSF in adapting and strengthening their NCD programme in Jordan, and influenced MSF NCD policy. For example, the costing findings helped with internal advocacy in countering the idea that NCD care was too expensive for MSF to engage in. While, initially, MSF was not open to discussing the concepts of sustainability, and emphasised that this had never been a goal of the Irbid NCD project, their internal discourse has since changed and the need for NCD programmes to engage in health system assessment and strengthening and to use a sustainability lens has been recognised.

5.6 Current research direction

Since completing this evaluation, I have continued to work on NCDs in humanitarian settings. Thematically, the research has focussed on more efficient service delivery; learning lessons from humanitarian actors' responses to the Covid pandemic; improved, person-centred models of care; and exploring NCD patient and caregiver experiences of living with NCDs in crisis-affected or resource-limited settings. I have also been involved in programming and policy activities.

From an efficient service delivery perspective, the MSF polypill implementation study explored the acceptability, feasibility and costs of introducing a fixed dose combination cardiovascular secondary pill in MSF NCD clinics, from provider and patient perspectives (185,192). Aiming to learn lessons from humanitarians' responses to the COVID-19 pandemic, our NCD/Covid study, funded by Novo Nordisk, explored the literature on approaches to providing care remote from facilities during periods of service disruption and surveyed humanitarian actors on the pandemic's impact on NCD care delivery (153). Focussing on innovative models of HTN/DM care in crisis settings, Partnering for Change (a collaboration between ICRC, DRC and Novo Nordisk) partnered with LSHTM to evaluate NCD care programmes in Iraq and Lebanon. For the latter, we undertook a Theory of Change process with partners to elucidate pathways towards developing an integrated approach to NCD care in Lebanon. I also lead the qualitative component of the HumAn-1 study, funded by the

Helmsley Charitable Trust, which aims to address key knowledge gaps around insulin and patients' lived experience of Type 1 diabetes in LMIC and humanitarian settings.

In terms of policy and programming contributions, I am a member of the NCDs in Humanitarian Settings Special Interest Group of the Global Alliance for Chronic Disease, and the research and data workstream co-lead for the International Alliance for Diabetes Action, a consortium of academic, implementing and advocacy organisations. I join the informal Interagency Working Group NCDs in humanitarian settings meetings and technically support the aforementioned ELRHA research prioritisation exercises and WHO operational landscaping review (section 5.2).

My research goal is to co-design with implementing partners, service-users and academic colleagues, a package of integrated, multidisciplinary care for NCDs in humanitarian settings, that incorporates CHWs, peer support, and multidisciplinary, person-centred approaches. I would propose a prospective implementation study of this care model, using participatory approaches, ideally in more than one setting. I aim to further explore the literature and methods that elicit and evaluate complexity in interventions. While using implementation science frameworks, such as RE-AIM, has helped me to identify and enumerate factors that contribute to complexity in previous studies, I have not been able to determine causality. Employing complex-systems thinking could help identify the causal mechanisms through which the external and internal contextual factors interact with a novel NCD care intervention (193,194). These identified factors could then be used to inform study design and statistical methods that seek conclusions around causal inferences (195) .

6. Conclusion

This study showed that it is possible to undertake implementation research evaluating a complex NCD care intervention in a humanitarian setting. RE-AIM proved a valuable tool and I have built on the experience of using it in co-designing subsequent evaluations. The evaluation findings have added to the sparse qualitative, costing and intervention effectiveness literature on NCDs in humanitarian settings and have shed light on some of the key considerations necessary in designing future models of NCD care in such settings.

These key considerations include providing person-centred, differentiated care, adapted to the range of clinical, psychosocial and functional needs within a patient cohort, adapting to and strengthening local health systems, and considering the sociocultural environment. In designing context-adapted, cost-efficient NCD programmes, humanitarian actors could consider adopting a multidisciplinary approach; integrating mental health, psychosocial, community or home-based care and rehabilitation services; utilising task sharing; simplifying treatment guidelines and tools; and using technology to support patient self-management. Designing and evaluating such care models could involve complex systems thinking, and could employ a decolonising and gender lens, while meaningfully engaging patients, communities and other key stakeholders throughout the process. Finally, exploring more participatory and collaborative governance models to support humanitarian actors to engage in strengthening NCD care delivery in crisis settings is a key area for further study.

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Annex 1. Main indicators and data method/source based on the RE-AIM domains

Objective (Questions)	**Domain**	**Indicator** (indicators not analysed due to lack of data are in blue text; examples of indicators relating to single theme and appearing under different RE-AIM domains are underlined)	**Methods** (a single methodology may feature under several RE-AIM headings)
Reach Does the programme reach its target population?	**Coverage**	Target population prevalence of diabetes & CVD Number of people eligible for care for diabetes & CVD (inclusion/exclusion criteria) Number of people receiving care for diabetes & CVD Representativeness of those reached Prevalence of NCD and identified, relevant MH comorbidity; eligibility for MHPSS services; numbers referred/receiving care; representativeness of those receiving MHPSS service	Existing cross-sectional survey previously conducted by MSF Routine facility cohort data 2 focus groups with patients 16 semi-structured patient interviews Key informant interviews
"Effectiveness"/ Quality of Care What are the trends in clinical outcomes and quality indicators of the programme? What are the perceived benefits/unintended consequences from a patient and provider perspective**?**	**Clinical Outcomes**	No./% patients with hypertension that have a most recent BP <= 140/90 6 and 12 months post enrolment and trend from baseline Number/ % of patients with diabetes that have a most recent BP <= 140/90 6 and 12 months post enrolment and trend from baseline Number/ % of patients with diabetes with last HbA1c < 8.0 %/ 7.0 % 6 & 12 months post entry Number/% with reduction >= 0.5 mmol/L in cholesterol from baseline to 6 &12 months from entry Number/% of patients with asthma / COPD free from exacerbations/admissions in last 6 months Number/ % of patients reporting decreased/quitting smoking within reporting period Number/ % of patients reporting higher levels of exercise from baseline within reporting period Trend recommended referrals to another facility for acute complications/specialist care	Routine facility cohort data Costing data (for incremental costing analysis) 2 Focus group with patients Semi-structured interviews with approximately 12 clinic staff and 16 patients
	Quality Indicators	Proportion of recommended referrals to other services that are appropriate as per guideline Number/ % of active patients with CVD prescribed a statin during reporting period Number/ % of patients with CVD prescribed aspirin during reporting period Number/ % of patients with CVD prescribed at least one anti-hypertensive during reporting period Number/% of patients with COPD/asthma with inhaler technique check documented Number/ % of times when appropriate clinical action taken according to guideline Trend in defaulters as a proportion of active cohort during reporting period Description of cohort deaths (patient characteristics)	Clinical audit Participant observation Routine health facility cohort data
	Perceived Effectiveness	Patient and providers perspectives on effectiveness of programme components (clinical review, medications, HE, HLO, MHPSS, HV)	Key informant interviews Patient and provider FGDs and SSIs
Adoption/ initial acceptance Is the MSF model of NCD care accessible and acceptable to patients, providers, organisation and community? Is the MSF NCD guideline acceptable to staff?	**Participation**	Description of intervention location, cadres of staff and qualifications; inclusion/exclusion criteria of staff/settings delivering service Sources and perceptions of information and support for participation in NCD service/components (e.g. HE, HLO, MHPSS, foot care) Experience of receiving and providing NCD care, including use of clinical guideline How programme participation has influenced patient/staff well-being and staff ways of working.	Routine facility cohort data 2 Focus groups with patients Semi-structured interviews with approximately 12 clinic staff and 16 patients
	Accessibility/ acceptability	Duration and frequency of NCD service and components Patient characteristics of those accessing programme components (e.g. HE, HLO, MHPSS, foot care) Staff (e.g. ratio of staff per patient) Structures and tools Treatment continuity/rupture	Routine facility cohort data Key informant interviews Participant observation 2 focus groups with patients

		Staff and patient perceptions of availability and accessibility / barriers to access of service components (clinical review, HE, HLO, MHPSS, HV, Foot care) Staff perspectives on acceptability / usability of NCD guideline Key stakeholder views on acceptability/ accessibility of service/components Self-reported medication adherence levels	Semi-structured interviews with approximately 12 clinic staff and 16 patients Self-report medication adherence questionnaire
Implementation To what extent was the intervention delivered as intended? What are the facilitators and barriers to implementing the programme from a patient, provider and programmatic perspective? What are the essential components and adaptations necessary to delivering an NCD service in this setting? What are the start-up and incremental costs of delivering such a service?	**Fidelity** (Process Indicators; indicators in **bold** also reflect quality of medical care)	Extent to which clinical guideline delivered as intended**:** **Number / % of eligible patients with HTN with annual FPG performed** **Number/ % of eligible patients with diabetes that have had an annual foot check/ eye check** **Number / % of DM patients that have micro-albuminuria or urinary protein testing** **Number / % of DM patients on ACE inhibitor (ACEi) with Creatinine testing** **Number/ % asthmatics and COPD with control review (spirometry or clinical)** Number / % of active cohort attending a health education session at last clinical visit Number of MHPSS group sessions taking place monthly during reporting period Number/ % of referred patients attending MHPSS individual counselling sessions Number/ % of times when clinical action taken based on clinical or laboratory findings according to guideline	Clinical audit Participant observation Routine health facility cohort data
	Adaptations	Programme adaptations to setting (e.g. cultural adaptations; dietary and exercise, smoking advice) Programme adaptations related to humanitarian setting and role e.g. response to patients' psychosocial needs and NCD-relevant mental health co-morbidities	Key informant interviews Participant observation Staff and patient interviews
	Cost	Staff time Start-up and recurrent implementation costs (indirect, intermediate and final cost centres) Average unit costs and unit costs stratified by morbidity	Key informant interviews Medicine/supply/ staff costs Staff time estimates
Maintenance What are the challenges and facilitators for patients to remain in the programme? What are the costs involved in maintaining the programme? What are the programmatic challenges and adaptations made to maintain the programme?	**Individual Level**	Number/% of patients active 6 months post enrolment in reporting period Numbers of medications and daily pill count at last consultation during reported period Self-reported medication adherence rates and medication beliefs Qualitative measure of individual-level maintenance: Key challenges in maintaining medical treatment (including medication concordance) Key challenges in altering lifestyle (diet, exercise, smoking) Key mental health/ psychosocial challenges Types of support available and strengths and challenges of the support (health education, MHPSS, HLO, family and community support)	Routine facility cohort data Clinical Audit Key informant interviews 2 Focus groups with patients Semi-structured interviews with 12 MSF/clinic staff and 16 patients Medicine/supply/staff costs Staff time estimates Self-report medication adherence questionnaire
	Organisational Level	Measures of cost of maintenance Institutionalisation of the programme/modifications made for maintenance Alignment with organizational mission	

SECTION 2: RESEARCH PUBLICATIONS

Paper 1: MSF experiences of providing multidisciplinary primary level NCD care for Syrian refugees and the host population in Jordan: an implementation study guided by the RE-AIM framework

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Student ID Number	299678	**Title**	Dr
First Name(s)	Éimhín Mary Brassil		
Surname/Family Name	Ansbro		
Thesis Title	MIXED METHODS EVALUATION OF A MÉDECINS SANS FRONTIÈRES NONCOMMUNICABLE DISEASES PROGRAMME FOR SYRIAN REFUGEES AND THE HOST POPULATION IN JORDAN		
Primary Supervisor	Professor Pablo Perel		

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

SECTION B – Paper already published

Where was the work published?	BMC Health Services Research		
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For multi-authored work, give full details of your role in the research included in the paper and in the preparation of the paper. (Attach a further sheet if necessary)	I drafted the protocol, designed data collection tools, trained the data collectors, supervised data collection, led the analysis of all data types, analysed the data using the RE-AIM implementation framework, drafted the paper as first author, integrated comments, finalised and submitted the paper as corresponding author, and responded to peer reviewers.

SECTION E

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MSF experiences of providing multidisciplinary primary level NCD care for Syrian refugees and the host population in Jordan: an implementation study guided by the RE-AIM framework

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Abstract

Background: In response to the rising global NCD burden, humanitarian actors have rapidly scaled-up NCD services in crisis-affected low-and-middle income countries. Using the RE-AIM implementation framework, we evaluated a multidisciplinary, primary level model of NCD care for Syrian refugees and vulnerable Jordanians delivered by MSF in Irbid, Jordan. We examined the programme's *Reach*, *Effectiveness*, *Adoption* and acceptance, *Implementation* and *Maintenance* over time.

Methods: This mixed methods retrospective evaluation, undertaken in 2017, comprised secondary analysis of pre-existing cross-sectional household survey data; analysis of routine cohort data from 2014 to 2017; descriptive costing analysis of total annual, per-patient and per-consultation costs for 2015–2017 from the provider-perspective; a clinical audit; a medication adherence survey; and qualitative research involving thematic analysis of individual interviews and focus group discussions.

(Continued on next page)

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Results: The programme enrolled 23% of Syrian adult refugees with NCDs in Irbid governorate. The cohort mean age was 54.7 years; 71% had multi-morbidity and 9.9% self-reported a disability. The programme was acceptable to patients, staff and stakeholders. Blood pressure and glycaemic control improved as the programme matured and by 6.6 mmHg and 1.12 mmol/l respectively within 6 months of patient enrolment. Per patient per year cost increased 23% from INT$ 1424 (2015) to 1751 (2016), and by 9% to 1904 (2017). Cost per consultation increased from INT$ 209 to 253 (2015–2017). Staff reported that clinical guidelines were usable and patients' self-reported medication adherence was high. Individual, programmatic and organisational challenges to programme implementation and maintenance included the impact of war and the refugee experience on Syrian refugees' ability to engage; inadequate low-cost referral options; and challenges for MSF to rapidly adapt to operating in a highly regulated and complex health system. Essential programme adaptations included refinement of health education, development of mental health and psychosocial services and addition of essential referral pathways, home visit, physiotherapy and social worker services.

Conclusion: RE-AIM proved a valuable tool in evaluating a complex intervention in a protracted humanitarian crisis setting. This multidisciplinary programme was largely acceptable, achieving good clinical outcomes, but for a limited number of patients and at relatively high cost. We propose that model simplification, adapted procurement practices and use of technology could improve cost effectiveness without reducing acceptability, and may facilitate replication.

Keywords: Non communicable disease, Diabetes, Hypertension, Cardiovascular disease, Humanitarian, Conflict, Effectiveness, Refugee, Syria, Jordan, Programme, RE-AIM, Evaluation, Implementation

Background

In recent years, humanitarian actors have had to rapidly scale-up NCD services in response to the rising global burden of NCDs and to the specific crises involving middle-income countries with high NCD burdens [1, 2]. There is strong evidence on cost-effective, primary care-based clinical management of NCDs in stable, high-income countries. However, there are limited clinical and programmatic tools available to guide NCD interventions in low- and middle-income countries (LMICs) and even less addressing those affected by humanitarian crises and forced displacement [3–5]. The literature describing NCD programme implementation or evaluation in humanitarian settings is especially limited [6, 7]. In response to this gap, humanitarian actors, including the medical humanitarian non-governmental organisation (NGO) Médecins sans Frontières, have adapted their traditional approaches to care for chronic disease, developing clinical and programmatic guidance, monitoring and evaluation tools and an NCD emergency response kit [8, 9]. As they have gained increasing experience of NCD care delivery, some humanitarians have called for the sustainability of NCD interventions to be considered in their design and for handover to local health structures to occur during protracted crises [2].

The challenges of evaluating interventions in humanitarian settings are well known [10–13]. Traditional experimental methods may be unfeasible or even unethical to implement in such settings; target populations are vulnerable and humanitarian contexts are dynamic and potentially insecure; and there may be limited skills, time and funding available for research and evaluation within humanitarian organisations [11]. There is a clear need to develop robust strategies to evaluate programmes in disaster settings that are rapid, pragmatic and that impose minimal burden on implementing teams [13]. RE-AIM is an implementation research framework that has been used successfully for planning and evaluating interventions in both high-income and LMIC settings [14]. To the best of our knowledge, it has not yet been comprehensively applied to a humanitarian intervention. It was designed to facilitate the translation of research into practice and to improve the reporting of key elements essential for successful programme implementation, at both individual- and organisational-levels [14–18]. Using mixed methods, the framework assesses programmes under five key domains: *reach, effectiveness, adoption, implementation,* and *maintenance* (Table 1).

The Syrian conflict, now in its tenth year, continues to devastate the Syrian people. Since 2011, over 6.1 million Syrians have been internally displaced, while over 6.6 million have fled as refugees, mostly into surrounding countries [22]. Jordan currently hosts almost 670,000 Syrian refugees registered with the United Nations High Commissioner for Refugees (UNHCR). Globally, it ranks second only to Lebanon in the number of refugees it hosts relative to the national population [22, 23].

NCDs have been responsible for more deaths than communicable diseases in Syria for several decades, causing 77% of mortality before the conflict [24, 25] Therefore, host country and humanitarian actors have had to tackle the high NCD burden amongst Syrian

Table 1 Example indicators and data method/source based on the RE-AIM domains

Objective / domain (questions)	Sub-domain	Indicator	Methods (a methodology may feature under several headings)
Reach • Target population reached?	**Coverage**	▪ % people among the target population eligible for programme and number served by the programme ▪ Prevalence of NCD and MH comorbidity[b]	• Existing MSF household survey [a] • Routine cohort data • Qualitative data
"Effectiveness"/ Quality of Care ▪ Trends in clinical outcomes and quality indicators? ▪ Perceived benefits/unintended consequences from a patient and provider perspective?	**Clinical Outcomes**	▪ % HTN patients with most recent BP < 140/90 mmHg, 6 & 12 months post enrolment and trend from baseline[b] ▪ % Patients with diabetes with last HbA1c < 8.0% 6 & 12 months post enrolment and trend from baseline[b] ▪ % Patients who report decreased/quitting smoking	• Routine cohort data • Qualitative data
	Quality Indicators	▪ % active[c] CVD patients prescribed a statin ▪ % COPD/ asthma patients with inhaler technique check documented ▪ Trend in defaulters[c] and deaths as a proportion of active cohort	• Clinical audit • Routine cohort data
	Perceived Effectiveness	▪ Patients' and providers' perspectives on effectiveness of programme components (clinical review, medications, HE, HLO, MHPSS, HV)	• Qualitative data
Adoption/ acceptance ▪ Care model accessible and acceptable to patients, providers, organisation and community? ▪ Guideline acceptable to staff?	**Accessibility/ acceptability**	▪ Availability and accessibility / barriers to access ▪ Acceptability/usability of NCD guideline ▪ Self-reported medication adherence and medication beliefs	▪ Routine cohort data ▪ Qualitative data ▪ Self-report medication adherence questionnaire
	Adoption/ participation	▪ Description of intervention location, cadres of staff and qualifications ▪ Experience of receiving and providing NCD care, use of clinical guideline ▪ How participation influenced patient/staff well-being and/or work practices	▪ Routine cohort data ▪ Qualitative data
Implementation ▪ Intervention delivered as intended? ▪ Facilitators and barriers to implementing the programme? ▪ Essential components and adaptations necessary? ▪ Implementation costs?	**Fidelity of programme delivery**	▪ % DM patients with micro-albuminuria or urinary protein tested ▪ % Active[c] cohort attending a health education session at last clinical visit ▪ No. of MHPSS group sessions monthly during reporting period	▪ Clinical audit ▪ Routine cohort data
	Adaptations	• NCD care adaptations to local setting (e.g. cultural; dietary, exercise) • Programme adaptations related to humanitarian setting e.g. response to patients' psychosocial needs	▪ Qualitative data
	Cost	• Staff time; • Capital and recurrent implementation costs[b]	▪ Qualitative data ▪ Medicine/supply/ staff costs[b] ▪ Staff time estimates
Maintenance • Challenges and facilitators for patients to stay in programme? • Organisational challenges, and costs; adaptations made to maintain programme?	**Individual Level**	• % Patients active[c] 6 months post enrolment[b] • Self-reported medication adherence rates • Key challenges in altering lifestyle (diet, exercise, smoking)	▪ Routine cohort data ▪ Clinical Audit ▪ Qualitative data ▪ Medicine/supply/staff costs[b] ▪ Staff time estimates ▪ Self-report medication adherence questionnaire
	Organisational Level	• Measures of cost of maintenance[b] • Institutionalisation of the programme/modifications made for maintenance • Alignment with organisational mission	

Key: *BP* blood pressure, *COPD* chronic obstructive pulmonary disease, *CVD* cardiovascular disease, *HbA1c* glycosylated haemoglobin, *HLO* humanitarian liaison officer, *HV* home visit, *MH* mental health, *MHPSS* mental health and psychosocial support, *NCD* non-communicable disease
[a]Relevant methods and results are reported in Rehr et al. [19]
[b]Detailed methods and results are reported in linked papers [20, 21]
[c]"Active patients" means continued to attend the service and not exited [i.e. died, departed the area or defaulted (i.e. have not attended for more than 90 days since their last planned appointment)]

refugees [23, 26–28]. In Jordan, the Ministry of Health (MOH) has been strengthening NCD care at primary level to address the rising NCD burden among its own population. At the time of this study, NCDs were diagnosed and monitored by family medicine specialists at MOH comprehensive primary centres while medication refills were provided by non-specialist doctors at primary health centre level. UNHCR funded registered Syrian refugees to access MOH primary care services and limited referral services. However, financial barriers

(including the addition of user co-payments from 2014, which have varied over time reaching full "foreigner" rate by 2018), complex care pathways and referral systems, and limited health facility capacity have impeded refugees' access to these services [29]. The burden, access issues and the broader health system response to Syrian refugees' NCD needs in Jordan are well documented [19, 29–31]. However, little is known about the content or quality of current NCD programming, either within the MOH or parallel humanitarian health systems.

Since 2014, Médecins sans Frontières (MSF), a humanitarian medical organisation, has supported the Jordanian health system by providing multidisciplinary, primary level NCD care to Syrian refugees and the vulnerable host population in Irbid, north Jordan. In response to the urgent need for evidence to guide humanitarian actors in tackling NCDs in complex settings, we undertook a mixed methods evaluation of the MSF programme. We hoped to learn lessons to both improve the current care model and to inform the design of future NCD programmes in Jordan and elsewhere. Detailed analyses of cohort, qualitative and costing data are reported in separate papers [20, 21, 32]. The aim of this paper was to summarise the full evaluation, which used the RE-AIM implementation framework to examine the *Reach*; *Effectiveness*; *Adoption* and acceptance of the programme; *Implementation* fidelity, adaptations and costs; and programme *Maintenance* over time [33].

Methods

This retrospective mixed methods evaluation of the MSF NCD programme in Irbid comprised secondary analysis of data from a pre-existing cross-sectional household survey [19], analysis of routine cohort data, a descriptive costing study, a clinical audit, a self-administered medication adherence survey and qualitative research. It was undertaken in late 2017 and covered the study period December 2014 to December 2017. This paper draws together the findings from all methodologies under the RE-AIM framework. Example indicators, based on the RE-AIM domains, and the relevant methods and data used to determine them are presented in Table 1. The full list is available in Supplementary Material 1.

Study setting

The study was conducted in Irbid, the second largest city in Jordan. Irbid governorate hosted over 165,000 Syrian refugees who were mostly urban-based [34]. MSF commenced an NCD service within a Ministry of Health (MOH) primary care facility in Irbid in December 2014 serving non-camp dwelling Syrian refugees and the vulnerable Jordanian host community. A second site in the city was opened within a local NGO clinic in April 2016. The MSF service was vertical, operating in parallel to the pre-existing activities at each site rather than integrating with them. Medicines, consultations and laboratory investigations were provided free-of-charge to patients. The cohort size was capped by MSF at approximately 4000 for operational and cost reasons and the two sites were later amalgamated in 2019.

Intervention

Detailed descriptions of the context, the intervention and a programme timeline are appended in the supplementary material (S2 and S3). In brief, this was a multidisciplinary, primary care model, which used context-adapted clinical guidelines, generic medications in line with the World Health Organization (WHO) Essential Medicines list and task sharing.

Enrolment

Eligibility for enrolment required both medical and social indications. The target medical conditions were: hypertension (HTN), established cardiovascular disease (CVD) [angina, myocardial infarction, ischaemic stroke, transient ischaemic attack, peripheral vascular disease, congestive heart failure], diabetes mellitus (DM) type I or II, chronic obstructive pulmonary disease (COPD), asthma or hypothyroidism). Hereafter, these are referred to as "target NCDs". Social indications included being a Syrian refugee (either registered or unregistered with UNHCR), a refugee of other origin or a vulnerable member of the Jordanian host population. Jordanians were considered vulnerable if they either lacked Jordanian national health insurance (and were therefore subject to co-payments to access MOH care) or were of low socioeconomic status. This was assessed using "vulnerability criteria" developed by the programme. Enrolment criteria changed over time, for example isolated hypothyroidism was removed and vulnerability criteria were adapted for ease of implementation. Enrolment was not limited by place of residence or age. Most patients presented with established, self-reported diagnoses; new diagnoses were made based on the MSF NCD guideline [8].

Service description

The multidisciplinary team initially included non-specialist doctors, nurses, health educators, pharmacy and reception staff, who provided appointment-based medical consultation, health education and behaviour change counselling, supported by a local management team and a coordination team in Amman. The service evolved to also incorporate individual- and group-based mental health and psychosocial support (MHPSS), social work, physiotherapy and a home visit service for housebound patients, with the addition of counsellors, a

humanitarian liaison officer, a home visit doctor and nurses, a physiotherapist and specialist family medicine practitioners. Facility-based services were provided 6 days per week from 8 am to 2 pm, while the home visit service operated on 6 days within a ten-mile radius of the clinics. By 2017, the team had introduced task sharing of some review visits. Further detail is available below and in Supplementary Material (S2 and S3).

Study design

The RE-AIM domains were defined with reference to the relevant literature [14–17] and with some adaptations specific to this evaluation. *Reach* was defined as coverage of the NCD service and its components to the intended target population, with a focus on MHPSS services. RE-AIM defines *effectiveness* as the impact of an intervention on important outcomes, including potential negative effects, quality of life and costs. *Effectiveness w*as determined by examining: 1) trends in intermediate clinical outcomes, 2) quality of care indicators, 3) perceived benefits, unintended consequences and behavioural outcomes, and 4) economic outcomes. *Adoption / acceptance* were explored in relation to the organisation, setting, staff and patients and included changes to behaviour and practice. The *Adoption* domain is usually a "setting-level" outcome, defined in the literature in terms of absolute number, proportion, and representativeness of settings and intervention agents who are willing to initiate a program. Since this definition was not relevant to the MSF programme, as there was no choice for staff or settings to take part, we adapted this domain to cover patient adoption of the programme, including access and acceptability. *Implementation* of the NCD service was explored in relation to each programme component. We examined the fidelity of guideline implementation and its usability; the adaptation of structures, processes and tools; and the costs of implementation. *Maintenance* referred to the continued implementation of the NCD service over time by patients, the programme team and the organisation. The specific indicators and methodologies used to operationalize these definitions are listed in Table 1 and Supplementary Material 1. Qualitative and quantitative data from the various data sources were synthetized using the RE-AIM framework.

Study participants, data collection and analysis

Household survey

To explore programme coverage, we used previously reported data from a Household Access and Utilisation Survey conducted by MSF in Irbid governorate, north Jordan in 2016. MSF undertook the survey to inform health service planning for the refugee population. They estimated the prevalence of NCDs and NCD multimorbidity and determined factors associated with high NCD prevalence. Data collection and analysis, using a two-stage cluster design, are described in detail elsewhere [19].

Retrospective cohort study

To explore cohort demographics, NCD prevalence and service use, we analysed data from all patients who ever attended an enrolment visit in MSF's NCD clinics from December 2014 to December 2017. Descriptive statistics were used to examine patient demographics and process indicators. We explored trends in intermediate clinical outcomes and treatment interruption from programme and patient perspectives, and the factors associated with these trends. We included patients 18 years and older with hypertension and/or diabetes type II (DM II), exploring control of systolic blood pressure (SBP < 140 mmHg) and glycaemia [fasting capillary blood glucose (FBG) ≤ 180 mg/dL or HbA1c < 8%] [21]. We plotted monthly means for each outcome (SBP, FBG, HbA1c or treatment delay) and the proportion of monthly visits at which targets were achieved. We used Generalised Linear Mixed-Effects Models (GLMM) to explore factors associated with each outcome. The analysis is elaborated on in our related paper [21]. Routine paper-based clinical data were collected by MSF data clerks and entered into a bespoke password-protected Microsoft Excel software database. Cohort data from both clinical sites were aggregated and analysed using R v1.0.136 (R, Boston, MA 02210, USA).

Costing study

A descriptive costing analysis from the provider perspective aimed to explore the annual total, per patient and per consultation costs for the Irbid NCD programme for 2015, 2016 and 2017. The analysis delineated capital and recurrent costs incurred at clinic- and project team-levels in Irbid and coordination team-level in Amman. Recurrent costs included human resources, medicines and equipment, building and vehicle costs, and training and supervision. We excluded direct or indirect patient-incurred costs. The analysis is described in detail in our companion paper [20].

Clinical audit

The clinical audit aimed to explore programme quality by examining fidelity of guideline implementation. We used a random selection of paper files from patients enrolled at least 12 months in the programme. Data were collected in August 2017 by programme medical staff on a paper-based checklist and entered into a purpose-designed Excel spread-sheet. We used process indicators analysed using descriptive statistics (Table 1; S1).

Medication adherence survey

A convenience sample of 300 consenting patients aged 18 or over attending either MSF clinic site during a 2-week period in September 2017 was selected (Supplementary material S4). The 17-item adherence survey included demographic information and pre-existing self-reported medication adherence and beliefs measures: the Medication Adherence Report Scale-5 item (MARS-5) and the Beliefs About Medicines Questionnaire (BMQ). Two trained data collectors took written informed consent from patients, who self-filled the survey in Arabic. Data collectors assisted those with limited literacy. Paper data were held securely and were entered into a purpose-designed Excel tool. Analysis included descriptive statistics and multivariate logistic regression.

Qualitative study

The methods are described in detail in Supplementary material S5. In brief, this involved two same-sex focus group discussions (FGDs) with eight Syrian adult patients each and 40 individual semi-structured interviews, including 16 with adult Syrian and Jordanian patients, 18 with MSF staff, and seven with key stakeholders, including staff from the MOH and other international NGOs involved in NCD care delivery. Data were collected by two local researchers and the principal researcher, in Arabic and English, in August 2017. EA and a second analyst (LM) performed thematic analysis, based on the RE-AIM framework, using a combination of inductive and deductive coding.

The findings are reported in accordance with the Consolidated Criteria for Reporting Qualitative Research checklist for transparency [35]. Mental health and social suffering emerged as prominent, data-derived themes and have been reported in detail separately [32]. The remaining themes are reported here.

This study protocol was granted approval by the MSF Ethics Review Board and LSHTM Ethics Committee. Written authorisation to implement the study was obtained from the Ministry of Health of Jordan.

Results

The results are presented according to each RE-AIM domain and subdomain (Table 1). These have been somewhat reordered compared to our protocol to facilitate logical presentation.

Reach

We explored the numbers eligible for the programme, numbers reached and representativeness of those reached. The project proposal defined the target population as Syrians with target NCDs resident in Irbid governorate. To explore access and coverage, MSF performed a Household Access and Utilisation Survey in 2016. Results showed one fifth of surveyed adult Syrians in Irbid governorate self-reported at least one NCD targeted by MSF (21.8% of 8041 surveyed adults aged 18 or over). UNHCR and others estimated that 95% of refugees resident in Irbid governorate in 2017 were registered with UNHCR (n = 135,144 in December 2017) of whom 48.7% were adults aged ≥18 years [19, 36]. This implies there were 142,256 total refugees with 69,278 ≥ 18 years. Applying the household survey figure of 21.8% meant 15,102 Syrian refugees ≥18 years in Irbid governorate had an MSF-targeted NCD and were therefore eligible for enrolment in the programme. Since 3531 Syrian adult patients were ever-enrolled (limited by the cap on cohort size), 23.4% of the target population was reached by this MSF programme [37]. Syrians resident in other governorates were also eligible. Patients were enrolled on a first-come-first-served basis and news of the programme quickly spread by word of mouth. The Jordanian government required that international medical providers enrolled a varying proportion of the host community in their programmes. MSF defined its own 'vulnerability' criteria which took into account economic as well as social factors, with reference to the Jordanian Ministry of Social Welfare. The definition of eligibility (vulnerability) changed over time.

Retrospective data were analysed from 5045 patients ever enrolled during the study period. The cohort comprised 3664 (72.6%) Syrians, 1365 (27.1%) Jordanians and 16 (0.3%) refugees of other origins (Palestinian or Iraqi), who were middle-aged [mean 54.7 years (SD 15.7)] with multimorbidity and relatively high rates of self-reported disability (9.9%). The majority (59.8%) were women and 71% (n = 3582) had two or more target NCD conditions, with hypertension (60.4%), type 2 diabetes (53.1%), cardiovascular disease (25.9%), hypothyroidism (7.6%) and asthma (7.0%) the most commonly treated conditions (Supplementary material S6). These findings are consistent with the MSF Household Access Survey, which reported a similar prevalence of target NCDs [19]. However, the MSF clinic cohort had greater rates of NCD multi-morbidity compared to the adults with NCDs in the household survey (71% vs. 44.7%). NCD risk factor levels were high at enrolment with obesity levels of 62.6%, self-reported smoking rates of 22.7%, and low or zero self-reported regular physical activity in 37.2% (Supplementary material S6). The reach of the MHPSS service is described below.

Access, acceptance and adoption

Under this domain, we described the programme's components, structures and staffing and we explored patient, provider and stakeholder perspectives on programme accessibility.

Accessibility

We considered access in terms of availability, cost and physical accessibility. MSF services were available to 23.4% of their targeted Syrian population. MSF took a "cohort approach" to their service provision and both MSF and Jordanian policy required services to also be delivered to the host population. MSF's policy of providing free-of-charge care facilitated access for the enrolled Syrians and vulnerable Jordanians to medical consultation, consistent medication supply and laboratory testing. Patients only incurred transport and indirect costs, such as loss of income. Syrian interviewees, in particular, reported carefully balancing stretched household finances, and prioritising expenditure on transport costs for aspects of the MSF service they valued, such as medical consultations, over those for MHPSS, health education or laboratory visits. Some chose to purchase their preferred medications from other sources if not provided by MSF.

Patients reported the MSF clinics were also accessible in terms of distance, transport and convenience.

We also explored Syrian community members' access to alternative, affordable primary level NCD services in north Jordan, since MSF's future programme plans hinged on whether such a source of affordable NCD care was available.

> *"…access to good quality care… that is reliable and regular and predictable…. I think that is a big challenge. Affordability is another challenge…"* MSF management staff member.

The MSF Household Access Survey corroborates our qualitative finding that cost was the main barrier to obtaining NCD care from other providers. Around a quarter of surveyed adult refugees with self-reported NCDs did not seek care when they felt it was needed. Only 10% reported poor availability as the reason, while the majority (60%) cited cost. Among those who received care, around half made a co-payment [19]. Interviewed MSF patients described their difficulty in obtaining a regular supply of affordable NCD medications before enrolling with MSF:

> *"It's difficult to buy the medicine always because I can't afford it. Thank god when I registered at (the MSF clinic) … I started to have it free. Before I used to take from other places by small amounts of money (or) from the community pharmacy I paid it all."* Syrian FGD participant.

Other international NGOs also provided NCD care to registered and unregistered refugees in Irbid governorate with some requiring co-payments. Registered refugees' access to MOH primary care clinics was initially free-of-charge but increasing co-payments were introduced from 2014 and most interviewed patients described such co-payments, coupled with travel costs as unaffordable.

Despite the other available options, MSF staff reported they had a long waiting list of people wishing to access the MSF service. When asked how NCD patients in their community who were not enrolled in the MSF programme coped, interviewees reported that they skipped medications, shared with family or neighbours or purchased from private pharmacies:

> Syrian patient: *"If there is a family that can't bring medicine, we collect pills from here and here, so people help each other … because there is extra. So people give to each other. I know a kid who takes insulin…I give to people. I'm forced to help people."*

Staff perceived that most Jordanian patients did not, in fact, meet vulnerability inclusion criteria and could, therefore, access alternative free-of-cost services via national or military insurance. This was the case for all interviewed Jordanian patients.

We focused particularly on the theme of access to specialist referral services. In the middle-income setting of Jordan, secondary and tertiary care services were widely available within the public and private sector, including essential NCD referral services such as ophthalmology, endocrinology, cardiology, nephrology and emergency services. However, as described by our interviewees, accessing specialist services for NCD complications or other conditions via the humanitarian system referral pathway was complex, inconsistent and burdensome for patients, while accessing them directly was costly. In addition to funding primary level MOH access, UNHCR funded registered and unregistered refugees' access to limited public and private specialist services via their implementing partner Jordan Health Aid Society (JHAS). JHAS played a gatekeeper role and interviewees from MSF and other NGOs perceived their decision-making process as "unhelpful" and lacking clear criteria:

> *"We don't really have any … clear structure dealing with (specialised secondary referrals). The identified system through JHAS and UNHCR, as the funding partner, is complex and lacks clarity and doesn't always suit our patients."* MSF clinical staff member.

MSF clinical staff could also refer patients to services provided by other NGOs but felt frustrated and disempowered by the lack of clarity and consistency regarding referral pathways, the lack of information returned by most referral services and lack of direct referral pathways to MOH specialist care. To address this, MSF had brokered agreements with other NGOs to provide retinopathy screening and angiography free-of-cost to patients as

part of a defined short-term project. MSF, MOH and other interviewed stakeholders, suggested that encouraging other international NGOs to fund and implement similar services was the only way to fill the referral gap, since international funding was limited and dwindling.

Acceptance and adoption/participation

Under this domain, we described the programme location, cadres of staff and qualifications. During interviews we explored patients', staff and stakeholders' acceptance of the programme. With patients, we explored their sources of information and support; their experiences of receiving NCD care and how programme participation influenced their well-being.

Most programme elements were acceptable to patients, staff and stakeholders. Interviewed patients felt they received trusted, good quality care in a caring and respectful environment. Patients reportedly valued free-of-charge medications, regular laboratory and vital sign testing most highly but also valued healthy living advice and "encouragement" given by staff. One female patient reported:

> "*(MSF is) honestly caring about the patient, caring about his appointments even the medication availability. We have never come here and told us that the medication is not available. Their performance is great.*"

Patients favourably compared their experience in the MSF clinic with their prior experiences at other NGO- or MOH-provided services. However, several expressed frustration at MSF narrow range of services and the limited provision of specialist care.

MSF national and international staff generally prided in their work for MSF:

> *"…Syrians, we save their lives, … for me this service is like life… this disease is very difficult and chronic …and treatment costs a lot."* Clinic staff member.

Clinical staff were mainly Jordanian medical and paramedical university graduates, many with previous NGO experience. They were committed to the MSF team and their patients and derived satisfaction from observing patients' improvements.

> *"I learned here how to see others' problems… the disaster they are coming from…how we work here like a team or a family for the benefit of the patients; how you can give to the people…without taking, with nothing in return."* Clinical staff member.

There was low turnover among clinical cadres other than non-specialist doctors, who tended to resign after gaining several months' experience with MSF to pursue specialist training. This turnover was considered problematic by clinical supervisors, other staff and patients, all of whom valued continuity of care. A minority of staff expressed dissatisfaction with the perceived lack of promotion opportunities or job security (given the limited duration of MSF programmes), high workload and six-day working week. Interviewed stakeholders valued the programme since it relieved a significant burden on the MOH. Several called for it to be expanded in terms of coverage and scope (for example, by financing specialist referral care).

Effectiveness

To evaluate *Effectiveness*, we examined clinical and quality indicators (Table 2) using retrospective analysis of routine clinical and programmatic data and clinical audit. Perceived effectiveness was explored using qualitative data.

Clinical indicators

Among 4044 adult patients meeting our inclusion criteria (i.e. diagnosed with hypertension and/or Type II diabetes (DMII) and enrolled during the study period), 2912 (72.0%) had hypertension and 2546 (63.0%) had DM II, while 1530 (37.8%) had a dual diagnosis. Within the programme's first 6 months, mean systolic blood pressure decreased by 12.4 mmHg from 143.9 mmHg (95% CI 140.9 to 146.9) to 131.5 mmHg (95% CI 130.2 to 132.9) among hypertensive patients, while fasting glucose improved by 1.12 mmol/l, from 10.75 mmol/l (95% CI 10.04 to 11.47) to 9.63 mmol/l (95% CI 9.22 to 10.04), among type II diabetic patients. The probability of achieving treatment target in a visit was 63–75% by end of 2017, improving with programme maturation but with notable seasonable variation. From the patient perspective, the mean SBP in hypertensive patients decreased by 6.6 mmHg within the first 6 months, from mean 137.9 mmHg (95% CI 137.1 to 138.7) at entry/new diagnosis to 131.3 mmHg (95% CI 130.3 to 132.3) Similarly, there was a marked improvement in FBG level by 1.43 mmol/l from a mean of 10.40 mmol/l (95% CI 10.19 to 10.62) at entry/new diagnosis to 8.97 mmol/l (95% CI 8.67 to 9.26) by 6 months; most of this improvement occurred within the first 3 months. These results and those related to treatment interruption are elaborated on in our companion paper [38].

Quality indicators

Additional clinical outcome and process indicators are presented in Table 2. At each health education session patients were asked to categorise their exercise level as active, inactive, moderately active, and moderately inactive but exercise was not otherwise quantified.

Table 2 Effectiveness indicator results

	Result or comment
a. Clinical Outcome Indicators	
% ≥ 0.5 mmol/L reduction in total cholesterol from enrolment to last visit (those enrolled > = 90 days)	Among those with a cholesterol test who were in the cohort for at least 90 days (2585), 651 had ≥ reduction of 0.5 mmol/L in total cholesterol = 25.1%
% patients with asthma free from exacerbations/ admissions in previous 6 months	Among 382 patients with asthma, only 25 recorded exacerbations in total during the 3-year study period.
% patients who report decreased/quitting smoking	Not available as self-reported smoking category (stopped, decreased, increased, re sumed, unchanged) was reported relative to the last appointment.
% patients who report increased levels of exercise from baseline	At each visit the category (active, inactive, moderately active, and moderately inactive) for recent activity behaviour was recorded. 3347 patients enrolled in the project at least 90 days had a first and last measurement. 610 (18.2%) had improved activity. 593 (17.7%) had worse activity. 2144 (64.1%) stayed the same. There was no significant improvement (chi sq. =0.284, $p = 0.594$).
Trend in referrals to another facility for acute complications/specialist care (% of active cohort)	Trend in referral by type of referral service and volume of referrals were analysed
b. Quality (Process) Indicators	
% recommended referrals to other services that are appropriate as per guideline	Not tested
% of active patients with CVD[a] prescribed a statin	$N = 369$ (25.8%)
% of patients with CVD[a] prescribed aspirin	$N = 717$ (50.1%)
% of patients with CVD[a] prescribed at least one anti-hypertensive[b] drug	$N = 1007$ (70.4%)
% of patients with asthma[c] with inhaler technique check documented	$N = 48$ (94%)
No./% of times when appropriate clinical action taken based on clinical or laboratory findings	Among 130 randomly audited diabetic patient files, 100% had cholesterol checked; 73.8% ($n = 82$) had a CVD risk score subsequently calculated. Of these, 65.9% had a statin correctly prescribed (or not prescribed) according to MSF guidelines[d].
Description of cohort deaths	2.6% ($n = 139$) of enrolled patients died by end of study period. Deaths were determined by word of mouth and a defaulter survey. Among all exited[e] patients deaths accounted for 9.3% (139 of 1489 exits).

[a]1431 patients with new or established CVD were ever enrolled during the study period
[b]Including: amlodipine, atenolol, bisoprolol, enalapril, hydrochlorothiazide, valsartan; excluding: exclusively frusemide or spironolactone
[c]Among 51 asthma patients randomly selected for clinical audit
[d]Technically, the MSF guideline did not require cholesterol testing to be performed before calculating a CVD risk score, but qualitative data confirmed most clinicians waited for cholesterol results before calculating it
[e]Exited patients refers to those that were known to have died, were lost to follow up despite efforts to trace them or who had informed the team that they would no longer be attending the MSF service

Activity levels did not seem to improve significantly. We could not determine whether smoking behaviour had changed since it was not quantified and patients' self-reported smoking behaviour change was only recorded relative to their previous visit. Some activities were under-performed such as statin prescribing, CVD risk scoring and performance of annual urinary protein testing in diabetic patients. There appeared to be good levels of asthma control with only 2.6% of patients with asthma reportedly having an exacerbation within the preceding 6 months. However, rates of statin prescribing were low for patients with CVD (25%).

Perceived effectiveness

Interviewed staff and patients perceived the programme as effective. Patients reported feeling physically and psychologically better after attending the programme, linking this to having a regular supply of medications and some relief of their financial burden. A Jordanian patient noted: *"I feel relieved and comfortable since the first day I came here, I felt the difference in my disease."*

Implementation

Under this domain, we examined the fidelity of programme delivery, the challenges and facilitators to implementation, the subsequent adaptations made and the costs of programme delivery.

Fidelity of programme delivery

Indicators exploring fidelity of programme implementation are presented in Table 3 and were determined via routine cohort data analysis and clinical audit.

Health education was reportedly not delivered as intended. Clinical supervisors described the staff's style as "*didactic*", "*harsh*" and "*combative*". Staff used a knowledge-based approach with patients, which involved

Table 3 Implementation indicator results

	Result or comment
Process Indicators	
% HTN patients with annual FBG performed	Not available (not calculated)
% DM patients[a] with annual eye check performed	Annual[b] fundoscopy documented OR referred for retinal screening = 50.8%
% of DM patients[a] with micro-albuminuria or urinary protein tested	Annual[b] Albumin creatinine ratio checked in 83.8%
% of DM patients[a] on ACE inhibitor with creatinine checked	Annual[b] creatinine check in 98.5%
% of active cohort with health education session at last clinical visit	66.9%[c]
Number of MHPSS group sessions monthly	Average 5.5 per month in 2016 and 2017
% of referred patients attending MHPSS individual counselling	Not available as number of internal MHPSS referrals was not captured
Adaptations	
Number/% of follow-up consultations performed by nurses	6% in 2017

Key: *ACE* angiotensin-converting enzyme, *FBG* fasting blood glucose, *HTN* hypertension, *MHPSS* mental health and psychosocial support
[a]Among 130 randomly selected diabetic patients' charts analysed for the clinical audit.
[b]Annual referred to the 12 months preceding their most recent appointment.
[c]Among patients active in 2017 ($n = 4011$)

"telling them what to do", whereas a "solution-focused" approach and motivational interviewing techniques were preferred:

> *"(Using) words like 'you are not being honest', 'I don't feel like you're telling the truth',' if you only would' … doesn't work… This concept of patient-centred care, solution focused therapy, it's what works."* Clinical supervisor.

Challenges and facilitators

Here we present the challenges and facilitators related to patient access, implementation and maintenance that led to the specific adaptations detailed in the following section. Specific individual-level challenges around adherence to medications and healthy living advice are discussed later.

For patients, the profound impact that war and the refugee experience had on Syrian refugees' lives proved to be the key challenge to delivering effective NCD care to these patients. Syrian patients' psychological distress, social suffering and poverty had enormous implications for their ability to access and engage with the programme, as explored in detail in our linked paper [32]:

> *"The hypertension goes high … when I get sad and remember my sons in Syria and they tell me what happens with them I keep crying and crying then my hypertension goes high or goes down… I take a hypertension pill to settle down whenever I read some news about them."* Syrian patient.

The challenges reported by clinical staff also related to Syrians' experience of war. Many staff clearly stated that they could not manage medical problems in isolation from the psychosocial issues patients faced. They felt ill-equipped to deal with Syrian patients' war-related trauma and found it personally challenging. They highlighted the added complexities involved in treating Syrian versus Jordanian patients due to their perceived lower education and literacy levels and limited "hope" for the future. Care delivery was also complicated by the culture of private medical care and patients' care seeking behaviour, with both nationalities tending to visit multiple concurrent providers and to prefer branded medication. MSF introduced an appointment system, contrary to common practice in Jordan, and patients' initial failure to adhere to appointments proved frustrating for staff. Clinical and supervisory staff discussed the challenges inherent in providing chronic NCD care, such as long consultation times and dealing with the complexity of multi-morbid patients, especially those with renal failure. They noted that frail, elderly or housebound patients found physical access to both clinics sites difficult (via stairs). Finally, staff also described contextual and cultural challenges around healthy living education and behaviour change. These included diet and exercise norms (high fat, high salt diet and low habituation to exercise for health or leisure), the acceptance of smoking (especially in men), the obesogenic environment and most patients' reliance on medications to provide solutions.

Staff perceived that facilitators to programme implementation included excellent patient-staff rapport, positive experiences of supervision, support and training, and good teamwork with colleagues. The MSF NCD guideline reportedly facilitated implementation and was largely acceptable and "useful". Staff found it comprehensive and adaptable to the local context, serving as a tool to negotiate patient demands. However, clinical staff also highlighted the limited guidance on complex multi-

morbid patients, while management staff requested additional programmatic guidance on defining a primary level NCD package ("what components are included…that is not clear") and predicting referral needs. Jordanian doctors reportedly perceived the guideline as limiting their autonomy and offering "second-class" generic medication. Several called for a digital version facilitating access via smart phone.

Adaptations

Interviewed management and clinical staff described how the programme, designed around a high-income country primary care model, adapted dynamically to identified patient, programmatic and contextual challenges. The major adaptations are listed below:

- The MHPSS service was an essential addition to the programme. It was initiated in response to high rates of mental ill health among Syrian patients and limited adequate referral options. Starting with individual counselling sessions, it was later expanded and reoriented to provide ad hoc psycho-education sessions in waiting rooms, peer-support groups and a targeted group 'living well' programme combining health education and psychosocial support.
- By the end of 2017, only 0.5% (n = 24) of enrolled patients were formally diagnosed with a comorbid mental health condition and only 3.0% (n = 154) attended individual counselling sessions. Sixty-six group-counselling sessions were held in 2016, when recording began. (MHPSS service data did not capture numbers enrolled in group or waiting room sessions and were not linked to the general dataset). Most patients interviewed for this evaluation were unaware of the MHPSS services. Staff reported issues around social acceptability from both their own and patients' perspectives and their reluctance to "label" patients as requiring MHPSS. Physical space, patient transport costs and limited patient engagement also proved barriers to patient engagement with MHPSS services. In response to the initial distrust and low rate of referrals from the programme doctors, the MHPSS undertook multidisciplinary staff training sessions and referral rights were extended to nurses.
- Depression screening was introduced and later paused as the numbers screening positive overwhelmed existing service capacity. At the time of the study, the team reported an ongoing lack of good quality referral options for patients requiring prescription of psychotropic medications or psychiatric input. Therefore, management staff planned to train one family medicine specialist and to expand MSF's medication list to address this need.
- The humanitarian liaison officer's social work role was introduced to address Syrians' social and protection needs by linking them with other available services. It was reportedly underutilised as few referrals were made by the clinical team.
- Interviewed staff adapted health education messages to patients' literacy and education levels, their limited financial means and their living environments. Staff also involved family members as informal treatment supporters.
- A home visit service was introduced in 2015 to improve access for elderly, housebound and frail patients. The team (a nurse, doctor and driver) initially served a 10 km radius from the clinics and both team and catchment area were later expanded.
- Management staff reported introducing clearer admission criteria relating to patient vulnerability.
- An appointment system with short message service (SMS) appointment reminders and an appointment tool were introduced to increase efficiency. Patients valued the reminders and the appointment system, which minimised the long waits and prevented the perceived favouritism they experienced in the MOH system. However, they also perceived it as rigid with services inaccessible outside of prescribed appointment times. Staff strongly encouraged patients to attend at their planned appointment day and time, achieving a 90% adherence rate by 2017.
- Task sharing to nurses of the care of "stable", less complex patients achieving clinial control was introduced and stable patients' appointment interval was increased from 1 to 3 months. Family medicine specialists were added to the team to support management of more complex patients. Task sharing had occurred in a very limited manner by the end of 2017 because of lack of clarity on clinical activity and patient flow, lack of clear eligibility criteria, reported resistance from patients and medical staff, national regulations limiting nurses' roles. Increasing stable patients' appointment interval to 3-monthly required dispensing of 3 months' worth of medications. This necessitated the expansion of pharmacy team capacity.

Costs

The total annual financial cost of the NCD programme from the provider perspective increased annually in parallel with greater patient volume, greater service complexity and with the addition of specialist staff. It increased by 52% from INT$ 4,206,481 in 2015 to INT$ 6,400,611 in 2016 and by a further 5% to INT$ 6,739,438 in 2017. Per-patient-per-year (PPPY) cost increased

23% from INT$ 1424 (2015) to 1751 (2016), and by 9% to 1904 (2017), while cost per consultation increased from INT$ 209 to 253 (2015–2017). The major cost drivers were human resources (accounting for 38.9–42.6% of total annual costs) and medications (34.8–43.2%). The costs are reported in detail in a related paper [20].

Maintenance

Under the *Maintenance* domain, we explored the challenges and facilitators related to programme maintenance at the individual and organisational level.

Individual level

We explored retention in care, medication burden, challenges and supports around psychosocial issues and adherence to medication and healthy living advice. Routine cohort data analysis showed that the majority of patients enrolled during the study period ($N = 5045$) were retained in care for over 6 months, with 85% attending a follow-up appointment six-months (+/− 30 days) after enrolment; while one-third of enrolled patients had exited (including 12.5% cumulative loss to follow up and 2.6% deaths) (Table 2).

Over half of adherence survey participants ($N = 300$; 74.4%) were prescribed four or more MSF-provided medications (Supplementary material S4B). The majority (60.4%) also took medications obtained from another source. Most patients (89%) had very high self-reported medication adherence scores. While the majority of individual interview participants (especially Syrians) declared themselves "very committed" to taking medications, several described stopping, taking intermittently or sharing medications with those in need. Staff and patients both emphasised the negative impact of mental distress on adherence to medications and healthy living advice:

> *"As I was hearing the stories I thought…this man's problem is not that he's smoking too much. His problem is that he … experienced sexual violence, physical violence in prison in Syria… these two are linked."* Clinical staff member.

Qualitative data confirmed that patients' medication adherence and behaviour change was facilitated by support from family and MSF staff.

Organisational level

Here we explored the costs, challenges faced and possible modifications necessary to maintain the programme at organisational and contextual levels. With senior management, we discussed the lessons learned that could improve the programme or facilitate its scale-up, transfer or adaptation to other settings.

Our costing data supported our interviewees' impression that this was an expensive programme. To support programme planning, we explored potential cost savings that could be achieved by varying the organisation of medical consultation workflow, which we presented in a related paper. The frequency of patient contact with the facility had the greatest influence on cost-savings; as more patients were categorised as "stable", they were thus more suitable for less expensive nurse review and for longer review intervals [20].

Many of the challenges elicited were related to delivering chronic care to a conflict-affected population in a refugee setting with all the attendant psychosocial, physical and financial challenges. This proved the key challenge to implementing and maintaining effective NCD care in the Syrian refugee population.

MSF staff and stakeholders described the programme as being delivered within the framework of a complex and fragmented humanitarian system. Staff struggled to assist patients in navigating an often opaque, frustrating and unresponsive referral system.

> "*The credibility of any service…depends on its ability to refer upwards…That is just as true for people with angina … (as it is) for mental health."* Management staff member.

Referral pathways were limited by: cost (MSF and UNHCR covered limited essential conditions, procedures and providers); inconsistent availability (some referral services provided on short-term project bases); and bureaucracy (MSF was required to refer to MOH services via an intermediary).

In addition, the programme operated in a middle-income country of the Middle East with well-established health systems, regulations and policies, which tightly regulated humanitarian actors' activities. Policies included the requirement that medications must be locally purchased (which increased costs); the lack of government focal point or set of regulations governing NGOs; significant bureaucratic delays; and strict regulation (for example around prescribing of psychotropic medications, nurse-prescribing and permission for Syrian clinicians to practice in Jordan).

In terms of facilitators of programme maintenance, management staff highlighted that the availability of highly qualified Jordanian professional staff facilitated implementation of this complex, multidisciplinary model of care but that this level of staffing would be unavailable in other settings where MSF works.

Qualitative data highlighted the importance placed by MSF staff on providing a good quality service that

fulfilled MSF's humanitarian remit. There was a perceived tension between their desire to continually improve the programme and the need to consider long-term planning and a potential future handover. While the MOH was considered by some management staff as the likely handover partner, they emphasised its limited capacity and the gulf between current MSF and MOH models of NCD care.

The internal debate within MSF around the appropriateness of a humanitarian NGO engaging in chronic NCD care and their relative inexperience in doing so also posed its own unique challenge to the maintenance of the programme, as described here:

> *"An NCD Programme is a relatively recent departure for MSF and it is getting very close to the dividing line between humanitarian and development aid. (There is a) general sense among the humanitarian community that NCDs are an epidemic and need to be dealt with, but I am not sure we have ...(a clear) view of how this should be managed..."* Management staff member.

Several MSF management staff noted the particular challenge involved in adapting MSF's more familiar approach, characterised as providing relatively short-term solutions to health care gaps in populations in crisis, to the setting of chronic disease care. Several also questioned the sustainability and/or the potential to hand over the complex Irbid care model and mentioned the Jordanian MOH and other NGOs as potential hand over partners. However, senior MSF staff highlighted the rationale for maintaining the specific vertical programme in Irbid. It served as an opportunity for MSF to "learn by doing" and to understand the essential components of NCD care. To continue operating in the Jordanian context, a middle-income country with established systems, regulations and policies, required a different type of engagement and negotiation with authorities compared to other contexts where MSF has traditionally worked, which may have fewer resources and weaker systems.

Several staff members suggested that MSF could engage more closely with pre-existing health systems in designing future NCD interventions, and could build on their HIV service model, by maximising task sharing and decentralisation of care to community level.

Discussion

Our mixed methods evaluation guided by the RE-AIM framework has helped to characterise the implementation strategies, challenges and adaptations made to a complex, multidisciplinary intervention providing primary level NCD care in a humanitarian setting.

Programme coverage, acceptability and access to chronic care in Jordan

The MSF Irbid NCD Programme provided free-of-charge care to a limited patient cohort, covering approximately one quarter of the target adult Syrian population and a number of Jordanians. Enrolled patients' NCD risk factors and disease prevalence reflected regional norms [19, 30, 39, 40]. The programme was largely acceptable to patients, staff and stakeholders, although patients were frustrated by the siloed approach to care and limited access to referral services.

One key finding, consistent with the literature, was the lack of access to affordable NCD care both for non-MSF patients and for MSF patients seeking care for conditions not covered by MSF [19, 29–31]. Syrian refugees' access to NCD care was likely diminished following Jordanian government policy to significantly increase their MOH co-payments to "foreigner" levels in 2018, which was later reversed in 2019 [31]. McNatt et al. reported that, following the policy change, NCD patients increasingly sought care from the NGO rather than MOH sector, attending multiple providers to create comprehensive NCD care for themselves. Patients in their study found this process financially and emotionally burdensome. MSF could also note their finding that the burden of indirect costs of clinic attendance (transport, lost work time) potentially outweighed the benefits of free NGO-provided care [31].

Delivering chronic care in a humanitarian setting

Many of the challenges in programme implementation encountered by MSF were related to a humanitarian organisation delivering chronic disease care to a conflict-affected population. The impact of Syrian patients' experience of war, loss and social suffering on their engagement with NCD care was a key finding [32]. The lack of accessible and consistent specialist care referral pathways for NCD complications in this context has been described in the literature [29, 41]. MSF's temporary solution via other international NGOs was dependent on short-term project-based funding. For future NCD programme design, we recommend attempting to secure essential referral pathways (e.g., ophthalmology, cardiology, nephrology) that are acceptable, accessible and affordable for patients, and linked directly with MOH services, where possible. We acknowledge that this may be extremely challenging, especially in low-income countries with constrained health systems, and would require agreement on financing, clear referral criteria and continuity of information. Strengthening NCD care within the MOH system in humanitarian settings also requires greater focus and financing of NCDs by major donors. Other challenges

identified were related to the specific Jordanian context, a middle-income country with well-established health systems, regulations and policies, which tightly regulated humanitarian actors' activities compared to other settings with weaker systems.

Key programme adaptations

This MSF programme repeatedly adapted to patient and programmatic needs. Key adaptations included the addition of a specific, culturally-relevant MPHSS service, the introduction of the HLO social work role and the development of specific referral criteria for MHPSS, social work and external services [32]. There appeared to be scope to further improve both patient education (by taking a more solution-focused approach, utilising patients' own strengths, skills and intrinsic motivation) and medication adherence support [42]. Further work is needed to develop adherence measurement and support tools in this population but joint decision making with patients and involving treatment supporters may prove valuable, as found in other contexts [43].

MSF also adapted recall and data collection tools to chronic care delivery by introducing specific appointment times, appointment reminders, individual patient files and a patient-level electronic database. The latter allowed for cohort analysis, as previously demonstrated by the UN Relief and Works Agency for Palestinian refugees (UNRWA) [44–46]. Key lessons included the need for a fit-for-purpose and actionable information system and the need to establish informative indicators without overburdening staff with data collection.

Effectiveness of the programme

The programme appeared to achieve good intermediate clinical outcomes for hypertension and diabetes. These findings reflect those reported by MSF and UNRWA in similar humanitarian settings [21, 44, 47]. However, it should be noted that we know little about the prevalence or outcomes of major complications of these illnesses, such as heart failure, ischaemic heart disease and peripheral vascular disease. This is partly because these conditions are difficult to measure at primary care level, requiring equipment and trained personnel, but also because of the limited affordable specialist care available to MSF patients for diagnosis of these conditions in Jordan [29, 48]. The apparently good asthma control outcomes relied on patient self-report and may have reflected poor recording of this variable. The low rate of statin coverage is an important finding. Since this is a proven, effective strategy to reduce mortality, we suggest that further staff training on CVD secondary prevention, further audits (ideally as part of a quality improvement strategy), and the introduction of fixed dose combination CVD secondary prevention drugs may boost statin prescribing [48–50]. In terms of hard outcomes, such as mortality, 2.6% of the cohort was known to have died during the study period. This is not surprising given this was an elderly population with multi-morbidity and limited access to specialist care. It may be underreported, since most deaths took place in hospitals or in the community and, in many cases, cause of death was not known. Further study of death rates and cause of death is warranted, necessitating longer follow up periods.

Maintaining the programme

We identified a number of key challenges to maintaining the programme and areas for further improvement. Principal among these was cost. MSF management staff perceived the programme to be costly but, to our knowledge, there are no available published data to directly compare the programme's costs with similar services, either in the Middle East region or in other humanitarian settings. This programme was more costly than MSF-reported *incremental* PPPY costs of adding NCD care to existing services in Mweso, Democratic Republic of Congo [INT$222 (2015)] and in Eswatini [INT$441 (2016)] [7, 33]. Limited data on NCD care from countries affected by the Syrian crisis have focused on the costs of secondary or tertiary level care [51–53]. High costs were at least partly responsible for MSF limiting the service's coverage and scope. However, some adaptations introduced by MSF, triaging the cohort patients by disease complexity and control, introducing task sharing to nurses and spacing review appointments for stable patients could result in cost savings, as discussed elsewhere [20]. It was possible to employ family medicine specialists to manage the more complex patients in Irbid because of the availability of highly qualified Jordanian staff, but such staff would likely be unavailable in many humanitarian settings with more constrained health systems. It is therefore essential to provide programmatic and clinical written guidance appropriate to different contexts, which could potentially be supported by technology, such as telemedicine and/or mHealth decision support tools, as trialled by other actors in Lebanon [54].

Humanitarian actors' modus operandi is to rapidly identify needs and bring healthcare to vulnerable or marginalised populations, then withdraw or hand over activities, as the context dictates. This approach is not consistent with the continuous care required for chronic conditions and may explain interviewed participants' apparent discomfort with the lack of a "handover strategy" and "vertical" nature of the programme. Senior staff emphasised the role the Irbid programme played as one of MSF's pilot NCD-specific programmes, serving both to anchor the organisation in Jordan and as a training programme. While the programme served MSF well as a learning ground it

was unlikely to be scalable in Jordan or reproducible in other humanitarian settings, mainly due to cost and the required numbers and skill mix of staff.

MSF and other humanitarian actors recognise that integration of NCD care within existing health systems, ideally at primary care level, may be the optimal approach [2]. Integration may provide an opportunity for health system strengthening, particularly in contexts where resource-poor health systems have previously focused on episodic emergency or infectious disease care and have limited capacity to provide chronic disease care [1, 55, 56]. Designing future NCD services may require a comprehensive analysis of the pre-existing health system's readiness to manage NCDs, particularly at primary care level, and its resilience in the face of crises.

Lessons learned and potential solutions

The lessons learned and adaptations made as the programme evolved may be relevant to MSF, the MOH and other humanitarian actors and may be transferable to other settings. A number of approaches are interlinked and could potentially achieve several things: increased patient-centeredness, increased cost-efficiency for patients and provider, and increased coverage. These goals could be achieved by reducing facility-based contact through decentralisation, enhancing community-level care and supporting patient self-management. These approaches could involve further task sharing to nurses or other non-physician health worker cadres, such as community workers or volunteers. Several aspects of the care pathway could be shifted to the community level, including prevention and sensitisation activities, diagnosis, treatment monitoring and adherence support. Patient centeredness (taking a holistic, responsive approach and actively collaborating with patients and families) could involve either providing "one stop shop" comprehensive primary care at a single facility visit or bringing care to the patient via outreach workers or home care teams [34, 57, 58]. Adherence and self-management could be supported via mobile phone or wearable technology or through peer support groups led by community workers or peers [56]. Clearly, the specific design and the successful implementation of these strategies would be context-dependent and would rely on local acceptance by patients, staff and the medical fraternity as well as political and regulatory support.

Several actors in Jordan have introduced community-based healthy living interventions or peer support groups for people with diabetes on project or pilot bases [59–62]. Some reported positively impacting intermediate clinical outcomes, such as weight and blood glucose levels. However, cost effectiveness, sustainability, acceptability or user experiences were not formally examined. The recently published HOPE4 trial also demonstrated the benefits of a community-based package of care for hypertension in a non-humanitarian setting [63].

Strengths and limitations

To the best of our knowledge this is the first study to comprehensively describe a mixed-methods evaluation of an NCD service in a humanitarian setting guided by the RE-AIM framework. It builds on our previous use of the framework in the Democratic Republic of Congo [6, 7]. We made comprehensive use of RE-AIM, addressing each of the domains and including more extensive explanatory qualitative and costing analyses than are often employed in the RE-AIM literature [15]. We could comment in only a limited way on *adoption and participation* as they have been traditionally used, since this intervention took place at a single site rather than involving multiple sites/providers. We included process indicators relevant to Quality of Care in several domains. Alternatively these could be grouped under the "Implementation-fidelity" subdomain.

The challenges of conducting research in humanitarian contexts, the need to improve evaluation of humanitarian programmes in general and the lack of evidence describing the effectiveness of NCD care models in humanitarian settings have previously been noted [3, 10–13, 64]. We demonstrated that implementation research can be conducted while placing limited burden on staff and patients. We also highlighted the challenges in retrospectively evaluating humanitarian programmes, which tend to be highly responsive to changing contexts, and in analysing routinely collected data. For example, it was not feasible for us to include a comparator group or use a quasi-experimental design, such as interrupted time series, given the dynamic and unique nature of the programme. Indicators designed for this evaluation have contributed to the ongoing development by humanitarian organisations of a set of shared NCD indicators. A number of our indicators could not be measured due to failure to collect or limited usability of data and we emphasise the need to co-develop indicators with implementers, especially when using routine programmatic data.

We note there is a need to replicate this model to distinguish what is essential to this site rather than essential across settings. We also note our limited understanding of the situation of people with NCDs who did not reach care, for instance, those who were undiagnosed, who attended irregularly, or who could not physically access services. Similarly, we did not interview patients currently attending MOH or other NGO services, although our findings about alternative NCD services reflect those of other authors [31]. We note, finally, that social desirability bias may have influenced results of the qualitative data and of the self-report medication adherence survey,

which was mainly administered by the data collectors rather than by patients as intended.

Future research and evaluation

As discussed, there is a need to design and perform implementation research around the streamlined high-quality NCD programme models described above in humanitarian settings, particularly facilitating access for mobile or dispersed populations. Designing and evaluating novel ways to improve access to diagnosis and management of NCD complications at primary care level is also essential, which could include use of telemedicine, mobile technology or artificial intelligence-supported diagnosis or clinical decision tools [48, 54, 64]. We recommend that future research should focus on elucidating programme impact, where possible, using methods such as causal inference frameworks and prospective interrupted time series analyses. Longer study durations would facilitate examination of hard outcomes, such as cardiac events and deaths. Further exploration of access and quality of care issues, utilising patient quality of life and satisfaction outcomes and disaggregating by sex, would also be useful. In addition, patient-level costing studies, examining direct and indirect patient costs, and cost-effectiveness studies are lacking.

Conclusion

RE-AIM has proven a valuable tool to guide the evaluation of a complex intervention in a protracted humanitarian crisis setting. Most elements of the MSF programme were perceived as acceptable to patients, staff and stakeholders, whereas adaptations were required to improve the acceptability of the MHPSS services. It was accessible and affordable for the programme's cohort of enrolled patients, while achieving good intermediate clinical outcomes. However, the programme had limited coverage and the current model was both costly and complex and therefore challenging for other actors to emulate or to translate to other, more financially constrained settings. We propose that simplification of the care model, reduction of costs and use of technology could improve effectiveness and efficiency without reducing acceptability and may improve transferability to other settings.

Key recommendations

1. **Patient-centred**. Adopt a contextualised, patient-centred approach where possible. For example, deliver care at community level, support patients and families to self-manage and provide holistic, "one-stop-shop" care at facility visits. Elicit and respond to patient priorities. In this case they were: consistent, affordable medication and respectful and caring staff.
2. **Complex, yet efficient care.** There is a broad range of patient complexity involved in NCD care, from asymptomatic hypertensive patients to frail, elderly patients with complex disease involving polypharmacy and multi-morbidity. It is important to acknowledge this complexity and the holistic approach needed when drafting guidelines and designing services. Consultations are time consuming and patients may require frequent review. Where appropriate, a context-adapted, algorithm-driven approach may facilitate task sharing to nurses of the stable, less complex patients. Introducing fixed dose combination pills, for example, may reduce pill burden and ease adherence, while simplifying prescribing and workload in relevant settings.
3. **Continuum of care.** NCDs require a continuum of care involving primary prevention, diagnosis and treatment, prevention and management of complications, psychosocial support, rehabilitation and palliation. A multi-disciplinary team would ideally deliver this package of care, where available.
4. **Mental health and psychosocial support** should be included as an integral part of primary level NCD services in humanitarian settings. This may be integrated or provided by partner organisations. Provide a tiered approach to MHPSS according to need: 1. Basic support available to all, 2. Psychosocial or peer support groups for specific patient groups (such as teenagers with diabetes), and 3. Individualised counselling and medical intervention.
5. **Adapted healthy living advice.** Adapt advice to patients' constrained circumstances and use proven techniques such as solution-focused counselling and motivational interviewing.
6. **Access to referral services.** A predictable proportion of patients will require referral for screening, diagnosis or treatment of NCD-related complications. However, it may be difficult to secure essential referral pathways (e.g. ophthalmology, cardiology, nephrology) that are acceptable, accessible and affordable for patients. Therefore, it is essential to maximise the quality of primary NCD care to prevent, identify and effectively manage complications.
7. **Low cost to patients yet cost-efficient for providers**. The ideal way to ensure access is to provide free-of-charge care to patients, where possible. The model of NCD care presented here was relatively costly from the provider perspective, especially in terms of HR and drugs. We have shown that savings could be made by reducing the frequency of

facility-based contact and by introducing context-adapted procurement practices.

8. **Health system strengthening.** Integrate with host health systems where possible and engage in health system strengthening appropriate to the local context, in order to ensure sustainability and facilitate movement of patients from private to state health systems. This may require a comprehensive analysis of the pre-existing health system readiness to manage NCDs, particularly at primary care level, and its resilience in the face of crisis, before embarking on an NCD intervention.
9. **Monitoring and evaluation adapted to chronic care.** Implement more broadly the structures, reporting mechanisms and indicators developed within the MSF Irbid programme to reflect the needs of a chronic disease programme.
10. **Research.** Engage patients and stakeholders in the design and evaluation of new models of NCD care in humanitarian settings. These may involve simplification, greater use of task sharing, decentralisation of care to the community level, and use of technology for patient and provider support.

Abbreviations

BP: Blood pressure; BMQ: Beliefs About Medicines Questionnaire; COPD: Chronic obstructive pulmonary disease; CVD: Cardiovascular disease; DM: Diabetes mellitus; FBG: Fasting blood glucose; FGD: Focus group discussion; HbA1c: Glycosylated haemoglobin; HLO: Humanitarian liaison officer; HTN: Hypertension; INT$: International dollars; JHAS: Jordan Health Aid Society; LMIC: Low- and middle-income countries; MARS-5: Medication Adherence Report Scale-5 item; MENA: Middle East and North Africa; MOH: Ministry of Health; MSF: Médecins sans Frontières; MHPSS: Mental health & psychosocial support; NCD: Non-communicable disease; NGO: Non-governmental organisation; RE-AIM: Reach, effectiveness, adoption, implementation and maintenance; SMS: Short message service; UNHCR: United Nations High Commissioner for Refugees; UNRWA: UN Relief and Works Agency for Palestinian Refugees; WHO: World Health Organization

Supplementary Information

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Additional file 1. Summary of MSF Irbid NCD programme REAIM evaluation indicators and methods. **A)** Table showing: main indicators relevant to each RE-AIM domain and the methods and data sources used to determine them, and **B)** Figure showing: schematic representation of methodologies and indicators.

Additional file 2. Intervention description for MSF NCD programme in Irbid, north Jordan. Detailed description of the MSF NCD programme, including enrolment criteria, elements of clinical management, patient circuit and follow up pattern.

Additional file 3. Programme Timeline MSF NCD programme in Irbid, north Jordan. Timeline showing key contextual and programmatic change during the study period December 2014 to December 2017.

Additional file 4. Medication Adherence Survey Additional Material. Tables showing: **A)** Medication adherence data collection and analysis, **B)** Demographics of 300 adult patients of the Irbid NCD programme who responded to a medication adherence survey in September 2017 and **C)** Proportions of answers to individual questions of MARS-5 questionnaire; 1D. Frequency of sum scores for MARS-5 from 300 survey patients from Irbid NCD Clinic.

Additional file 5. Qualitative Study Additional Material. **A)** Detailed description of the qualitative study methods for MSF Irbid NCD programme evaluation, **B)** Participant list for patient, staff and stakeholder semi-structured individual interviews and **C)** Topic guides for focus group discussion with patients and individual interviews with patients, health care providers and staff and stakeholders.

Additional file 6. Cohort Study Demographics, Cardiovascular Risk Factors at Enrolment and NCD Diagnoses at Last Visit. Tables showing: **A)** Demographics by country of origin of 5029 Syrian and Jordanian patients enrolled in Irbid NCD Programme 2014–2017, **B)** Cardiovascular Risk Factors at Enrolment for the cohort 2015–2017 and **C)** Per patient diagnoses at last visit for all patients enrolled in the Irbid NCD Programme 2015–2017 by age and gender.

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Authors' contributions

EA, KJ, BR, PP, KB, MT were involved in conception and/or design of the study; EA, TH, JQ collected the data and EA, KJ, BR, PP, JQ were involved in data interpretation; EA drafted the paper with contributions from KJ, BR, PP. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request, with the permission of Médecins sans Frontières (ocaresearch@london.msf.org) and under a data sharing agreement.

Declarations

Ethics approval and consent to participate

The Médecins sans Frontières Ethics Review Board, the London School of Hygiene and Tropical Medicine Ethical Review Committee [Reference 12239] and the Jordanian Ministry of Health granted ethical approval for conduct of this study.
Informed written consent to participate in the study and for publication was obtained from participants in the qualitative and medicine adherence components of the study. Consent was not sought from patients for use of their de-identified, routinely collected clinical data for the cohort analysis or clinical audit study components.

Consent for publication

Not applicable

Competing interests

Several of the authors (EA, TH, JQ, KB, KJ) are currently or were previously employed by Médecins sans Frontières and were involved in programme design, study design, data collection, data interpretation and drafting of the manuscript. The authors declare they have no other competing interests.

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Publisher's Note

Appendix 1: Programme Description

Title: Intervention description for MSF NCD programme in Irbid, north Jordan:

Description: Detailed description of the MSF NCD programme, including enrolment criteria, elements of clinical management, patient circuit and follow up pattern.

The multidisciplinary team initially included non-specialist doctors, nurses, health educators, pharmacy and reception staff. The team provided appointment-based medical consultation, incorporating health education (HE) and behaviour change counselling, and were supported by a local management team and a coordination team in Amman. The service evolved to also incorporate individual and group-based mental health and psychosocial support (MHPSS), social work, physiotherapy and a home visit team for house-bound patients. Further staff roles were added including counsellors and a specialist family medicine practitioner at each clinic site as well as a physiotherapist, a humanitarian liaison officer (HLO), who performed a social work role, linking patients with protection and other humanitarian services, and the pharmacy and home visit teams were expanded (Programme Timeline S3).

Most patients (>90%) presented with established, self-reported diagnoses on enrolment; new diagnoses were made based on the MSF NCD guideline (35). The MSF guideline was adapted from international guidance and WHO PEN and Primary Care International guidance, both specifically developed for resource-poor and humanitarian settings (68–70). At first visits, doctors recorded a complete past medical, medication and family medical history and performed a clinical examination. In addition, lifestyle CVD risk factors (smoking status, alcohol intake, exercise levels) were recorded; the global cardiovascular risk score was calculated using WHO CVD risk prediction chart; acute complications were identified and treated; long-term medications were prescribed for symptom management and secondary prevention of complications; patients were referred for laboratory testing as appropriate; and a follow-up interval was determined (71).

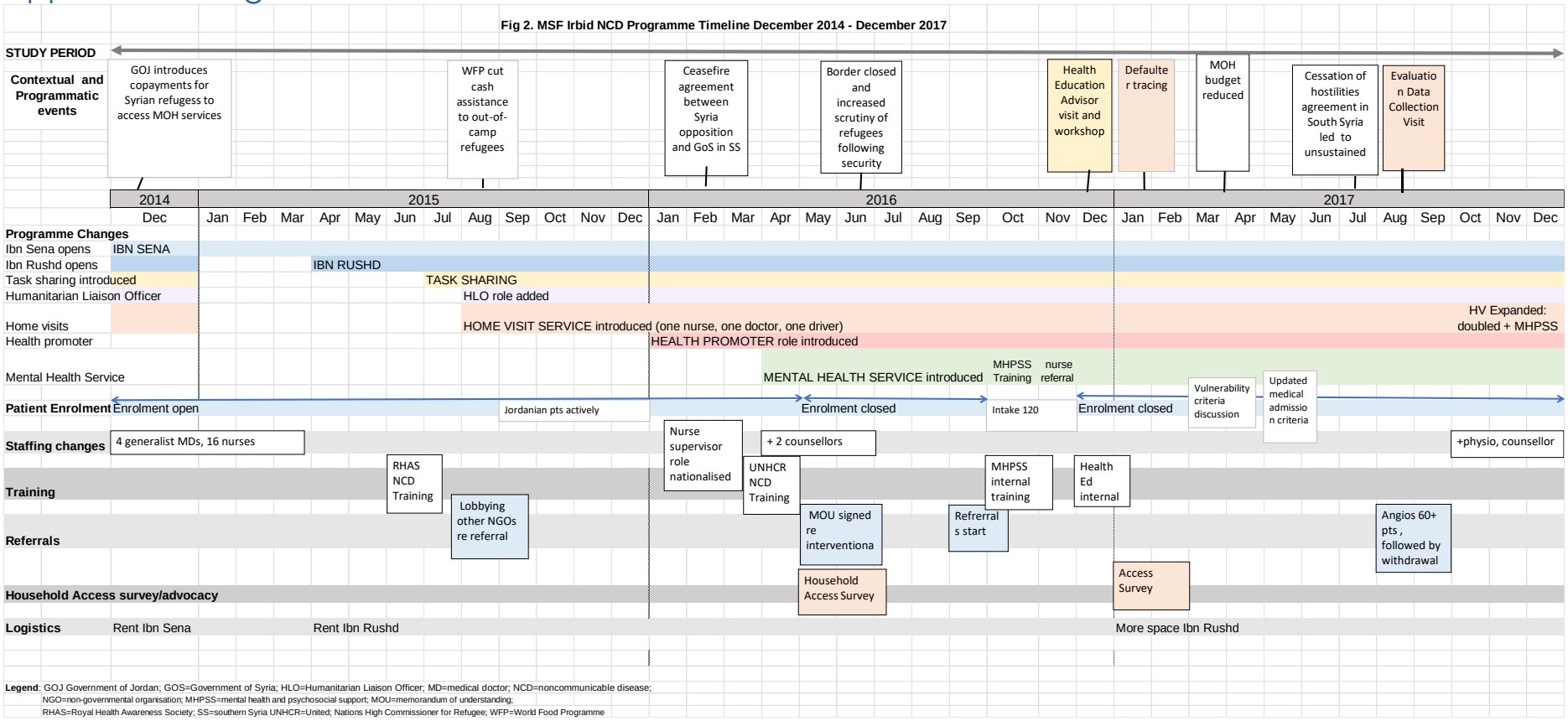
Patients were initially reviewed on a monthly basis and followed a defined patient circuit involving a registrar/clerk, triage nurse, doctor, health educator and the pharmacy team. Clinics ran six days per week from 8 am to 2 pm, while the home visit service operated on six days within a ten-mile radius of the clinics. Ton increase programme efficiency, policy for stable patients changed in 2016. Their clinical review appointments were task-shared to nurses and the review interval was increased to three months. However, medications were still dispensed monthly, so they were required to attend monthly to collect them. Stable patients were defined as those achieving the programme's clinical targets i.e. blood pressure < 140/90 mmHG; FBG < 180 mg/dL or HbA1c < 8%; and clinically controlled asthma, COPD or angina, as relevant to the patient.

Complications screening and referral. Hypertensive and CVD patients had annual fasting capillary blood glucose (FBG) performed to screen for diabetes. Clinic staff measured diabetic patient's blood pressure and capillary blood glucose at each visit and screened for micro-and macrovascular complications with annual foot checks (examination and monofilament testing) and referral to an external laboratory for annual microalbuminuria, serum creatinine and cholesterol testing.

Referrals pathways were complex, changed over time and were made to multiple other actors. Referrals for specialist care or care for non-target NCDs (e.g. musculoskeletal disease or cancer) were not funded by MSF. Emergency cases were stabilised (e.g. acute asthma exacerbation, diabetic ketoacidosis, acute coronary syndrome) and were then referred to the Jordanian public health emergency services by

ambulance. Non-urgent referrals (most frequently ophthalmology, cardiology and nephrology) were made to public, private or other humanitarian providers. MSF's referral patterns varied greatly over time as the availability of services, e.g. NGO-provided cardiac catheterisation, depended on short donor funding cycles. UNHCR oversaw the funding for registered refugees and covered MOH primary care and limited secondary, tertiary and emergency care according to strict eligibility criteria. Appointments were noted in an appointment book; clinical data were collected in paper-based files and entered weekly into a patient-level, macro-based Excel spread sheet by a data entry operator.

Appendix 2: Programme Timeline



Appendix 3: Medication Adherence Survey

Methods: Data collection and analysis

Our 17-item self-report medication adherence survey included questions about demographic information (gender, nationality, age group, education level, household size, number of NCD medications, and number and sources of other medications) and the utilised pre-existing medication adherence and beliefs about medicines tools. The Medication Adherence Survey-5 (MARS-5) is a five-item self-report measure of medication adherence. The Beliefs about Medicine Questionnaire – Specific (BMQ-S) is a 10-item self-report measure exploring people's beliefs about their current medications.

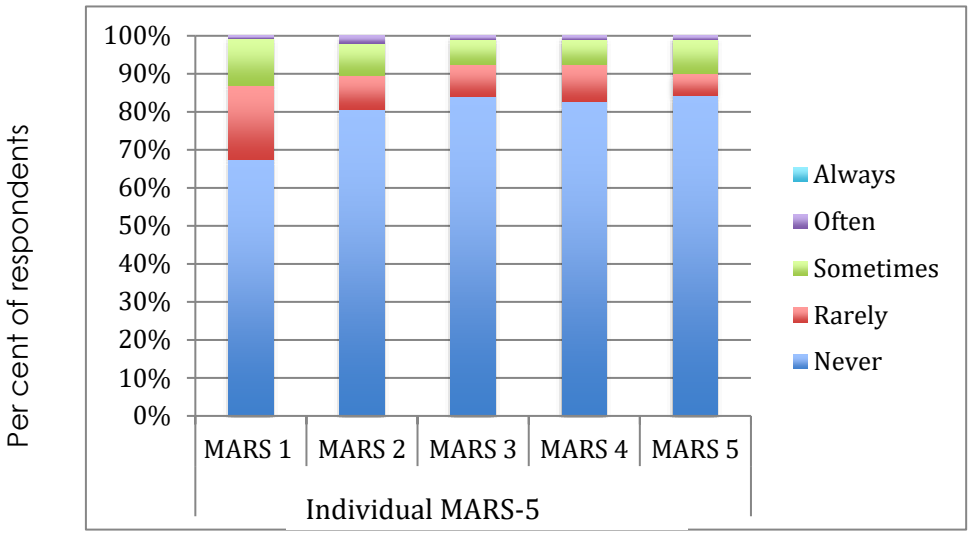
Respondents were asked to rate the frequency they engage in each of the adherence-related behaviours on a five-point scale, where 5 = 'never', 4 = 'rarely', 3 = 'sometimes', 2 = 'often' and 1 = 'always'. Scores for each item are summed to give a total score; higher scores indicate higher levels of reported adherence. The MARS-5 may be used to distinguish between intentional and unintentional adherence, which may guide intervention strategies to improve adherence. The BMQ-S consists of 10 statements about medications scored using a 5-point Likert scale (from 1 = strongly disagree to 5 = strongly agree). Five questions relate to the perceived *necessity* of medications and five relate to patients' *concerns* about taking medication.

Frequencies, mean, median and standard deviations were calculated for the individual and sum scores of the MARS-5. For the BMQ, the total per patient scores for "necessity" questions (possible scores 5 to 25) and "concerns" questions (possible scores 6 to 30) were calculated. The individual MARS5 scores were transformed to a 0 to 1 scale to allow for logistic regression. For each variable, the MARS total and individual question scores and the BMQ necessity and concerns scores were described using univariate analysis. P-values for heterogeneity were applied. Multivariate logistic regression analysis tested the effect on adherence of medication beliefs (necessity–concerns difference scores AND necessity scores AND concerns scores), demographic variables (age, gender, nationality, marital status, educational experience, household size) or clinical factors (number of diagnoses, number of prescribed medicines, number of medication sources).

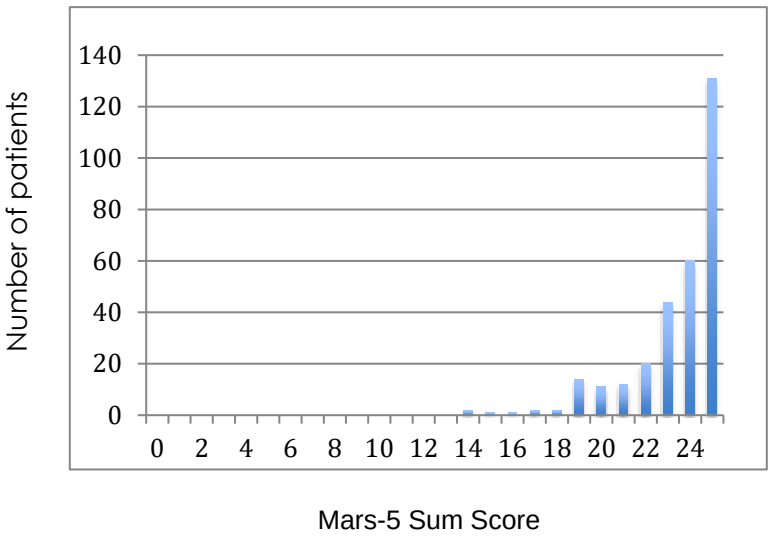
Demographics of 300 adult patients of the Irbid NCD programme who responded to a medication adherence survey in September 2017.

Variable	Category	n	%
Age (years)	<50	73	24.3
	50-59	100	33.3
	60-69	86	28.7
	70+	41	13.7
Gender	Male	99	33.0
	Female	136	45.3
	Not answered	65	21.7
Nationality	Jordanian	87	29.0
	Syrian	212	70.7
Marital status	Married	240	80.0
	Other	12	
	Widow(er)	48	16.0
Education Level	None	42	14.0
	Primary	191	63.7
	Secondary +	90	28.0
Diagnoses	Diabetes	212	70.7
	Asthma	11	3.7
	Lung disease	2	0.7
	Thyroid	28	9.3
	Hypertension	230	76.7
	CVD	109	36.3
	Other	51	17.0
No NCD Diagnoses	1	84.0	28.0
	2	118.0	39.3
	3+	98.0	32.7
MSF medications	1-3	76.0	25.3
	4-6	152.0	50.7
	7-15	72.0	24.0
No other sources of meds	0	121.0	40.3
	1	162.0	54.0
	2+	17.0	5.7

Proportions of answers to individual questions of MARS-5 questionnaire



Frequency of sum scores for MARS-5 from 300 survey patients from Irbid NCD Clinic



Appendix 4: Qualitative Study Material

Detailed description of the qualitative study methods for MSF Irbid NCD programme evaluation

The qualitative study involved two same-sex focus group discussions (FGDs) with eight Syrian adult patients each and forty individual semi-structured interviews (SSI): sixteen with adult Syrian and Jordanian patients, eighteen with MSF staff, and seven with key stakeholders.

Patients scheduled for medical review during a 2-week period were stratified by NCD diagnosis and then randomly selected by study staff to be invited to participate in an interview or FGD, held at times convenient to patients. Syrian and Jordanian patients were eligible for interviews, while programme staff recommended that Syrians alone were included in FGDs to avoid participants feeling inhibited by the presence of Jordanians. Additional patients were purposively selected from clinic waiting rooms to ensure both sexes, both main nationalities and those accessing each clinic location and specialised service element (MHPSS, HLO, Home Visit) were represented. MSF staff were purposively selected to represent a range of clinical, support and managerial staff, past and present. More medical staff than other staff cadres were selected to evaluate the acceptability and implementation of the MSF NCD guideline. Key stakeholders were selected to represent different levels of the MOH, other NGOs involved in delivering NCD care in north Jordan and a representative of the Syrian community.

Qualitative data were collected in August 2017. All invited participants agreed to participate and signed an informed consent form. We conducted individual patient interviews until data saturation was achieved, which resulted in a relatively small sample since we were interested in broader, over-arching themes rather than in fine-grained themes. The number of staff and stakeholder interviews were based on practical time limitations but theoretical saturation was felt to have been reached. A topic guide included introductory questions about the patient's NCD or the participant's role in relation to NCD care and questions relating to each domain of the RE-AIM framework. We focussed on specific components of NCD care (e.g. service provision, clinical consultation, medication prescription and adherence, health education, MHPSS and/or support from the HLO, home visit service). The English-language FGD and SSI topic guides are included as Supplementary material S3. All FGDs, patient interviews and three staff interviews were conducted in Arabic by two trained research assistants (HT, male, current HLO; SE, female, former HLO) at MSF clinics or in one patient's home. The remaining interviews were conducted in English by EA (female, public health researcher at LSHTM) at MSF premises, stakeholders' offices, or via Skype for former MSF staff. In each case, participant privacy was assured. Interviews were audio-recorded, translated and transcribed by a study team member with quality checks performed by a second team member. Patient interviews included nine male and seven female patients, of whom ten were Syrian and six were Jordanian. The majority (n=13) had two or more NCD diagnoses, three had attended MHPSS services, two attended the HLO and one was a home visit patient (Supplementary material S3).

Data were coded in NVivo11© and analysed by EA and a co-analyst using template analysis whereby a coding template was developed, based on an initial subset of data, then applied to further data and refined iteratively (196,197). This allowed for an integrated approach employing both deductive and inductive coding. Deductive coding was framed around the *a priori* themes based on RE-AIM (79,82). Data were analysed by participant subset, i.e. patient, staff or stakeholder, and were checked with reflexive practice to mitigate against the insertion of preconceived assumptions. Themes were then related back to the research question and to existing literature. Negative cases or exceptions were examined to explore what set them apart. Both analysts reviewed the final template to enhance inter-rater reliability and analytic credibility.

Participant list for patient, staff & stakeholder semi-structured individual interviews

PATIENT			
Code	**Diagnosis**	**Origin**	**Gender**
PT01	DM, HTN	Jordanian	Male
PT02	DM, HTN	Jordanian	Female
PT03	DM	Syrian	Female
PT04	CVD asthma	Jordanian	Male
PT05	DM, CVD, MH	Syrian	Male
PT06	DM, HTN,	Syrian	Male
PT07	HTN	Syrian	Male
PT08	DM, HTN	Syrian	Male
PT09	DM	Jordanian	Female
PT10	MD, MH, HLO	Syrian	Female
PT11	DM, asthma, MH	Syrian	Female
PT12	DM, CVD	Syrian	Male
PT13	DM (wife of patient)	Jordanian	Female
PT14	DM, HTN	Jordanian	Male
PT15	DM, HTN, CVD, HLO	Syrian	Female
PT16	HTN, CVD, HV	Syrian	Male
STAFF			
Code	**Role**		**Gender**
ST01	Psychosocial counsellor		Female
ST02	Psychosocial counsellor		Female
ST02	Registrar (reception staff)		Female
ST04	Doctor		Female
ST05	Doctor		Male
ST06	Health educator		Female
ST07	Nurse		Male
ST08	Pharmacist		Female
ST09	Doctor		Female
ST11	Medical Coordinator		Female
ST12	Project Coordinator		Female
ST13	Mental Health Activities Manager		Female
ST14	Medical Activities Manager		Male
ST15	Medical Activities Manager		Male
ST16	Project Coordinator		Male
ST17	Medical Coordinator		Male
ST18	Pharmacist		Male
STAKEHOLDERS			
Code	**Role**		**Gender**
KS01	NGO		Male
KS02	MOH District		Male
KS03	MOH District		Female
KS04	MOH Clinic		Male
KS05	MOH Central		Male
KS06	Syrian Community Member		Male
KS07	NGO		Female

Qualitative Study Focus Group Discussion and Individual Interview Topic Guides

Topic guide – Focus group discussions with NCD patients

Key area	Themes	Question
Introduction	Study aim and agencies involved	Why invited to participate? Consent & any questions?
background	Getting to know+building rapport	Could you tell us a bit about yourself? *Prompt: e.g. profession, what area live in, when you were first diagnosed with [NCD condition]?*
Reach	Access Barriers to accessing care for NCDs Ways of reducing barriers	What do you know about your NCD condition(s)? *Prompt – e.g. causes, types, who gets it, treatment* Could you tell me about how you came to learn about your NCD condition(s)? ? *Prompt - from friends/family, radio (or other media), when diagnosed at hospital.* What were you told about NCD condition(s) when you were enrolled in the MSF clinic? *Prompt – probe understanding of NCD condition(s) such as causes, risks and its management (medication and diet).* What do you think might prevent people from attending this service for their NCD condition(s)? *Prompt: lack of knowledge, lack of services, costs, time, quality of services, stigma etc.* How could access to healthcare for NCD condition(s) be improved?
Adoption and implementation	Information Support	How did you feel when you were enrolled into this clinic? *Prompt: counselling/support experience. Prompt: subsequent days/weeks experience* Who did you talk to about your experience at the clinic? *Prompt: E.g. family members, friends.* What were you told about managing your NCD condition(s) after you were enrolled in clinic (by the NCD staff)? *Prompt: medicine types and usage, managing medicines, diet changes, risks and symptoms, frequency of check-ups etc.* What sources of support did you receive in managing your NCD condition? *Prompt: emotional support from family/friends, information support from health workers, MHPSS from health workers.* What made it easier for you to access care – initially and continuing care? What made it difficult for you to access care – initially and continuing care? What made it easier for you to self-manage your NCD condition at home? What made it difficult for you to self-manage your NCD condition at home? How acceptable do you find the NCD service / treatment. *Prompt: e.g. logistically, socially, culturally etc., differences with previous experience of treatment/ service?* What has been your experience of the psychosocial services offered by the programme – group sessions/individual counselling*?*
Maintenance	Challenges Supportive factors To support adoption and implementation	What have been the main challenges in maintaining your medical treatment for your NCD condition? *Prompt: time, costs, information, drug supply, pill burden, stigma/shame etc.* What have been the main challenges in altering your diet? *Prompt: information, costs, support* What have been the main challenges in increasing your levels of exercise? *Prompt: information, suitable facilities or locations, physical condition, support, costs* What have been the main challenges in reducing or quitting smoking? *Prompt: information, support, costs, desire* What could have made accessing care easier for you? *Prompt: e.g. information given – content and way it was delivered; costs; type and quality of care and support; focus on role of the NCD programme/services.* What could have made achieving lifestyle changes easier for you? *Prompt: e.g. information given – content and way it was delivered; costs; type and quality of care and support; focus on role of the NCD programme/services;* What support is available to help you to continue to attend the clinic and self-manage your condition? What additional supports regarding your NCD condition would you like to have?
Effectiveness	Unintended consequences Benefits	What have been the negative consequences of taking NCD treatment / attending the service? *Prompt: physical, psych, costs, time.* What have been the benefits of receiving NCD treatment / attending the service? *Prompt: e.g. physical, psychological, social, economic.* What have been the benefits or negative consequences of attending group sessions/ individual counselling?
Thanks and close	Anything else to add Questions/Thanks, feedback info	Anything else to add on topic that we haven't discussed today? Any questions for me? Feedback again on how the discussion will be used and fed back.

Topic guide – Semi-structured interviews with NCD patients

Key area	Themes	Question
Introduction	Study aim and agencies involved Why invited to participate Consent & any questions?	
Participant Background	Getting to know + building rapport	Could you tell us a bit about yourself? *Prompt: e.g. profession, what area live in, when you were first diagnosed with NCD condition?*
Reach	Knowledge in community Access to testing for [NCD condition] Barriers to testing	What do you know about your condition? *Prompt – e.g. causes, types, who gets it, treatment* What has been your experience in accessing healthcare and medications for your condition? *Prompt – in Syria, in Jordan, other NGOs or clinics, why choose to come to MSF clinic, does experience differ?* Do you think a lot of people have your NCD condition in your community? What do you think prevents people from accessing healthcare/medications for NCD conditions? What do you think would make it easier for people to access healthcare / medications for NCD conditions? If MSF were not providing this service what would you do to manage your condition?
Adoption and implementation	Information and other support provided Adjusting to condition	What type of information provided to you about your condition and its treatment when you were enrolled in the MSF clinic? *Prompt: causes, who gets it, chronic nature, medicine types and usage, managing medicines, diet changes, risks and symptoms, frequency of check-ups etc.* What sources of support did you receive? *Prompt: emotional support from family/friends, information support from health workers, psychosocial support from health workers* What other support would you have liked to receive? Do you find it easy to come in to the clinic from the beginning? *Prompt: facilitators or barriers e.g. logistically, socially, culturally* How has having your NCD condition changed your daily life/routine? *Prompt: e.g. difficulties in changing your daily routine, in Syria or in Jordan?* What is your experience of the MHPSS part of the programme (group sessions or individual counselling)?
Maintenance	Barriers/challenges to adhering to appointments and prescribed medicine/ lifestyle change.	Do you come in regularly for all your appointments? Do you find it easy or difficult to do so? Why? (e.g. travel, time, stigma) What is your experience when you come to the clinic? Do you experience any difficulties when you are visiting the clinic for follow up? What could be done to make it easier for you to come to the clinic? Do you take your medicines as often as you are prescribed? Why? *(Prompt: don't think it's important, unsure how to take them, can't read the instructions, too many pills, share with family/ friends, supply rupture)* Do you find it easy or difficult to do so? Why? (*Prompt difficult to remember)* Do you feel any pressure not to take your medicines (*Prompt: stigma from family or community, cost, medication sharing)* What could be done to make it easier for you to take your medications? Do you find it easy to maintain the recommended diet, exercise levels, smoking cessation for your condition? What has helped you to make lifestyle changes? Prompt: health education, medical staff, family or community support? What challenges do you face in adapting your diet, exercise levels and smoking habits? Do you thing MHPSS is important? What challenges do you face in taking part in or attending MHPSS support (group sessions, or individual counselling)?
Effectiveness	How coming to the clinic has affected patient's condition	What have been the negative consequences of taking treatment for the condition/ attending the service? *Prompt: physical, psych, costs, time.* What have been the benefits of receiving treatment for your condition / attending the service? *Prompt: e.g. physical, psychological, social, economic.* *What have been the positive and negative consequences for you in attending the MHPSS sessions (group or individual counselling)? (Prompt: feel supported, feel better, assists with managing NCD condition, upsetting, difficult)*
Thanks and close	Anything else to add	Questions/Thanks, feedback info

Topic guide – Semi-structured interviews with NCD health care providers and staff

Key area	Themes	Question
Introduction	Study aim and agencies involved Why invited to participate Consent & any questions?	
Participant Background	Getting to know each other + building rapport	Could you tell us a bit about yourself? Prompt: e.g. professional, involvement in the NCD service at Irbid (and previously if relevant)?
Reach	Access Barriers to NCD care provision Ways of reducing barriers	What are the key challenges for patients to access healthcare (medications, regular clinical review, investigations, interventions) for their NCD condition(s) e.g. knowledge, costs, time, availability or quality of care [expand], stigma etc. How could access to healthcare for NCD condition be improved? Prompt: improve knowledge (e.g. outreach, radio, health workers etc.), improve availability of services, quality of services etc.
Adoption and implementation	Information and support	What types of information are provided to patients when they are enrolled in/ attend the NCD service? What sources of support are offered to patients when they are enrolled in/ attend the NCD service)? How acceptable do you think the MSF NCD programme, including treatment, is for patients? Prompt: e.g. quality, responsiveness, socially, culturally etc. What is your experience with implementing the new MSF NCD guideline? What sources of support and information were available to you to facilitate implementing the guideline?
Maintenance	Challenges Supportive factors To support adoption and implementation	What do you think are the main challenges facing NCD patients here in terms of managing their condition? Prompt: medicines/testing/attendance - time, costs, information, drug supply etc.; lifestyle changes – knowledge, social/cultural pressures etc. What could be done to make it easier for NCD patients to access care? Prompt: e.g. information given – content and way it was delivered; costs; type and quality of care and support; [note: focus on role of the [NCD condition] programme/services]. What do you think are the main challenges facing staff here in terms of delivering the NCD care programme in Irbid? Prompt: time, training, clinical support/supervision, guidelines or tools What could be done to make it easier for staff to deliver this NCD care programme? Prompt: knowledge, time, training, clinical support/supervision, guidelines or tools What are the benefits of using the MSF NCD guideline? What are the challenges around using the MSF NCD guideline? What could be done to facilitate implementation of the guideline?
Effectiveness	Unintended consequences Benefits	What are the benefits of the NCD care programme in Irbid? Prompt: more efficient, less complications, for patients, for staff, for system, for community etc. What are negative consequences of the NCD care programme in Irbid? Prompt: time, complexity, costs etc. for patients, for staff, for system, for community What particular aspects of the programme have helped or hindered NCD care? Prompt: clinical aspects, task shifting, introduction of HLO, MHPSS, HV, structures, tools, systems What particular aspects of the guideline have helped or hindered NCD care? Prompt: supports decision making, ease of use, contradictory, not acceptable to patients, different to usual practice in Jordan.
Thanks and close	Anything else to add Questions Thanks, feedback info	Anything else to add on topic that we haven't discussed today? Any questions for me? Feedback again on how the discussion will be used and fed back.

Topic guide – Semi-structured interviews with key stakeholders

Key area	Themes	Question
Introduction	Study aim and agencies involved Why invited to participate Consent & any questions?	
Participant Background	Getting to know each other + building rapport	Could you tell us a bit about yourself? Prompt: e.g. professional, involvement in the NCD service at Irbid (and previously if relevant)?
Reach	Access Barriers to NCD care provision Ways of reducing barriers	What are the key challenges for patients to access healthcare (medications, regular clinical review, investigations, interventions) for their NCD condition(s) e.g. knowledge, costs, time, availability or quality of care [expand], stigma etc. How could access to healthcare for NCD condition be improved? Prompt: improve knowledge (e.g. outreach, radio, health workers etc.), improve availability of services, quality of services etc.
Adoption and implementation	Information and support	How acceptable do you think the MSF NCD programme, including treatment, is for patients? Prompt: e.g. quality, responsiveness, socially, culturally etc.
Maintenance	Challenges Supportive factors To support adoption and implementation	What do you think are the main challenges facing NCD patients in this area in terms of managing their condition? Prompt: medicines/testing/attendance - time, costs, information, drug supply etc.; lifestyle changes – knowledge, social/cultural pressures etc. What could be done to make it easier for NCD patients to access care? Prompt: e.g. information given – content and way it was delivered; costs; type and quality of care and support; [note: focus on role of the [NCD condition] programme/services]. What do you think are the main challenges facing staff here in terms of delivering the NCD care programme in Irbid? Prompt: time, training, clinical support/supervision, guidelines or tools What could be done to make it easier for staff to deliver NCD care programme? Prompt: knowledge, time, training, clinical support/supervision, guidelines or tools What are the benefits of using the MSF NCD guideline? [ask if appropriate] What are the challenges around using the MSF NCD guideline? [ask if appropriate] What could be done to facilitate implementation of the guideline? [ask if appropriate]
Effectiveness	Unintended consequences Benefits	What are the benefits of the NCD care programme in Irbid? Prompt: more efficient, less complications, for patients, for staff, for system, for community etc. What are negative consequences of the NCD care programme in Irbid? Prompt: time, complexity, costs etc. for patients, for staff, for system, for community What particular aspects of the programme have helped or hindered NCD care? Prompt: clinical aspects, task shifting, introduction of HLO, MHPSS, HV, structures, tools, systems What particular aspects of the guideline have helped or hindered NCD care? Prompt: supports decision making, ease of use, contradictory, not acceptable to patients, different to usual practice in Jordan.
Thanks and close	Anything else to add Questions Thanks, feedback info	Anything else to add on topic that we haven't discussed today? Any questions for me? Feedback again on how the discussion will be used and fed back.

Appendix 5: Cohort Study Results

Demographics by country of origin of 5029 Syrian and Jordanian patients enrolled in Irbid NCD Programme 2014- 2017

Variable	Category	Total	%	Syrian	%	Jordanian	%
Country of Origin		5029	100	3664	72.9	1365	27.1
Gender	Male	2021	40.2	1429	39	592	43.4
	Female	3008	59.8	2235	61	773	56.6
	Age <5	18	0.4	14	0.4	4	0.3
	Age 5-15	150	2.9	119	3.2	31	2.3
	Age 15-40	498	9.9	384	10.5	114	8.4
	Age 40-65	3035	60.3	2163	59	872	63.9
	Age >65	1328	26.4	984	26.9	344	25.2
Education level	None	724	14.4	613	16.7	111	8.1
	Not asked/answered	1874	37.3	1472	40.2	402	29.5
	Primary	1423	28.3	1123	30.6	300	22.0
	Secondary or higher	1008	20	456	12.4	552	40.4
Household size	1-3	889	17.7	480	13.1	409	30.0
	4-6	1743	34.7	1143	31.2	600	44.0
	7+	2019	40.2	1738	47.5	281	20.6
	Not asked/answered	378	7.5	303	8.3	75	5.5
Impaired mobility	Yes	498	9.9	358	9.8	140	10.3
	No	4381	87.1	3207	87.5	1174	86.0
	Not asked/answered	150	3.0	99	2.7	51	3.7

Cardiovascular Risk Factors at Enrolment for the cohort 2015-2017

	Total (N=5045)	%	Male (N=2023)	%	Female (N=3022)	%
Current smoker	1144	22.7	825	40.8	319	10.6
Inactivity (moderate/total)	1879	37.2	560	27.7	1319	43.6
Obesity (BMI>30)*	2555	62.6	799	47.2	1756	73.5
Current alcohol intake	15	0.3	12	0.6	3	0.1

*Based on first available BMI measurement; N=4082 (1692 men and 2390 women).

Per patient diagnoses at last visit for all patients enrolled in the Irbid NCD Programme 2015-2017 by age and gender

	Total		Age Category								Gender			
NCD	**n= 5045**	**%**	**05-15 n= 151**	**%**	**15-40 n= 501**	**%**	**40-65 n= 3041**	**%**	**>65 n= 1334**	**%**	**Male n= 2023**	**%**	**Female n= 3022**	**%**
Hypertension	3047	60.4	3	2.0	303	60.5	1796	59.1	945	70.8	1135	56.1	1912	63.3
CVD total [1]	1306	25.9	0	0.0	73	14.6	700	23.0	533	40.0	762	37.7	544	18.0
DM I [2]	155	3.1	56	37.1	89	17.8	10	0.3	0	0.0	76	3.8	79	2.6
DM II	2680	53.1	2	1.3	308	61.5	1659	54.6	711	53.3	1095	54.1	1585	52.4
Hypothyroid	383	7.6	13	8.6	123	24.6	207	6.8	40	3.0	37	1.8	346	11.4
Asthma	352	7.0	77	51.0	117	23.4	124	4.1	34	2.5	142	7.0	210	6.9
COPD [3]	71	1.4	0	0.0	5	1.0	35	1.2	31	2.3	57	2.8	14	0.5
MSK [4]	296	5.9	0	0.0	30	6.0	169	5.6	97	7.3	90	4.4	206	6.8
Neurological	78	1.5	0	0.0	14	2.8	40	1.3	24	1.8	27	1.3	51	1.7
Obesity	2555	50.6	13	8.6	449	89.6	1606	52.8	487	36.5	799	39.5	1756	58.1
DM II + HT [5]	706	14.0		0.0	169	33.7	437	14.4	100	2.2	338	16.7	368	12.2
DM II + HT + CVD	702	13.9	0	0.0	25	5.0	374	12.3	303	6.6	369	18.2	333	11.0
HT + CVD	449	8.9	0	0.0	10	2.0	241	7.9	198	4.3	232	11.5	217	7.2

Paper 2: Clinical outcomes in a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: A cohort analysis using routine data

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Thesis Title	MIXED METHODS EVALUATION OF A MÉDECINS SANS FRONTIÈRES NONCOMMUNICABLE DISEASES PROGRAMME FOR SYRIAN REFUGEES AND THE HOST POPULATION IN JORDAN		
Primary Supervisor	Professor Pablo Perel		

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RESEARCH ARTICLE

Clinical outcomes in a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: A cohort analysis using routine data

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Abstract

Background

Little is known about the content or quality of non-communicable disease (NCD) care in humanitarian settings. Since 2014, Médecins Sans Frontières (MSF) has provided primary-level NCD services in Irbid, Jordan, targeting Syrian refugees and vulnerable Jordanians who struggle to access NCD care through the overburdened national health system. This retrospective cohort study explored programme and patient-level patterns in achievement of blood pressure and glycaemic control, patterns in treatment interruption, and the factors associated with these patterns.

Methods and findings

The MSF multidisciplinary, primary-level NCD programme provided facility-based care for cardiovascular disease, diabetes, and chronic respiratory disease using context-adapted guidelines and generic medications. Generalist physicians managed patients with the support of family medicine specialists, nurses, health educators, pharmacists, and psychosocial and home care teams. Among the 5,045 patients enrolled between December 2014 and December 2017, 4,044 eligible adult patients were included in our analysis, of whom 72% (2,913) had hypertension and 63% (2,546) had type II diabetes. Using visits as the unit of analysis, we plotted the following on a monthly basis: mean blood pressure among hypertensive patients, mean fasting blood glucose and HbA1c among type II diabetic patients, the proportion of each group achieving control, mean days of delayed appointment attendance, and the proportion of patients experiencing a treatment interruption. Results are presented from programmatic and patient perspectives (using months since programme initiation and months since cohort entry/diagnosis, respectively). General linear mixed models explored factors associated with clinical control and with treatment interruption. Mean age was 58.5

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Abbreviations: BP, blood pressure; CVD, cardiovascular disease; DM II, diabetes mellitus type II; FBG, fasting blood glucose; HbA1c, glycosylated haemoglobin; HTN, hypertension; MOH, Ministry of Health; MSF, Médecins Sans Frontières; NCD, non-communicable disease; NGO, non-governmental organisation; SBP, systolic blood pressure; UNRWA, United Nations Relief and Works Agency for Palestinian Refugees.

years, and 60.1% (2,432) were women. Within the programme's first 6 months, mean systolic blood pressure decreased by 12.4 mm Hg from 143.9 mm Hg (95% CI 140.9 to 146.9) to 131.5 mm Hg (95% CI 130.2 to 132.9) among hypertensive patients, while fasting glucose improved by 1.12 mmol/l, from 10.75 mmol/l (95% CI 10.04 to 11.47) to 9.63 mmol/l (95% CI 9.22 to 10.04), among type II diabetic patients. The probability of achieving treatment target in a visit was 63%–75% by end of 2017, improving with programme maturation but with notable seasonable variation. The probability of experiencing a treatment interruption declined as the programme matured and with patients' length of time in the programme. Routine operational data proved useful in evaluating a humanitarian programme in a real-world setting, but were somewhat limited in terms of data quality and completeness. We used intermediate clinical outcomes proven to be strongly associated with hard clinical outcomes (such as death), since we had neither the data nor statistical power to measure hard outcomes.

Conclusions

Good treatment outcomes and reasonable rates of treatment interruption were achieved in a multidisciplinary, primary-level NCD programme in Jordan. Our approach to using continuous programmatic data may be a feasible way for humanitarian organisations to account for the complex and dynamic nature of interventions in unstable humanitarian settings when undertaking routine monitoring and evaluation. We suggest that frequency of patient contact could be reduced without negatively impacting patient outcomes and that season should be taken into account in analysing programme performance.

Author summary

Why was this study done?

- Humanitarian actors have recently turned their attention to formally incorporating care for chronic non-communicable diseases (NCDs) into their programmes. NCDs include conditions such as hypertension (high blood pressure), heart disease, and diabetes.
- Little is known about the quality or effectiveness of current NCD programmes in humanitarian contexts, and more research is needed around how to deliver good-quality NCD care to people affected by humanitarian crises.

What did the researchers do and find?

- Using routine clinic data, rather than research study data, we examined the levels of blood pressure and diabetes control as well as treatment interruption among a group of Syrian refugee and Jordanian patients attending a Médecins Sans Frontières (MSF) primary care clinic in north Jordan.
- Among 4,044 adult NCD patients eligible to be included in the study, 72% (2,913) had hypertension and 63% (2,546) had type II diabetes.

- Within both groups, disease control was achieved at about 63%–75% of monthly visits. Clinical control varied by season; better blood pressure control was achieved in the hot summer months. In addition, the chances of treatment interruption decreased both as the programme matured and as individual patients remained longer in the programme.

What do these findings mean?

- Having taken account of multiple potential influencing factors in our analysis, we found that the MSF programme was achieving good clinical results compared to previous published literature.
- However, these good outcomes were achieved in the context of a complex and costly programme and using conservative clinical targets.
- We suggest that (1) similar results may be possible while reducing the frequency of patient visits, (2) our analysis approach may be useful for monitoring and evaluation of complex programmes in unstable environments, and (3) season should be taken into account when analysing NCD programme performance.

Introduction

Now into its ninth year, the Syrian crisis continues to ravage the Syrian population. Since 2011, over 6.1 million people have been internally displaced, while over 6.6 million people have fled as refugees into the neighbouring countries Jordan, Lebanon, and Turkey [1]. Syria has passed through an epidemiological transition. Before the conflict, non-communicable diseases (NCDs) (mainly cardiovascular disease [CVD], cancer, chronic respiratory disease, and diabetes) caused more deaths than infectious disease and accounted for 77% of total mortality [2]. Host country and humanitarian health systems have had to adapt to new realities in responding to the Syrian crisis: tackling a high NCD burden and reaching a mainly urban-based (rather than camp-based) refugee population in the context of stressed local health systems [3–7].

Jordan hosts almost 670,000 United Nations High Commissioner for Refugees (UNHCR) registered Syrian refugees and, globally, ranks second only to Lebanon in number of refugees hosted relative to national population [1,8]. In addressing the rising NCD burden, Jordanian health policy has shifted focus from secondary- or tertiary-level NCD care to strengthening its primary NCD care delivery. Registered Syrian refugees are eligible to access Ministry of Health (MOH) primary care NCD services, but financial barriers, complex care pathways and referral systems, and limited health facility capacity have curtailed their access [7]. Jordan has enacted sequential humanitarian policy changes during the crisis, initially providing free, limited primary care to Syrian refugees, adding user fees in 2014, and then increasing user fees to the full 'foreigner rate' in early 2018 [9]. In response, Syrian refugees have shifted care seeking from the public sector towards non-governmental organisations (NGOs) and the private sector [10].

Since 2014, Médecins Sans Frontières (MSF), a humanitarian medical organisation, has provided primary-level NCD care for Syrian refugees and the host population at 2 clinics in Irbid, in north Jordan. Humanitarian actors' programmatic experience in NCD care delivery

has grown in the last decade due to the increasing global NCD burden, current conflicts in several middle-income countries of the Middle East, and the synergies between HIV, tuberculosis, and NCDs [11,12]. In response to the limited evidence, guidelines, and tools available to guide NCD interventions in low- and middle-income countries, especially for displaced, conflict-affected populations, humanitarian actors are developing NCD-specific clinical and operational guidance and monitoring and evaluation tools [13–16]. The recent discourse around quality of care and universal healthcare has underlined the importance of measuring quality and effectiveness as primary-level NCD care is scaled up in humanitarian settings and in low- and middle-income countries more broadly [17–20]. NCD programmes in humanitarian crises pose unique challenges for programme evaluation since they are often complex interventions that rapidly adapt to volatile contexts. Routine data may be limited and of poor quality, and accurate evaluation methods that involve minimal disruption to busy staff providing routine care are needed. Programmes with electronic health records, such as United Nations Relief and Works Agency for Palestinian Refugees (UNRWA) clinics and some MSF settings, have published descriptive cohort analyses of NCD cohorts involving quarterly or annual new registrations and outcomes reporting [21–23].

MSF undertook a mixed methods evaluation of the Irbid NCD programme using the RE-AIM implementation research framework [24]. In this paper, we explore the programme's effectiveness, from both programmatic and patient perspectives. For this we modelled the per visit probability of achieving intermediate clinical targets, that is, blood pressure (BP) control in adults with hypertension (HTN) and glycaemic control in patients with diabetes mellitus type II (DM II). We also modelled the chances of treatment interruption. Finally, we explored which factors (including patient, programme, and contextual factors) may have affected the chances of a patient achieving clinical targets or of experiencing an interruption to their treatment.

Our specific objectives were to (1) describe patterns in the attainment of intermediate clinical targets (BP and glycaemic control) and treatment interruption, since the start of the programme; (2) describe patterns in the attainment of intermediate clinical targets (BP and glycaemic levels) and treatment interruption, from entry to the cohort (or from month of new diagnosis); and (3) explore factors associated with achievement of clinical outcomes and with treatment interruption.

Methods

Study design

This was a retrospective cohort study that included all adult patients (18+ years) with a diagnosis of HTN and/or DM II who entered the MSF NCD programme in Irbid, Jordan, between 14 December 2014 and 31 December 2017 (see S1 Protocol).

Setting

The study was conducted in Irbid, the second largest city in Jordan, located 30 minutes south of the border with Syria. Irbid governorate hosts over 165,000 Syrian refugees, who are mostly urban-based and living amongst the host population [4]. MSF commenced an NCD programme within a MOH primary care facility in Irbid, in north Jordan, in December 2014. A second site in the city was opened within a local NGO clinic in April 2016. The MSF programme was vertical, operating in parallel to the pre-existing activities at each site rather than integrating with them. The cohort size was capped by MSF at approximately 4,000 for operational and cost reasons, and the service achieved coverage of about 23% of Syrian adult refugees with NCDs in Irbid governorate [9].

Participants

To be enrolled in the programme a person had to have a medical indication and a vulnerability indication (Syrian refugee or vulnerable member of the Jordanian host population). Medical indications included a history of HTN, established CVD (angina, myocardial infarction, ischaemic stroke, transient ischaemic attack, peripheral vascular disease, congestive heart failure), diabetes mellitus type I or II, chronic obstructive pulmonary disease, asthma, or hypothyroidism. Vulnerability was defined as having refugee status, low income, and/or no Jordanian public health insurance (thus required to co-pay for MOH services). Both medical and vulnerability enrolment criteria changed over time, for example isolated hypothyroidism was removed as an enrolment criterion, and vulnerability criteria were adapted. There were no limitations to enrolment in terms of place of residence or age. For this paper, only data of patients with HTN and/or DM II, aged 18 years and older, were included in the analysis. Only patients with HTN—either with a previously known diagnosis at programme entry or newly diagnosed at enrolment or subsequent visits—contributed data to the BP control analyses. Similarly, only DM II patients contributed data to the glycaemic control analyses.

Intervention

The MSF programme was a multidisciplinary, primary care model, which used context-adapted clinical guidelines, medications based on the MSF and World Health Organization (WHO) Essential Medicines List, and task sharing to nurses where appropriate. It served Syrian refugees and vulnerable members of the Jordanian host population. The programme evolved from initially providing medical consultation, health education, and behaviour change counselling to also including individual- and group-based mental health and psychosocial support (MHPSS), a home visit service for house-bound patients, a humanitarian support worker providing social work services, and physiotherapy services. Care was provided by non-specialist doctors, supported by a family medicine specialist at each clinic, along with a team of nurses, trained health educators, psychosocial counsellors, pharmacists, physiotherapists, a social worker, and a home care team. Programmatic changes introduced during the study period included the initiation of task sharing to nurses of follow-up consultations for stable patients and the introduction of formal MSF NCD guidelines (S2 Fig).

Most patients were enrolled during the first 6 months of the programme (S2 Fig). The majority (over 90%) presented with established, self-reported diagnoses and were already on treatment at enrolment; measurements and new diagnoses were made based on the MSF NCD guidelines [16]. For hypertensive patients, BP was measured at each visit, and capillary fasting blood glucose (FBG) was checked annually. For diabetic patients, BP and FBG were measured at each visit, while glycosylated haemoglobin (HbA1c) was measured by an external laboratory every 3 months. At the first visit, doctors recorded a complete past medical, medication, and family medical history and performed a clinical examination. In addition, lifestyle CVD risk factors (smoking status, alcohol intake, exercise levels) were recorded, the global cardiovascular risk score was calculated using WHO CVD risk prediction charts, acute complications were identified and treated, long-term medications were prescribed for symptom management and secondary prevention of complications, patients were referred for laboratory testing as appropriate, and a follow-up interval was determined [25].

Follow-up visits involved reviewing patients' symptoms and disease control, vital signs, and laboratory results; determining and recording new diagnoses; adjusting and/or initiating medications; and referring for further laboratory tests or to other health providers, as required. Health promoters provided individually tailored health education at each clinical contact. At enrolment, the doctor and health educator saw patients for 30 minutes each; patients on return

visits spent approximately 15 minutes each with a clinician (either a doctor or nurse) and a health educator. By the end of 2017, nurses were performing 6% of follow-up consultations for stable patients, with doctors continuing to initiate and adjust all patients' medications.

Variables

The main outcomes of interest were HTN control (<140/90 mm Hg) and glycaemic control (capillary FBG ≤ 180 mg/dl [10.1 mmol/l] or HbA1c < 8% [46 mmol/mol]). MSF and other humanitarian actors have taken a consensus-based approach to developing guidelines, based on international best practice. They adopted a more conservative HbA1c target than the international norm of 7% (53 mmol/mol) to avoid hypoglycaemia in insulin-treated patients (who usually have no means to self-monitor in crisis settings) and used the same targets for all patients, irrespective of age or comorbidity, to simplify clinical guidelines and delivery [21,23,26]. Both FBG and HbA1c were used in this analysis since the FBG data were more complete and the sensitivity of HbA1c appears to be reduced in Arab populations [27].

Treatment delay was defined as the difference in days between the planned next appointment date and the actual next visit date. Treatment interruption was defined as a treatment delay greater than 31 days. If the planned appointment date was not registered, we assumed this was 1 month from the previous visit if the patient was not achieving clinical targets at that visit, and 3 months from the previous visit if the patient was achieving targets. We used the variables 'treatment delay' and 'treatment interruption', rather than the operational definition of 'treatment defaulter' included in our protocol, in order to capture periods of treatment interruption followed by a return to care (S1 Protocol).

Data collection and management

Routine clinical data were maintained in paper-based, purpose-designed chronic care files, stored securely at each clinic. On a weekly basis, MSF data clerks entered data into a password-protected macro-based Excel software database specifically developed for the NCD programme. Data from all patients aged 18 years and older with a new or established diagnosis of HTN or DM II enrolled from December 2014 through to December 2017 in either of MSF's NCD clinics in Irbid were included. Data from both clinics were aggregated and analysed using the statistical software R version 3.6.1 (2019-07-05).

Data analysis and reporting

We used visits as the unit of analysis when analysing the main study outcomes. This allowed us to include all data from all patients, irrespective of their frequency or duration of attendance or whether they had missed appointments. It also accounted for the fact that BP and glycaemic control may vary from appointment to appointment.

Descriptive statistics were used to explore patient demographics at baseline and among those who remained in care at 6 and/or 12 months post-enrolment.

To examine control from the programmatic perspective, we plotted the monthly means across visits of systolic BP (SBP), the glycaemic variables (FBG and HbA1c), and the days of treatment delay as defined above, for each month from December 2014 to December 2017. We also plotted, for each month, the proportion of visits achieving BP and glycaemic control and the proportion of visits after which there was an interruption of treatment (i.e., delay to next visit of >31 days after the planned appointment).

To examine control from the patient perspective, we calculated the same means and proportions in periods of 30 days from disease identification (enrolment visit for those with pre-existing diagnoses, or the visit when a new diagnosis was made).

To explore factors associated with the mean levels of SBP, FBG, and HbA1c; control of BP, FBG, and HbA1c; and treatment delay/interruption at a given visit, we used 8 generalised linear mixed-effects models (GLMMs). For each of these outcomes, 2 models were adjusted: (1) a linear model for the continuous level of the outcome and (2) a logistic model to estimate the probability of the clinical target being reached or a treatment interruption occurring, as defined above. A random effect coefficient was included to adjust for repeated patient visits. The variables included in the models were time since patient's diagnosis, time since beginning of the programme, sex, age, Syrian versus other nationality, diabetes status (for models exploring HTN control), HTN status (for models exploring glycaemic control), number of relevant NCD conditions, number of MSF-prescribed NCD medications, history of previous treatment interruption, and month of the year as a categorical variable (to account for seasonality). The specific statistical models were not pre-specified. We have reported our results in accordance with the STROBE checklist (S1 STROBE Checklist).

The London School of Hygiene & Tropical Medicine Ethics Review Committee (reference: 12239), the Médecins Sans Frontières Ethics Review Board, and the Jordanian MOH approved this study. Consent was not obtained from the study participants as these routinely collected programmatic data were analysed anonymously.

Results

From December 2014 to December 2017, 5,045 patients attended an enrolment visit at the MSF NCD programme in Irbid, of whom 4,729 adult patients had an NCD targeted by the programme and were actually enrolled. Among the 4,044 patients with HTN and/or DM II (therefore, eligible for inclusion in the study), 2,913 (72%) had HTN and 2,546 (63%) had DM II at baseline, while 1,530 (32.4%) had both diagnoses. Among those with HTN, 92.7% were hypertensive at enrolment, and 7.3% were newly diagnosed at their first or subsequent visits; the proportions were similar for DM II (90.8% at first visit and 9.2% at subsequent visits).

Table 1 presents HTN/DM II patients' socio-demographics, cardiovascular risk factors, and targeted NCD diagnoses (1) at enrolment, (2) among those who continued in care after 6 months, and (3) among those who continued in care after 12 months. Most were female (n = 2,432, 60.1%) and aged 41 years or older (mean = 58.5 years, SD = 11.6). Syrians made up 71.2% of included patients, while the remainder were mostly Jordanian. Of those with available data, most had either primary-level or no formal education (n = 1,220, 30.3%, and n = 672, 16.6%, respectively), and many lived in households of 7 or more people (n = 1,590, 39.1%). Over one-tenth (n = 446, 11.0%) defined themselves as mobility impaired, almost a quarter as active smokers (n = 946, 23.4%), and only around a third (n = 1,493; 36.9%) as physically active at enrolment. Over 80% (n = 3,341, 82.6%) of included patients attended a 6-month follow-up appointment, while 76.9% (n = 3,109) attended a 12-month appointment. The demographic profile of those attending was similar at baseline, 6 months, and 12 months.

Programmatic performance

Fig 1 shows patterns in the achievement of treatment targets and in the occurrence of treatment interruption since the programme began in December 2014.

Hypertension. Among patients with HTN, mean per visit SBP decreased by 12.4 mm Hg in the programme's first 6 months, from a mean of 143.9 mm Hg (95% CI 140.9 to 146.9) in December 2014 to 131.5 (95% CI 130.2 to 132.9) at 6 months, and by a further 1.6 mm Hg by the end of the study period, with a mean of 129.9 mm Hg (95% CI 128.9 to 130.8) in December 2017 (Fig 1A). There appeared to be seasonal variation as SBP increased annually by 4 to 5 mm Hg during the winter months (October to December).

Table 1. Demographics, CVD risk factors, and NCD diagnoses among adult patients with hypertension and/or diabetes type II at enrolment and among those with visits at 6 and 12 months.

Variable	Baseline* *N* = 4,044		Patients returning at 6 months^ *N* = 3,341		Patients returning at 12 months# *N* = 3,109	
	n	Percent	*n*	Percent or *p*-value	*n*	Percent or *p*-value
Age group (years)				$p = 0.665$		$p = 0.688$
18–40	243	6.0	174	5.2	164	5.3
41–65	2,690	66.5	2,244	67.2	2,099	67.5
66–80	987	24.4	824	24.7	758	24.4
>80	121	3.0	96	2.9	86	2.8
No data	3	0.1	3	0.1	2	0.1
Sex				$p = 0.651$		$p = 0.947$
Female	2,432	60.1	1,991	59.6	1,873	60.2
Male	1,612	39.9	1,350	40.4	1,236	39.8
Syrian				$p = 0.342$		$p = 0.064$
No	1,166	28.8	998	29.9	960	30.9
Yes	2,878	71.2	2,343	70.1	2,149	69.1
Education				$p = 0.018$		$p < 0.001$
No data	1,265	31.3	932	27.9	768	24.7
None	672	16.6	580	17.4	553	17.8
Primary	1,220	30.2	1,052	31.5	1,032	33.2
Secondary/higher	887	21.9	777	23.3	756	24.3
Household size				$p = 0.721$		$p = 0.185$
No data	281	6.9	217	6.5	179	5.8
1–3	792	19.6	672	20.1	629	20.2
4–7	1,391	34.4	1,172	35.1	1,100	35.4
>7	1,580	39.1	1,280	38.3	1,201	38.6
Impaired mobility				$p = 0.508$		$p = 0.408$
No data	123	3.0	87	2.6	80	2.6
No	3,475	85.9	2,891	86.5	2,699	86.8
Yes	446	11.0	363	10.9	330	10.6
Smoker				$p = 0.494$		$p = 0.517$
No data	15	0.4	6	0.2	6	0.2
Never smoked	2,511	62.1	2,078	62.2	1,953	62.8
Ex-smoker	572	14.1	478	14.3	440	14.2
Current smoker	946	23.4	779	23.3	710	22.8
Exercise				$p = 0.997$		$p = 0.988$
No data	228	5.6	190	5.7	177	5.7
Inactive	750	18.5	614	18.4	571	18.4
Moderate	1,573	38.9	1,306	39.1	1,221	39.3
Active	1,493	36.9	1,231	36.8	1,140	36.7
Hypertension				$p = 0.984$		$p = 0.961$
No	1,131	28.0	936	28.0	872	28.0
Yes	2,913	72.0	2,405	72.0	2,237	72.0
Diabetes type II				$p = 0.839$		$p = 0.850$
No	1,498	37.0	1,229	36.8	1,144	36.8
Yes	2,546	63.0	2,112	63.2	1,965	63.2
Diabetes type I				$p = 0.898$		$p = 0.722$
No	4,023	99.5	3,322	99.4	3,090	99.4
Yes	21	0.5	19	0.6	19	0.6

(*Continued*)

Table 1. (Continued)

Variable	Baseline* *N* = 4,044		Patients returning at 6 months^ *N* = 3,341		Patients returning at 12 months# *N* = 3,109	
	n	**Percent**	***n***	**Percent or *p*-value**	***n***	**Percent or *p*-value**
CVD				$p = 0.483$		$p = 0.241$
No	3,345	82.7	2,785	83.4	2,605	83.8
Yes	699	17.3	556	16.6	504	16.2
Asthma				$p = 0.491$		$p = 0.540$
No	3,914	96.8	3,223	96.5	3,000	96.5
Yes	130	3.2	118	3.5	109	3.5
COPD				$p = 0.491$		$p = 0.680$
No	4,008	99.1	3,317	99.3	3,085	99.2
Yes	36	0.9	24	0.7	24	0.8

p-Values compare distributions at 6 and 12 months with baseline distribution for each factor. Patients may have experienced treatment interruptions before returning at either 6 months or 12 months, and the group returning at 12 months may contain patients who did not attend at 6 months.

*Refers to proportion of total eligible adult patients with hypertension/type II diabetes.

^Proportion of enrolled patients in each category returning at 6 months (±30 days).

#Proportion of enrolled patients in each category returning at 12 months (±30 days).

COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; NCD, non-communicable disease.

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Rates of control similarly improved from only 26% (95% CI 20% to 32%) in the first month, with a seasonal pattern. About 51%–60% of visits achieved BP targets in summer, decreasing by about 6% to 46%–54% in winter (Fig 1B).

Diabetes. Among patients with DM II, mean per visit FBG similarly decreased from the programmatic perspective, by 1.12 mmol/l, from 10.75 mmol/l (95% CI 10.04 to 11.47) in December 2014 to 9.63 mmol/l (95% CI 9.22 to 10.04) at 6 months, and by a further 0.37 mmol/l to 9.26 mmol/l (95% CI 8.89 to 9.62) at 12 months (Fig 1C), which mirrors the increasing proportion of visits achieving control over time since the programme began (Fig 1D). HbA1c control improved markedly during the programme course, from a mean of 73.23 mmol/mol (95% CI 64.07 to 82.39) in month 1, with approximately 33% (95% CI 12% to 55%) of DM II patients achieving target, to a mean of 56.97 mmol/mol (95% CI 53.50 to 60.43), with 72% (95% CI 65% to 80%) achieving control after the first 6 months of operation (Fig 1E and 1F). FBG control seemed to worsen during the month of June, especially in 2017. HbA1c control appeared to show a similar pattern of seasonality, with control deteriorating in the winter and improving in the summer.

Treatment interruption. The mean monthly days of delay following the next planned appointment fell from 43 days (95% CI 20 to 66) in December 2014 to 14 days (95% CI 10 to 18) 12 months later and to only 3 days in December 2017. The probability of treatment interruption also showed a downward pattern, dropping from 0.07 (95% CI 0.04 to 0.10) in the first month to 0.04 (95% CI 0.03 to 0.05) 12 months later.

Individual (closed) cohort analysis

Fig 2 shows the monthly pattern in clinical control from the patient perspective, starting with the month of entry into the cohort, for those with established diagnoses, or the month when a new diagnosis was made.

Hypertension. The mean SBP in hypertensive patients decreased by 6.6 mm Hg within the first 6 months, from mean 137.9 mm Hg (95% CI 137.1 to 138.7) at entry/new diagnosis to 131.3 mm Hg (95% CI 130.3 to 132.3) after 6 months. The proportion achieving BP control

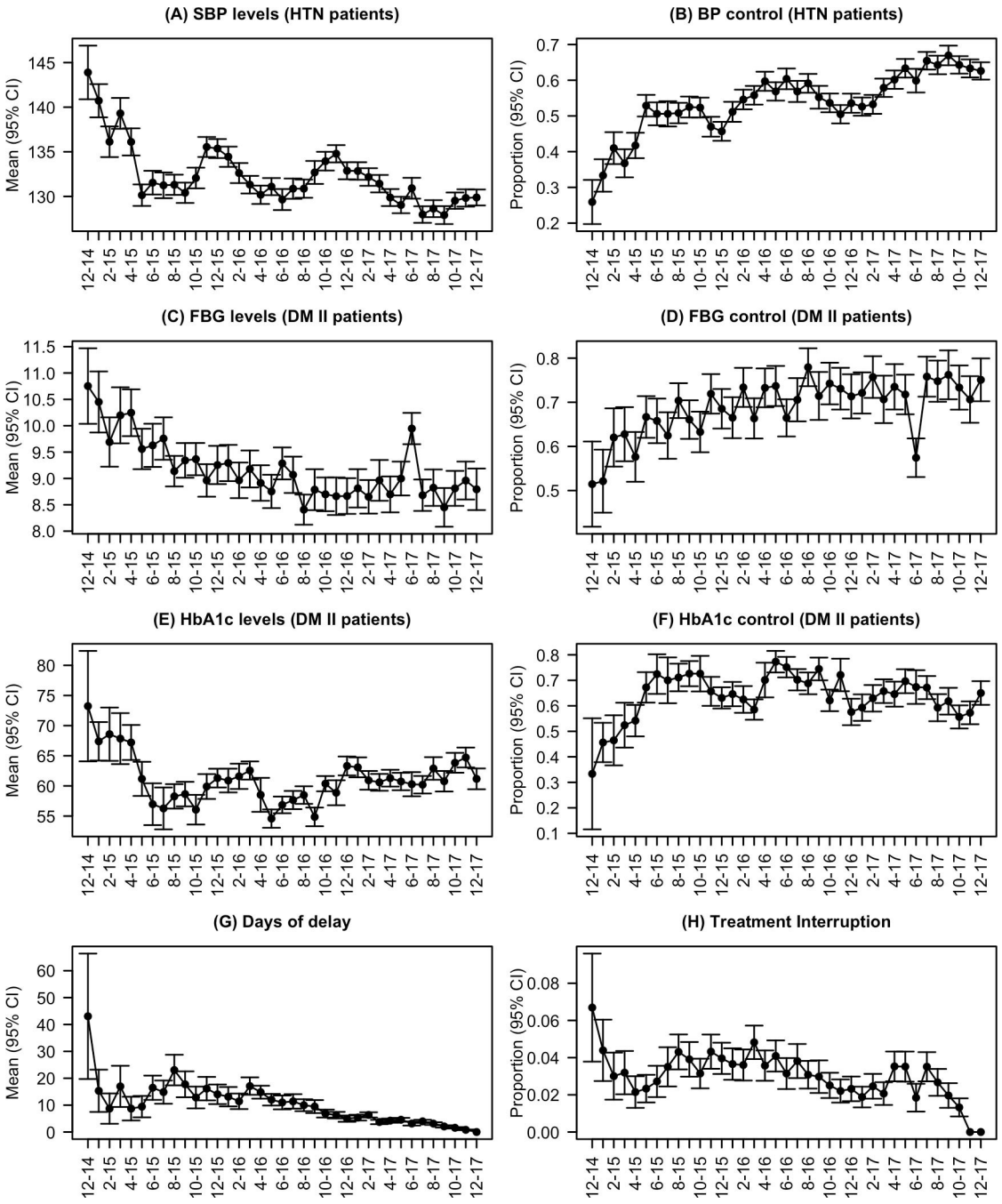

Fig 1. Programmatic patterns in achievement of clinical outcomes and in treatment interruption. (A) Mean monthly systolic blood pressure (SBP; mm Hg) for all visits of patients with hypertension (HTN). (B) Proportion of visits per month of patients with hypertension at which BP control was achieved. (C) Mean monthly fasting blood glucose (FBG) value (mmol/l) for all visits of patients with diabetes mellitus type II (DM II). (D) Proportion of visits per month of patients with diabetes type II at which FBG target was achieved. (E) Mean monthly glycosylated haemoglobin (HbA1c) value (mmol/mol) for all visits of patients with diabetes type II. (F) Proportion of visits per month of patients with diabetes type II at which HbA1c target was achieved. (G) Mean monthly days of delay (number of days after planned next visit that next visit actually occurred) for all visits of patients with hypertension and/or diabetes type II. (H) Proportion of visits per month of patients with hypertension and/or diabetes type II at which a treatment interruption occurred (next visit was >31 days after next planned visit date). Each panel reports the average per visit value, using visits as the unit of analysis, for each month since the start of the programme (December 2014 to December 2017 inclusive). BP control was defined as BP < 140/90 mm Hg; control targets in patients with type II diabetes were capillary FBG ≤ 180 mg/dl (10.1 mmol/l) or HbA1c < 8% (46 mmol/mol).

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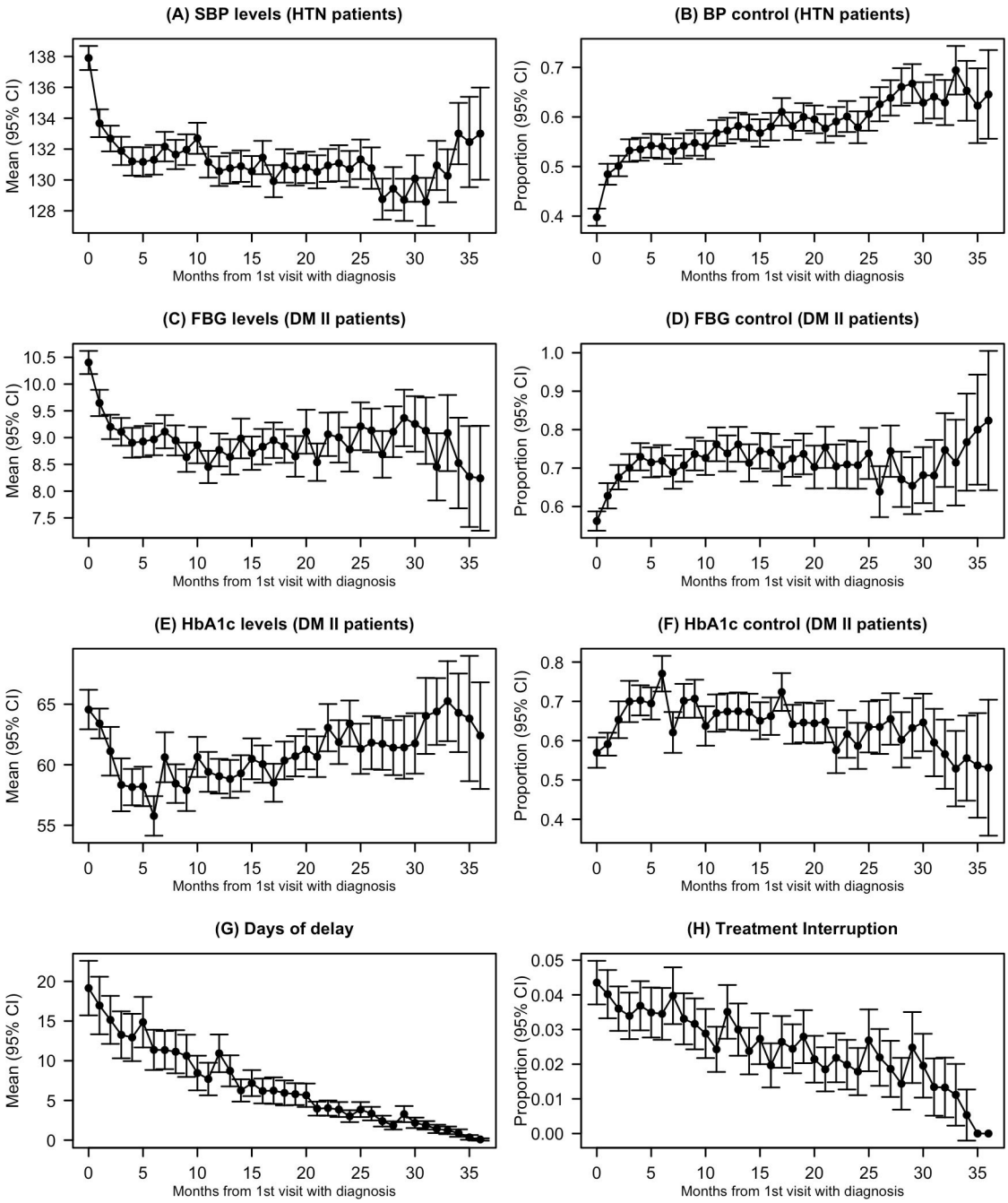

Fig 2. Patterns in control of clinical parameters and treatment interruptions from the patient perspective. (A) Mean systolic blood pressure (SBP; mm Hg) for all visits of patients with hypertension (HTN) per month since diagnosis. (B) Proportion of visits per month of patients with HTN at which BP control was achieved. (C) Mean fasting blood glucose (FBG) value (mmol/l) for all visits of patients with diabetes mellitus type II (DM II) per month since diagnosis. (D) Proportion of visits per month of patients with diabetes type II at which FBG target was achieved. (E) Mean glycosylated haemoglobin (HbA1c) value (mmol/mol) for all visits of patients with diabetes type II per month since diagnosis. (F) Proportion of visits per month of patients with diabetes type II at which HbA1c target was achieved. (G) Mean monthly days of delay (number of days after planned next visit date that next visit actually occurred) for all visits of patients with HTN and/or diabetes type II. (H) Proportion of visits per month of patients with HTN and/or diabetes type II at which a treatment interruption occurred (next visit was >31 days after next planned visit date). Each panel reports the average per visit value, using visits as the unit of analysis, for each month since diagnosis, for the reporting period December 2014 to December 2017 inclusive. 'Diagnosis' refers either to the month of enrolment for patients who had a known diagnosis on programme entry (90% of the cohort) or to month of new diagnosis for patients diagnosed at enrolment or at a subsequent visit. BP control was defined as BP < 140/90 mm Hg; control targets in patients with DM II were capillary FBG ≤ 180 mg/dl (10.1 mmol/l) or HbA1c < 8% (46 mmol/mol).

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improved from a baseline of 40% (95% CI 38% to 42%) to 54% (95% CI 52% to 57%) by month 6 after entry/new diagnosis.

Diabetes. Similarly, there was a marked improvement in FBG level by 1.43 mmol/l from a mean of 10.40 mmol/l (95% CI 10.19 to 10.62) at entry/new diagnosis to 8.97 mmol/l (95% CI 8.67 to 9.26) by 6 months; most of this improvement occurred within the first 3 months. From month 4 onwards, patients with DM II achieved FBG targets at over 70% of visits. The pattern in HbA1c (which reflects the previous 120 days of glycaemic control) was more variable. There was a rapid decline in the first 6 months, from a mean of 64.56 mmol/mol (95% CI 62.93 to 66.19) at the first visit to a mean of 55.77 mmol/mol (95% CI 54.14 to 57.41) after 6 months, but then a gentle slope upwards seemed to follow (Fig 2E). The percentage of visits where glycaemic control was achieved seemed to follow a similar pattern, with an increase in the first 6 months and then a levelling off or even a slight decrease in the following months (Fig 2F).

Treatment interruption. The mean number of days from the next planned appointment to the actual visit almost halved, from 19.2 (95% CI 15.7 to 22.6) in month 1 to 10.9 (95% CI 8.6 to 13.3) 12 months after entry/new diagnosis.

Factors associated with clinical control and treatment interruption

In Tables 2 and 3 we report the multivariable linear and logistic regression analyses exploring factors associated with achieving BP/SBP, FBG, and HBA1c targets (using continuous and binary outcomes), with days of delay (continuous outcome), and with having at least 1 treatment interruption (binary outcome).

Hypertension. Among patients with HTN, mean SBP was higher by 2.58 mm Hg for each 10-year increase in age (95% CI 1.99, 3.17; $p < 0.001$), by 1.43 mm Hg with comorbid diabetes (95% CI 0.01, 2.85; $p = 0.048$), and by 1.92 mm Hg in the winter month of December (95% CI 0.27, 3.56; $p = 0.022$). However, visits with controlled diabetes and visits taking place in the warmer months (May to September) were associated with a reduction in SBP of approximately 2–3 mm Hg. Having additional NCD conditions and receiving additional medications were both associated with a small SBP reduction (less than 1 mm Hg), as shown in Table 2. Results for the logistic regression were similar, with target BP less likely to be reached during the winter months and more likely to be reached during the warmer months of the year.

Diabetes. Among patients with DM II, male sex, increasing age, years since diagnosis, and having controlled BP were all strongly associated with improved FBG control. There was a notable deterioration in the month of June, leading to a mean increase of 0.58 mmol/l (95% CI 0.35, 0.81; $p < 0.001$). Logistic regression results showed that in addition to the above factors, a diagnosis of comorbid hypertension increased the odds of achieving target FBG. Improved mean HbA1c was associated with increasing age, a comorbid diagnosis of HTN (and, if hypertensive, with having controlled BP), and warmer months (May to September). Having a previous treatment interruption slightly increased mean HbA1c by 1.12 mmol/mol (95% CI 0.25, 2.00 $p < 0.05$). The same factors influenced whether the HBA1c target was reached.

Treatment interruption. The mean number of days the next visit took place after the planned appointment date was significantly decreased by having had a previous treatment interruption, with increasing age, and with maturation of the programme. Risk of delayed attendance for the next appointment increased with time since enrolment/diagnosis, with each additional NCD medication prescribed, with having a diagnosis of diabetes, and with having FBG at target at the index appointment. It was not affected by calendar month. The risk of treatment interruption decreased with time since enrolment/diagnosis and with each additional NCD diagnosis. It was increased by having a previous interruption (Table 3).

Table 2. Multivariable linear regression models to explore factors associated with achieving control of intermediate clinical outcomes and on days of delay (continuous outcomes).

Factor	Effect: Mean difference (95% CI)			
	BP control (mm Hg)	FBG control (mmol/l)	HBA1c control (mmol/mol)	Delay (days)
Previous treatment interruption	−0.02 (−1.21, 1.18)	−0.02 (−0.19, 0.16)	**1.12 (0.25, 2.00)**[a]	**−6.92 (−10.34, −3.50)**[c]
Male sex	0.75 (−0.57, 2.08)	**−0.42 (−0.65, −0.20)**[c]	−0.38 (−1.22, 0.47)	2.13 (−3.55, 7.81)
Age (per decade)	**2.58 (1.99, 3.17)**[c]	**−0.29 (−0.40, −0.19)**[c]	**−0.75 (−1.17, −0.34)**[c]	**−2.50 (−4.95, −0.04)**[a]
Syrian versus other nationality	0.96 (−0.53, 2.46)	0.07 (−0.18, 0.32)	−0.07 (−0.97, 0.84)	1.35 (−5.04, 7.74)
Per each year of programme	−0.76 (−1.84, 0.32)	−0.01 (−0.19, 0.17)	0.45 (−0.34, 1.25)	**−7.74 (−11.99, −3.50)**[c]
Per each year since diagnosis	−0.60 (−1.72, 0.51)	**−0.37 (−0.55, −0.19)**[c]	−0.10 (−0.89, 0.69)	**5.80 (1.47, 10.14)**[b]
Per additional NCD condition	**−0.56 (−1.09, −0.03)**[a]	−0.02 (−0.11, 0.06)	0.13 (−0.24, 0.51)	−1.05 (−2.92, 0.82)
Per additional medication	**−0.20 (−0.37, −0.02)**[a]	−0.01 (−0.04, 0.02)	−0.13 (−0.29, 0.03)	**0.90 (0.39, 1.41)**[c]
Hypertensive	—	−0.20 (−0.44, 0.04)	**−1.06 (−2.03, −0.08)**[a]	−0.44 (−6.02, 5.14)
Hypertensive, with controlled BP	—	**−0.22 (−0.33, −0.11)**[c]	**−1.00 (−1.68, −0.31)**[b]	1.36 (−0.66, 3.37)
Diabetic	**1.43 (0.01, 2.85)**[a]	—	—	**7.32 (1.61, 13.02)**[a]
Diabetic, with controlled FBG	**−2.20 (−3.15, −1.25)**[c]	—	—	**4.74 (2.31, 7.18)**[c]
February	−0.00 (−1.72, 1.72)	−0.18 (−0.42, 0.07)	0.06 (−1.58, 1.70)	−3.37 (−7.80, 1.05)
March	0.27 (−1.45, 1.98)	0.09 (−0.15, 0.33)	−0.03 (−1.53, 1.47)	2.84 (−1.59, 7.28)
April	−0.74 (−2.42, 0.93)	0.09 (−0.15, 0.33)	−0.39 (−2.02, 1.24)	−0.65 (−5.02, 3.71)
May	**−2.10 (−3.74, −0.47)**[a]	−0.05 (−0.28, 0.18)	**−3.81 (−5.34, −2.27)**[c]	−1.04 (−5.26, 3.19)
June	**−2.25 (−3.85, −0.64)**[b]	**0.58 (0.35, 0.81)**[c]	**−4.29 (−5.93, −2.64)**[c]	−0.10 (−4.27, 4.07)
July	**−2.37 (−4.06, −0.69)**[b]	0.14 (−0.10, 0.38)	**−4.14 (−5.71, −2.58)**[c]	−3.17 (−7.52, 1.19)
August	**−2.78 (−4.38, −1.18)**[c]	−0.17 (−0.40, 0.06)	**−2.53 (−4.05, −1.01)**[b]	0.11 (−4.04, 4.26)
September	**−1.73 (−3.43, −0.03)**[a]	−0.07 (−0.31, 0.17)	**−4.12 (−5.65, −2.58)**[c]	−2.05 (−6.44, 2.34)
October	−0.60 (−2.27, 1.07)	−0.04 (−0.27, 0.20)	−1.38 (−2.90, 0.14)	0.91 (−3.39, 5.21)
November	0.95 (−0.75, 2.66)	−0.17 (−0.41, 0.07)	−0.61 (−2.21, 0.99)	−1.79 (−6.18, 2.61)
December	**1.92 (0.27, 3.56)**[a]	0.04 (−0.19, 0.27)	−0.62 (−2.10, 0.85)	−0.88 (−5.14, 3.37)

Significant values in bold:

[a]p-value < 0.05,

[b]p-value < 0.01,

[c]p-value < 0.001.

BP control was defined as BP $<$ 140/90 mm Hg; control targets in patients with diabetes mellitus type II were capillary FBG $\leq$ 180 mg/dl (10.1 mmol/l) or HbA1c $<$ 8% (46 mmol/mol).

BP, blood pressure; FBG, fasting blood glucose; HbA1c, glycosylated haemoglobin; NCD, non-communicable disease

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Discussion

To our knowledge, this is the first study describing clinical outcomes in a primary-level NCD programme for Syrian refugees and the vulnerable host population in Jordan. Overall, we found that intermediate clinical outcomes improved, and the risk of treatment interruption decreased, with programme maturation. From a programmatic perspective, the greatest gains in SBP and FBG control occurred in the first 6 months of the programme. From a patient perspective, clinical parameters also improved in the initial months after entry into the programme (or after diagnosis).

We found a marked seasonal variation in SBP control, with an increase in the mean of up to 5 mm Hg during the colder winter months, which was confirmed by regression analyses. An inverse relationship between ambient temperature and BP (with higher BP reported during colder weather and vice versa) has been identified previously, but, to the best of our

Table 3. Multivariable logistic regression models to explore factors associated with achieving control of intermediate clinical outcomes and with treatment interruption (binary outcomes).

Factor	Effect: Odds ratio (95% CI)			
	BP control	FBG control	HBA1c control	Treatment interruption
Previous treatment interruption	0.99 (0.84, 1.16)	0.96 (0.80, 1.16)	**0.86 (0.76, 0.97)**[a]	**1.55 (1.15, 2.08)**[b]
Male sex	0.88 (0.75, 1.02)	**1.53 (1.24, 1.90)**[c]	1.05 (0.94, 1.18)	1.06 (0.86, 1.31)
Age (per 10 years)	**0.83 (0.78, 0.89)**[c]	**1.27 (1.15, 1.41)**[c]	**1.10 (1.03, 1.16)**[b]	0.93 (0.85, 1.02)
Syrian versus other nationality	0.89 (0.75, 1.07)	0.99 (0.78, 1.25)	1.02 (0.90, 1.16)	0.95 (0.74, 1.22)
Per each year of programme	**1.16 (1.02, 1.33)**[a]	1.05 (0.88, 1.24)	1.00 (0.90, 1.12)	0.84 (0.67, 1.04)
Per each year since diagnosis	1.12 (0.98, 1.29)	**1.39 (1.17, 1.67)**[c]	0.97 (0.87, 1.09)	**0.75 (0.58, 0.97)**[a]
Per additional NCD condition	**1.15 (1.08, 1.23)**[c]	0.96 (0.88, 1.05)	1.01 (0.96, 1.07)	**0.80 (0.71, 0.89)**[c]
Per additional medication	**1.03 (1.01, 1.06)**[b]	0.98 (0.95, 1.01)	1.01 (0.98, 1.03)	1.03 (0.98, 1.08)
Hypertensive	—	**1.38 (1.10, 1.76)**[b]	**1.19 (1.04, 1.36)**[a]	1.06 (0.82, 1.38)
Hypertensive, with BP controlled	—	**1.28 (1.14, 1.44)**[c]	**1.18 (1.07, 1.30)**[b]	1.16 (0.94, 1.43)
Diabetic	0.90 (0.75, 1.07)	—	—	1.26 (0.93, 1.72)
Diabetic, with FBG controlled	**1.34 (1.17, 1.53)**[c]	—	—	1.21 (0.96, 1.54)
February	0.89 (0.70, 1.15)	1.23 (0.95, 1.60)	0.97 (0.78, 1.22)	0.92 (0.57, 1.50)
March	0.95 (0.74, 1.22)	0.94 (0.73, 1.22)	1.00 (0.81, 1.23)	0.94 (0.58, 1.52)
April	1.11 (0.87, 1.41)	1.03 (0.79, 1.33)	1.15 (0.92, 1.45)	1.01 (0.63, 1.61)
May	1.19 (0.94, 1.51)	1.12 (0.87, 1.44)	**1.78 (1.42, 2.21)**[c]	0.86 (0.54, 1.39)
June	1.17 (0.93, 1.47)	**0.63 (0.49, 0.80)**[c]	**1.79 (1.41, 2.27)**[c]	0.81 (0.50, 1.29)
July	1.20 (0.94, 1.53)	1.04 (0.80, 1.34)	**1.55 (1.24, 1.94)**[c]	0.90 (0.56, 1.47)
August	1.19 (0.94, 1.50)	**1.38 (1.07, 1.77)**[a]	**1.32 (1.07, 1.63)**[a]	1.09 (0.70, 1.70)
September	1.12 (0.87, 1.43)	1.14 (0.87, 1.48)	**1.55 (1.24, 1.92)**[c]	0.63 (0.37, 1.08)
October	1.10 (0.86, 1.40)	1.01 (0.78, 1.30)	1.01 (0.82, 1.25)	1.08 (0.68, 1.73)
November	0.81 (0.63, 1.03)	1.22 (0.94, 1.58)	1.12 (0.90, 1.40)	0.68 (0.40, 1.16)
December	**0.73 (0.58, 0.93)**[a]	1.04 (0.81, 1.34)	1.08 (0.88, 1.33)	0.68 (0.41, 1.14)

Significant values in bold:

[a]p-value < 0.05,

[b]p-value < 0.01,

[c]p-value < 0.001.

BP control was defined as BP $< 140/90$ mm Hg; control targets in patients with diabetes mellitus type II were capillary FBG ≤ 180 mg/dl (10.1 mmol/l) or HbA1c $< 8\%$ (46 mmol/mol).

BP, blood pressure; FBG, fasting blood glucose; HbA1c, glycosylated haemoglobin; NCD, non-communicable disease.

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knowledge, this had not been reported in humanitarian settings [28–30]. The opposite was true for diabetes control. The regression analyses showed the month of June was associated with a marked deterioration in FBG control. There were no known programmatic or service use changes, such as an increase in new patient intake (S2 Fig), to explain this, and we postulate that it may coincide with fasting during the holy month of Ramadan followed by the 3-day Eid ul-Fitr festival [17].

From the patient perspective (the cohort analysis), the marked improvement in SBP control within the first 6 months among patients with HTN (mean drop 6.6 mm Hg) is similar to that seen in other studies [23,31]. A clear improvement within the first 6 months was also seen in diabetic patients. Thereafter, time in programme or programme duration did not appear to affect the odds of achieving glycaemic control. We note, however, that the proportion achieving the HbA1c target by month 12 (67%) was lower than the proportion attaining FBG control (74%), potentially reflecting patients' improved treatment adherence in the days around their

clinic appointments, as has been shown in other settings [32]. However, other potential explanations concern the variable relationship between mean plasma glucose and HbA1c and the individual variability in haemoglobin glycation rates, due to different erythrocyte longevity and genetic factors, which may explain the apparent reduced HbA1c sensitivity in Arab populations [27,33].

Increasing age was associated with lower odds of achieving BP control. While BP rises with age, and elevated BP generally requires additional classes and higher doses of antihypertensive drugs over time, further work is needed to determine whether patients with uncontrolled HTN had resistant HTN or whether they were undertreated. Conversely, increasing age and having comorbid HTN were associated with better diabetes control. This may reflect the fact that older patients with multi-morbidity received greater clinical attention or were more adherent to treatment. These differences may have implications for programme planning as the factors to consider in bringing about improvements in one clinical parameter may vary from those for another.

Syrians made up approximately two-thirds of the cohort, and the remainder were mainly Jordanian, reflecting Jordanian policy that access to humanitarian programmes should be extended to the host population. In our analysis, nationality did not impact the odds of reaching clinical targets, despite the Syrian cohort being more vulnerable, less educated, and generally poorer, with a decreased capacity to access care than their Jordanian counterparts, as highlighted by other authors [10,34]. Having a previous treatment interruption was the main risk factor for a further episode of treatment interruption, as might be expected, while the number of days of delayed attendance decreased with programme maturation. It may be that patients retained in the cohort were potentially more adherent than those who stopped attending, but this finding may also reflect the fact that clinic staff strongly emphasised adherence to appointments, achieving a 90% attendance rate by 2017 (MSF data). Patients with FBG at target were more likely to delay attending their next planned appointment or to have a treatment interruption yet maintained FBG control, perhaps highlighting that patients with controlled diabetes could be given greater intervals between appointments.

The number of published studies that include outcomes on the clinical effectiveness of NCD care models in humanitarian settings is growing from a low baseline [13]. UNRWA published several cohort studies assessing clinical outcomes in cumulative and quarterly cohorts of new admissions using an electronic medical record. They reported similar proportions achieving SBP $<$ 140/90 mm Hg (76%) and glycaemic control (between 50% and 78%, using a target of 2-hour postprandial glucose $\leq$ 180 mg/dl [10.1 mmol/l]), with improved testing rates over time but rising rates of loss to follow-up and complications [21,22,35,36]. Several studies of MSF NCD cohorts using routinely collected clinical data have now been published utilising different service models, lengths of follow-up, treatment targets, and statistical analyses [23,31,37,38]. In integrated NCD/HIV programmes in Cambodia and in Kenya, 49.3% (n = unknown) of non-diabetic hypertensive patients and 50% (n = 466) of HIV-negative patients achieved SBP control ($<$140 mm Hg), while amongst Syrian refugees in Lebanon, 49% (n = 75) of non-diabetic hypertensive patients achieved BP targets ($<$140/90 mm Hg). In the Kenyan and Cambodia cohorts, less than a quarter (19% [n = 26] and 24% [n = 51]) reached the target HBA1c of $<$7%, while, in Lebanon, 61% (n = 40) reached the more conservative target of $<$8%, similar to our findings.

The HbA1c and FBG target levels used in this analysis, drawn from the MSF NCD guidelines, were less strict than international norms, which is reflected in the comparatively high rates of control. If we reanalyse using a target HbA1c of $<$7% rather than $<$8%, the proportion of visits meeting the target 6 months post-enrolment drops from 77% (95% CI 73%–82%) to 53% (95% CI 47%–58%). Since many patients in this study would have met the stricter

treatment targets suggested by international bodies such as the American Diabetes Association (HbA1c 6.5%–8%), it may be reasonable to introduce tighter, individualised treatment targets for many patients in this context, as suggested in similar humanitarian settings [23,39].

We also note that the high levels of clinical control seen in this study were achieved in the setting of a complex, facility-based, multidisciplinary programme and may reflect MSF's substantial resources and programmatic experience. In addition, consultations, medications, and laboratory investigations were provided free of charge to patients, as is MSF's standard practice, which removed the main cost barrier to NCD care reported by Syrian refugees in Jordan [9,10,34]. However, this service was limited in coverage (reaching only 23% of adults with self-reported NCDs in Irbid governorate) and in scope, treating a limited number of medical conditions [9]. Multiple studies have highlighted the complex, fragmented, and inadequate NCD care available to Syrian refugees in Jordan and neighbouring host countries [7,10,40]. The high cost of NCD care remains the principle barrier to the MOH, UNCHR, and other actors providing more comprehensive NCD services, while patients often face unaffordable co-payments and transport costs to access existing services [7,10]. Qualitative data from our RE-AIM evaluation confirmed that Syrian refugees in Jordan attempt to meet their perceived NCD care needs by attending a mix of providers (public, NGO, and private facilities or pharmacies) and by carefully balancing costs and household income [41]. When they are financially stretched, they cope by rationing, borrowing, or begging, often depending on the generosity of the Syrian and Jordanian communities [10]. Solutions to increase the coverage of high-quality, standardised, and cost-effective primary-level NCD care and to improve access to essential secondary and tertiary investigations and interventions are urgently needed.

Strengths and limitations

A key strength of this paper is that changes in clinical patterns were explored both using calendar time (programmatic perspective), which may be useful for programme managers, and using patients' time in the programme (closed cohort approach), which is useful for clinicians. The former allowed us to identify and adjust for seasonality in BP control, which a cross-sectional approach at a single time point may have missed. Additionally, we maximised use of the rich, continuous routine data collected by the programme at every patient visit, given that all enrolled adults with HTN and DM II contributed data to the analysis, regardless of whether they had periods of treatment interruption or were lost to follow-up. An additional important strength is that we conducted a multivariable analysis using random effect models that explored the association of patient, programme, and contextual factors with each of the outcomes.

The limitations include that this was a retrospective implementation study of a complex intervention in an unstable humanitarian setting and, thus, subject to the significant challenges inherent in performing evaluations in such contexts. These include using routine clinical and programmatic data, which may have missing variables and be of limited quality. However, the dynamic nature of the context and interventions preclude implementing more traditional experimental designs (such as randomised controlled trials). Our study design did not allow us to establish the causal mechanisms responsible for the reported outcomes or to attribute effectiveness to individual programme components, but we explored associations that could be analysed in future studies [42,43]. We did not focus on other NCD comorbidities, such as chronic respiratory disease and CVD, which are potentially more complex to diagnose and treat at the primary care level and may have achieved less favourable outcomes [44]. We used intermediate clinical outcomes to analyse programme quality since following up hard outcomes, such as mortality and complication rates, requires time. Monitoring these hard outcomes is more complex in humanitarian settings due to high attrition rates, mobile populations, and poor

communication links with secondary care, where many NCD-related deaths are likely to occur. Finally, our outcome results were compared to targets that had been adapted to the humanitarian context and may not represent ideal targets for best clinical outcomes.

Implications for practice, policy, and research

Since a previous treatment interruption was the main risk factor for delayed appointment attendance and future treatment interruptions, MSF could consider specific interventions and strategies to support access and continuity of care for this group, ideally developed in consultation with them. For example, these may include person-centred options such as flexible opening hours or decentralisation of certain aspects of care to the community level through use of community adherence groups or technology to promote self-monitoring (eHealth). Limited evidence shows that there is no benefit to reviewing stable patients more often than 6-monthly (depending on severity, comorbidities, etc.), so service use could potentially be rationalised by extending appointment intervals for those with good disease control [45].

MSF may also consider revising their BP and HbA1c targets in the Middle East population to stricter, individualised treatment targets, in line with international norms, given the high rates of control. The service may need greater focus on achieving SBP control in older patients, as clinically appropriate. This may involve both exploring whether prescriber fatigue, patient non-adherence, and/or resistant HTN are contributing to the poorer BP control in this group and introducing individualised treatment targets. More lenient treatment targets may also need to be considered during winter months. Diabetic patients could potentially benefit from additional support and advice during Ramadan.

Further research is needed to improve monitoring and evaluation tools to (1) utilise the continuous routine data being collected by some NCD programmes in humanitarian settings, (2) determine the important components for quality assessment of these programmes, and (3) explore the effectiveness of the individual components of NCD programmes and explore causal mechanisms, nesting randomised controlled studies within programmes (for more narrow or specific questions) and using novel methodological approaches such as causal inference frameworks appropriate to the evaluation of complex interventions.

Lessons learned around the implementation of this programme may be useful for the Jordanian MOH system as it continues to strengthen primary-level NCD care. We note the increasing role played by MSF nurses in health education, monitoring, and, more generally, management of stable patients with NCDs. Given the pressure on the Jordanian health system and the pull of the private sector and Gulf countries on Jordanian medical practitioners, empowering nurses to play a greater role in the provision of primary-level chronic disease care may be an option for policy makers, regulators, and training bodies to consider. We also note that the positive results presented here were achieved in a relatively complex and costly programme [46]. There may be scope to design and test simplified, more cost-efficient, person-centred programmes that include features such as fixed dose combination therapy, reduced frequency of clinic contact, decentralisation of care to the community, empowerment of patients to self-care and to act as peer supporters, and increased use of technology in this tech-savvy population [47]. Any such modifications to the care model would require careful evaluation of their feasibility and acceptability to policy makers, practitioners, and patients.

Conclusion

In conclusion, we have added to the existing evidence base around the NCD disease burden and barriers to accessing care among Syrian refugees in Jordan, by describing the content and quality of a specific NCD programme designed to meet these patients' needs. This study shows

that good treatment outcomes and reasonable rates of treatment interruption can be achieved in a multidisciplinary, primary-level NCD programme in north Jordan. We suggest that monitoring and evaluation of NCD programmes could be further improved by building on the analysis we have presented here. We also suggest that this comprehensive model of care could be adapted to make it more person-centred, more cost-efficient, and more easily replicated in Jordan and similar contexts in the Middle East.

Supporting information

S1 Fig. MSF Irbid NCD programme timeline.
(XLSX)

S2 Fig. Monthly new and follow-up appointments by nationality at the MSF NCD clinic in Irbid, Jordan (January 2015 to December 2017).
(DOCX)

S1 Protocol. MSF London School of Hygiene & Tropical Medicine Irbid, Jordan, NCD evaluation protocol.
(DOCX)

S1 STROBE Checklist.
(DOC)

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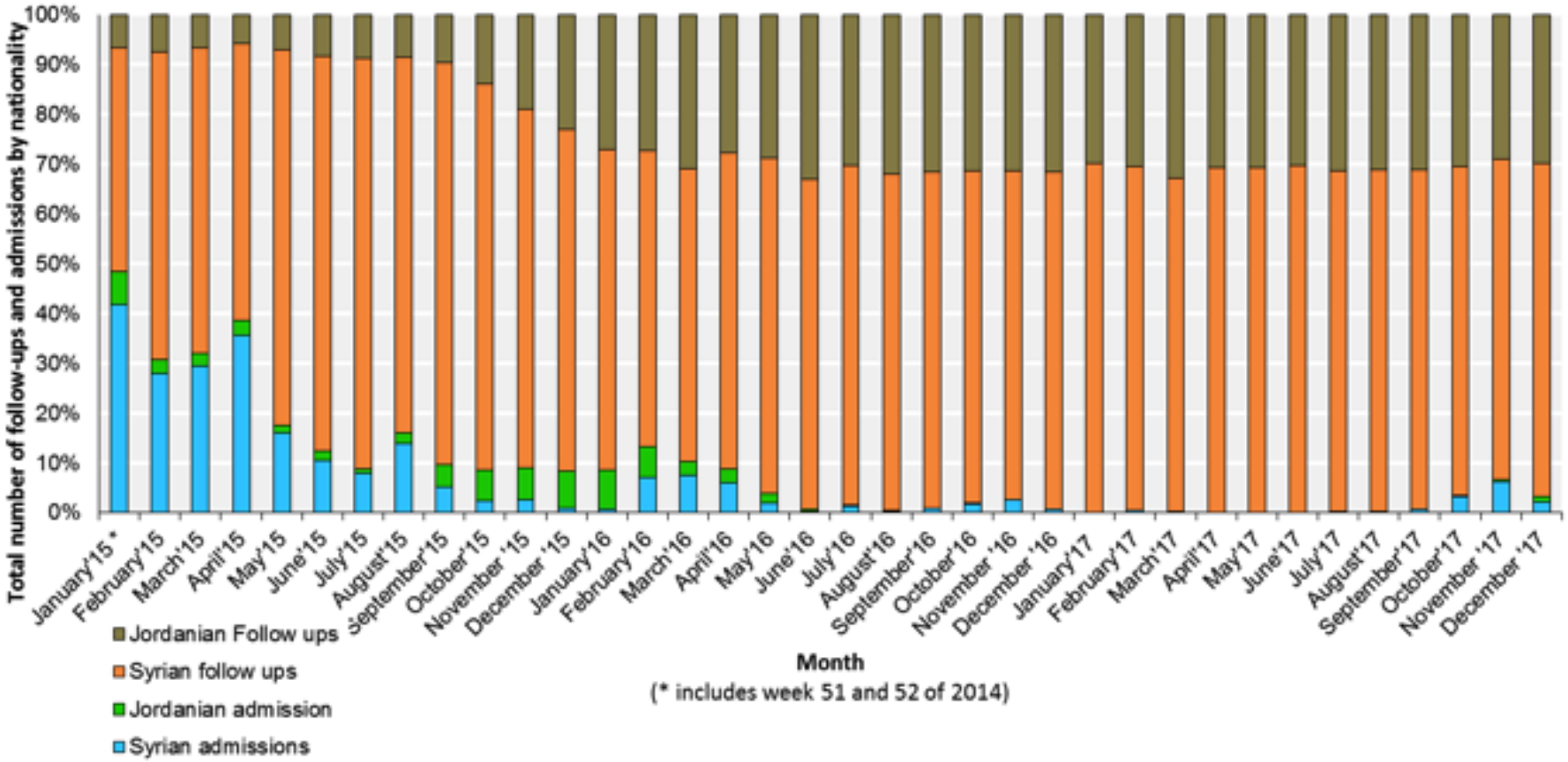
Appendix 1: Monthly new and follow up appointments

by nationality at MSF NCD Clinic in Irbid, Jordan (January 2015 to December 2017)



Paper 3: ‘To die is better for me’, social suffering among Syrian refugees at a noncommunicable disease clinic in Jordan: a qualitative study

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"To die is better for me", social suffering among Syrian refugees at a noncommunicable disease clinic in Jordan: a qualitative study

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Abstract

Background: The conflict in Syria has required humanitarian agencies to implement primary-level services for non-communicable diseases (NCDs) in Jordan, given the high NCD burden amongst Syrian refugees; and to integrate mental health and psychosocial support into NCD services given their comorbidity and treatment interactions. However, no studies have explored the mental health needs of Syrian NCD patients. This paper aims to examine the interaction between physical and mental health of patients with NCDs at a Médecins Sans Frontières (MSF) clinic in Irbid, Jordan, in the context of social suffering.

Methods: This qualitative study involved sixteen semi-structured interviews with Syrian refugee and Jordanian patients and two focus groups with Syrian refugees attending MSF's NCD services in Irbid, and eighteen semi-structured interviews with MSF clinical, managerial and administrative staff. These were conducted by research staff in August 2017 in Irbid, Amman and via Skype. Thematic analysis was used.

Results: Respondents describe immense suffering and clearly perceived the interconnectedness of their physical wellbeing, mental health and social circumstances, in keeping with Kleinman's theory of social suffering. There was a 'disconnect' between staff and patients' perceptions of the potential role of the NCD and mental health service in alleviating this suffering. Possible explanations identified included respondent's low expectations of the ability of the service to impact on the root causes of their suffering, normalisation of distress, the prevailing biomedical view of mental ill-health among national clinicians and patients, and humanitarian actors' own cultural standpoints.

Conclusion: Syrian and Jordanian NCD patients recognise the psychological dimensions of their illness but may not utilize clinic-based humanitarian mental health and psychosocial support services. Humanitarian agencies must engage with NCD patients to elicit their needs and design culturally relevant services.

Keywords: mental health, psychosocial, Humanitarian, conflict, Refugee, Jordan, Syria, non-communicable disease, Social suffering

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Introduction

Since it began in 2011, the conflict in Syria has resulted in the displacement of approximately 6.1 million people within Syria and over 6.5 million refugees into neighbouring countries, including Jordan [1]. The high burden of chronic non-communicable diseases (NCDs) such as diabetes, hypertension and cardiovascular disease among the affected population has been a key feature of the health sector response to the Syria crisis [2]. Humanitarian actors have limited experience in managing NCDs and have needed to develop specific tools, and programmatic and clinical guidance [3, 4].

Armed conflict has a profound impact on refugees' mental health due to their exposure to violent and traumatic events, forced displacement and ongoing daily stressors [5–7]. There are surprisingly few reliable studies on the burden of mental disorders and psychological distress among Syrian refugees in Jordan, but evidence does suggest elevated levels of mental disorders among Syrian refugees in Turkey and Lebanon [8–10], while reduced functioning has been recorded among Syrian urban refugees compared to host populations in Jordan [11]. Guidance for mental health and psychosocial support (MHPSS) interventions to protect or promote psychosocial well-being and/or prevent or treat mental disorders in humanitarian emergency settings was developed in 2007 [12]. Specific MHPSS guidance has also been produced for the humanitarian sector in relation to the Syria crisis [12, 13].

People living with NCDs are at higher risk of mental health disorders in any context, due to direct effects on the brain or as a result of the disability, impaired functioning and chronic ill health related to the NCD [14]. Equally, mental disorders, such as depression, are also independent risk factors for development of poorer outcomes related to physical NCDs [14–16] and having a co-morbid mental disorder is associated with reduced help-seeking, poorer treatment adherence, and poorer prognosis for chronic physical conditions [17–21]. For conflict-affected populations, psychological trauma and the daily hardships of forced migration may increase their vulnerability to both mental and physical ill-health [22]. Physical NCDs may be impacted upon by the loss of control over daily life, financial difficulties, the breakdown of social networks and attendant harmful coping mechanisms, such as smoking and excess alcohol use [23–25].

Social suffering is a valuable explanatory framework to help understand mental and physical health needs [26]. It captures the close links between personal and societal problems and between individual and collective experiences to allow for a holistic view of health within a socio-political context [26, 27]. Analysis of individual narratives through the perspective of social suffering may shed light on how respondents make meaning of their health and broader conditions.

The advantages of integrating MHPSS and physical health services have gained increasing attention and MHPSS integration into general primary and secondary services is underway [28–31]. However, it is not clear how well the need to manage interconnected physical NCDs and mental health issues has been recognised, either in terms of the Syrian refugee response or more widely in humanitarian settings, and the evidence to guide such integrated responses is lacking. Given the psychosocial stressors and the rising global burden of NCDs impacting conflict-affected populations, this is an important gap. Designing relevant and effective interventions requires an understanding of both service users' and providers' perspectives. This paper aims to examine the interaction between physical and mental health of patients with NCDs at a Médecins Sans Frontières (MSF) clinic in Irbid, Jordan, in the context of social suffering.

Methods

Study setting

This paper is part of a wider evaluation, using the RE-AIM implementation framework, of the NCD services provided by the humanitarian agency MSF in Irbid, Jordan [32]. Almost 680,000 registered Syrian refugees fled to Jordan, of whom, 21% live in Irbid governorate, outside of formal refugee camp settings. MSF initiated the NCD service in 2014 in response to the high burden of NCDs and the barriers Syrians faced in accessing government health facilities. The service targeted patients with one or more of the following: cardiovascular disease, chronic respiratory disease or diabetes types 1 or 2 and provided free services, which included consultations by appointment, medications, laboratory testing and health education using context-adapted evidence-based clinical guidelines. While the majority were Syrian refugees, 30% of patients were from the Jordanian host population, in accordance with government requirements. A MHPSS service was incorporated in 2016 as staff recognised that patients' MHPSS needs were significantly affecting their ability to engage with NCD care. The MSF service consisted of individual counselling and group psycho-education sessions delivered by trained national staff (Jordanian) counsellors with psychology qualifications, supported by an international supervisor, and it initially focused on mental health in relation to medication adherence. However, a significant burden of untreated mental health problems, ranging from psychological distress, anxiety, depression, psychosis, suicidality, and self-harm was identified by MSF staff that was not being addressed by their own or other available services.

Therefore, the MSF service evolved to encompass a wider range of mental health needs.

Study design and data collection

A qualitative study design was used, based on semi-structured interviews and focus group discussions conducted in August 2017. Adult patients attending NCD medical appointments were purposively selected to reflect different NCD diagnoses, genders, nationalities and those accessing different aspects of the NCD service. A convenience sample of patients from the waiting room was also invited to participate. Both Syrian and Jordanian patients were included, reflecting the fact that it is UNHCR policy to provide equitable access to MHPSS services to both host and forcibly displaced populations [33]. From a research perspective, it is important to understand potential differences in these populations' attitudes or help seeking behaviour and how this may impact on care delivery. All patients interviewed attended the general MSF NCD service, while only one participant accessed the MHPSS component. A purposive sample of clinical, managerial and administrative staff was also interviewed, aiming to include staff from each cadre, national and international, past and present. National staff were all Jordanian, while supervisors and management staff tended to be international.

Topic guides for the semi-structured interviews and focus groups are presented in Supplementary Material 1. While these contained limited prompts on mental health, the interviews covered mental health in significant detail because participants focussed on it and interviewers then explored the issues raised.

Sixteen semi-structured interviews with adult NCD patients (eight women and eight men; six Jordanians and ten Syrians; all aged 60 or older, which was representative of the broader cohort), and two same-sex focus groups were conducted with a different group of eight female and eight male adult Syrian NCD patients (moderated by same-sex research assistants). All had NCDs (mainly hypertension and/or diabetes) and refugees had been in Jordan for between three and 5 years. Eighteen interviews were conducted with MSF staff from a range of clinical, managerial and support roles. See Supplementary Material 2 for further participant details.

The semi-structured interviews were conducted in Arabic by SE or a male research assistant or in English by EA, depending on participant language preference. Interviews were conducted at the MSF clinics (for patients) and at MSF offices or via Skype (for staff); one patient of the home visit service was interviewed at home. The interviews were audio recorded and field notes were taken. Arabic language interview transcripts were translated by research team members. Each translation was cross-checked by a second translator and by one of the Arabic-speaking interviewers.

Analysis

A thematic analysis approach was applied using NVivo 11. Initial codes and themes were generated and revised in an iterative process. Patient interviews were analysed for differences in responses between genders and by nationality (Syrian vs. Jordanian). Staff interviews were analysed for differences in national versus international staff and MHPSS versus other clinical staff's responses. Patient quotes were labelled according to the patient gender and country of origin for context. Staff quotes were not labelled in order to protect the confidentiality of staff respondents.

Ethics

Written consent was obtained and information sheets were provided. A referral mechanism was in place for patients who expressed health or protection needs during interviews. Confidentiality was assured by use of private spaces for interview and removal of all identifying information from written documentation. Focus group participants were asked to respect the confidentiality of all participants, while being informed that the research team could not guarantee against residual disclosure. Ethical approval was provided by the Ministry of Health in Jordan, the MSF Ethics Review Board, and the Ethics Committee of the London School of Hygiene and Tropical Medicine.

Results

Both Jordanian and Syrian patients described the interconnectedness of their mental and physical health, and demonstrated similar attitudes to mental health services. The Syrian patient accounts differed from Jordanian accounts with respect to describing the high burden of distress within their community, barriers to help seeking associated with displacement and their expectation that they should suffer from poor mental health as a result of their circumstances. Themes that emerged were similar for men and women. The findings of the qualitative analysis are described separately for patient and staff interviews, categorized into a coding tree (Supplementary Material 3).

Patient interviews

Impact of social stressors and war experience on mental health

Daily stressors and their impact on the mental health of the individual and family were discussed by Jordanian and Syrian respondents of both sexes. These included economic hardship, lack of available employment and

working restrictions (the latter were specific to Syrians). Male Syrian focus group participants explained:

> '*We do not have money, our finances are bad, and they all (other facilities) take money, only here (at the MSF clinic) they do not take money*.

> '*For us as refugees, you do not have any work chances, you only have to be young and work in construction; … work depends on physical powers, and we all (older people) here do not have this*.'

A Syrian woman described her financial worries and ways of coping:

> *'Sometimes poor finance makes me anxious, sometimes I keep all the night awake talking to myself from where I will get money … , so I … ask (our neighbor) to give me 5 (Jordanian dinar) and I tell him once I have money I will pay you back'*

Among Jordanians, those with low income described similar financial worries and, even those from a higher socioeconomic bracket reported that the affordability and accessibility of MSF care alleviated their financial concerns.

Both Syrians and Jordanians appeared to link social stress to their individual and family circumstances, while Syrian respondents also reflected on the suffering that the war in Syria had caused themselves and their wider community. Men and women expressed suffering in similar terms, such as anger, sadness, grief, hopelessness or even expressing a passive death wish. Both sexes described similar physical symptoms, which may be associated with psychological distress (tiredness, poor appetite and not feeling 'comfortable'). The specific sources of suffering included concern for family members remaining in Syria, witnessed suffering or violence, displacement from home and, most prominently, separation and loss of family:

> '*When I am upset, I have trembles in my body, you know every one of us in different places, some people here, others still in Syria*,' female Syrian patient.

> *'The mental status and the mood was better than here in Jordan … you know when one is in his country, things are different'*, male Syrian patient.

The collective suffering of the Syrian people was described by several Syrian respondents:

> '*...all the incidents that occurred in front of us, like killing and destroying. What should I say, something can't be imagined by the brain … the suffering, which our people went through wasn't witnessed by any other people in the earth*.' male Syrian patient.

They perceived that others in their community experienced similar psychological, ('*all people have anxiety, not only me*') or physical manifestations of suffering ('*we are all tired as Syrians. We were destroyed*').

Further examples of the language used to describe mental distress are given in Supplementary Material 4.

Interconnectedness of physical and mental health

Both Syrian and Jordanian patients consistently described their health in terms of interconnected physical, psychological and social dimensions. Psychological distress, or specific traumatic events could trigger their illness, while "anger", low mood or sadness could negatively impact on diabetes and hypertension control:.

> *"My brother … had a heart attack and died, it was a shock for us … and since then I had hypertension. Then another brother died in 2005 and my husband died the same year … so these are the reasons behind having diabetes and hypertension,'* female Jordanian patient.

> '*I say my diabetes is not because of food … bad emotional status can increase the sugar level especially if the one is always tired*,' male Syrian patient.

For Syrians, the psychological distress induced by their war and refugee experience was directly linked with their NCD condition:

> '*When I get sad and remember my sons in Syria … I keep crying and crying. Then my hypertension goes high or goes down … then I take a hypertension pill to settle down whenever I read some news about them*,' female Syrian patient.

By contrast, patients of both nationalities perceived that "good psychological status" was necessary to avoid symptoms and that improving psychological health could benefit their physical health, possibly to a greater degree than medications.

> '*Let me tell you, I have tried when I am mentally comfortable, everything is good and it helps more than medication*.' male Syrian patient

Patients of both nationalities described how social circumstances, mental health and physical health were closely interlinked. A Jordanian male respondent described this biopsychosocial relationship linearly, in that

poor finances caused depression and sadness, which in turn worsened diabetes and hypertension. Echoing several other accounts, a male Syrian patient described how his own wellbeing impacted on the wider social network:

> '*When someone is surrounded by comfortable things, he has money and things good then he feels good and his life is happy, so he speaks with others and feels fine with them and communicates with them. … When anyone has love and trust with others, he'll help him to stay in a good mood... if the family had bad mood … it affects the human's health*,' male Syrian patient.

Psychological distress impacting on engagement with NCD care

For Syrian patients, their social suffering translated into difficulties engaging with the healthy living advice provided at the NCD clinic. They described being too preoccupied with thoughts of Syria or feeling psychologically or economically ill-equipped to follow lifestyle advice:

> *Interviewer: 'has anyone of you changed his lifestyle after he found about his disease?'*

> *Male focus group participant: 'nothing changed … we don't feel comfortable, always thinking about what happened at our country'*

> *'Because of circumstances I cannot follow this plan … I mean the psychological circumstances, I'm out of hard circumstances so all of this affects, and when the financial situation is difficult as well.' male Syrian respondent.*

One female Syrian focus group participant expressed thoughts of death and lack of motivation to engage in self-care:

> '*Every time I come here, they advise me take care of yourself and I always tell them to die is better for me.'*

By contrast, Jordanian patients seemed well engaged with the NCD clinic and, in addition to its affordability and convenience, many attributed their good disease control to feeling "comfortable" due to the "care", individual attention and respect they received from MSF staff. Staff explained the differences in engagement between Syrians and Jordanians in relation to psychological distress and lack of agency, as discussed further below.

Seeking help and health beliefs around psychological distress

Despite the majority of patients speaking openly about psychological distress and clearly linking it to the onset or exacerbation of their physical disease, they did not seek help for this distress at the MSF clinic. The main reason appeared to be a lack of awareness of the MSF MHPSS services among patients of both sexes and nationalities. Only two interviewees were aware of the services, with one attending individual counselling sessions and a second attending a waiting room psychoeducation session. Moreover, when MHPSS services were described to them, most appeared reluctant to engage. We identified a number of health beliefs that my have influenced this.

One key belief was that the MSF clinic was not the appropriate place to seek help for psychological difficulties. Patients appeared to believe that there was a separation between biomedical services and sources of help for psychological distress. They perceived the doctors' role as focussed on interpreting clinical data and prescribing, as illustrated here:

> ' … if I told them (that I feel upset or can't sleep), they don't react because it's not their business...their mission is to give me medication only,' female Syrian patient.

Having control over biomedical parameters appeared to satisfy and relieve the patients. For example, despite a female Syrian patient becoming tearful when describing her family's separation, ('you can say that most of the days I feel upset, I'm so sensitive … when I am upset I have trembles in my body, you know every one of us in different place, some people here others still in Syria {patient began crying}'), she maintained that she did not need the MSF MHPSS services, since her biomedical care was in order: 'my lab test results always good … so everything is OK'.

The second key belief was that mental health issues were a private matter. Patients of both nationalities agreed that they held no place in the biomedical model of care provided at the clinic, as illustrated by one Jordanian male, who expressed anxiety: 'I do not think this (clinic) is a proper place (to seek help for psychological issues) … these are personal things.'

There was a sense also that Syrian respondents, in particular, sought to normalise their distress as similar to that of others in their community and therefore not a problem or illness amenable to a healthcare solution:

> 'Honestly (I have complained about anxiety) for four years … This is the first time I tell... but what to tell about this, all people have anxiety not only me, everybody that comes here say he or she has anxiety, all people have anxiety and I am like them, what shall I do?' female Syrian patient.

Since there was a perceived inevitability to their distress, which had known and inalterable root causes, males and female respondents of both nationalities questioned the utility and effectiveness of bringing these issues into the medical consultation:

> *'What would I tell them about this, and how could they help? … I have members of my family still in Syria, how do you think my psychological status will be, would I be comfortable...? So what would I say to them here, that I have family still in Syria, what would they do? Or how can they help? I only say thanks Allah for everything'* female Syrian patient.

> *'(I do not you tell them in the clinic if I feel upset since) the reasons for sleeplessness are known*.' male Syrian patient.

Among the minority of respondents who were aware of MSF MHPSS services did not perceive it as useful, rather a passive counselling service where, as a male Syrian patient explained, "you explain to him your situation and he listens to you, so you express your feelings.' One respondent implied that psychological symptoms were not "clear" and therefore not amenable to intervention by doctors, whose role, again, was to prescribe:

> Interviewer: '*when you feel anxious or having sleeping disorders, do you share this with the staff at the clinic and ask for their help*?'

> Patient: '*If the disease was clear we tell them and they give us medications, and if not … they tell us that they do not have medication for this disease*.'

Among the minority of patients who described alternative health seeking strategies to manage their distress, respondents of both nationalities reported relying on family or religion.

> 'I *did not try (to talk to someone at the clinic about anxiety) because I have sons and daughters and I have good relation with them.*' female Jordanian Patient

Several patients discussing distressing topics such as bereavement and loss concluded by referring to how Allah is ultimately the only source of a solution to their troubles:

> '*Our situation is miserable and we can't have emotional comfort. Never. It's our destiny to be in a big crisis and our problems can't be solved except by Allah, (not) even the researcher, (or) even the doctor. All the people have problems. May Allah help all people … May Allah protect us all*,' female Syrian patient.

Staff interviews

The findings from staff interviews we have included here focus on staff perceptions of the mental health of their patients, the barriers to patients accessing the MHPSS service, and the impact of mental ill-health on their engagement with physical NCD care. While the topic guide referred only briefly to these issues, all staff emphasised the high burden and impact of mental health problems amongst their Syrian patients and many contrasted their experiences with those of Jordanian patients. Multiple staff reported recent cases of patients requiring psychiatric intervention, some with suicidal ideation and others experiencing gender-based violence, which complicated NCD care delivery.

Interaction between mental health and physical health

The majority of staff respondents, including clinicians and counsellors, echoed patient beliefs that traumatic experiences and ongoing daily stressors were interlinked with patients' physical health. These stressful experiences also impacted on patients' engagement with care for physical NCDs. Staff emphasised Syrian patients' exposure to violence, their loss of family and home, social isolation and the breakdown of traditional community structures. MHPSS staff in particular, reiterated patients' belief in the causal link between psychological stress and the onset or exacerbation of their NCD condition:

> *'You find out that these patients not only suffer from hypertension, diabetes, they are refugees who lost almost everything, especially when they keep saying that they had these diseases because of their circumstances like (losing a child), and they blame themselves for everything'*.

One national staff member agreed with the patient perspective that, given the circumstances, suffering was inevitable among Syrians (' … *they were exposed to war and their current situation is very bad … they are refugees so they will have some sort of mental problems*.').

Staff recounted the chronic daily stressors to which Syrian patients were exposed, including poverty and indebtedness; vulnerability to exploitation; crowded, poor-quality living conditions; and social isolation. Some considered financial pressures and the inability to work in Jordan as the key psychosocial challenge facing Syrians and that this impacted directly on their mental and physical health.

'The financial challenges, the social challenges, are the most important factor in anxiety existence and other psychological disorders for NCD patients, which can affect their medical readings for blood pressure and sugar … '

Psychological distress impacting on NCD care

They In contrast to patient accounts of the interlinked physical, psychological and social dimensions of health, one staff member felt that both patients (of either nationality) and MSF doctors were slow to acknowledge the psychological component of illness and the need to address it to successfully manage the physical component.

'Unfortunately I see that people are not capable of admitting that they have psychological aspect that would affect their bodies, you have to admit this and ask for help, inform the staff that I need someone to support me through psychological counselling or support.'

They reported how financial hardship was both a source of distress and directly prevented patients of both nationalities engaging in lifestyle change such as formal exercise activities and healthy eating. Both national and international staff respondents emphasised that medication adherence was also negatively impacted by psychosocial issues related to Syrian patients' war and refugee experience:

'To be honest the social side, the loss, the situations they have been in, affect them a lot. This is one of many things that affects their adherence to medications or treatment in general.'

'And then … intimate partner violence … yeah, the lady has diabetes but … the reason she is not taking her medicine is … all these other home psychosocial factors … '

In addition to reducing adherence, non-medical national staff members perceived that psychological comorbidity directly impeded the effectiveness of NCD medications:

" … anxiety and other psychological disorders for NCDs patients, which can affect their medical readings … despite taking medications … the tension medications will not do their effect.'

Several staff commented on the futility of promoting lifestyle change when their patients were dealing with traumatic war experiences:

'As I was hearing the stories I thought … this man's problem is not that he's smoking too much. His problem is that he … experienced sexual violence, physical violence in prison in Syria … these two are linked.'

Jordanian national staff recounted how social stress was tied to Syrians' psychological distress and illustrated the differences they experienced in providing care for Syrian refugees compared to Jordanians:

' There isn't really much traditional or cultural differences between me and Syrian patients because we come from the same area but mostly the social economic status is different, the lifestyle is different … let's say the impact of their life situation it affects their disease and it affects the way they want to deal with these diseases.'

Staff contrasted Syrians' and Jordanians' engagement with care and motivation to self-care, which many linked to the concept of 'hope'. They reported that Syrian patients' hopelessness for their future either in Syria or Jordan, their disempowerment and disengagement from their current existence in Jordan, and their lack of meaningful daily activity, all impacted on their motivation..

'This certain population of people (Syrians) they don't have much hope in their future life so they don't really...some of them they just don't care about improving their status to be better because they think that life has ended since they left Syria.'

In one striking example of this focus on the importance of 'hope', one interviewee described a young man's lack of social support and harmful coping strategies, and how this created a cycle of deteriorating physical and mental health:

'If he has been used to a small village in rural environments, without support from family or society, he is inclined just to get very fed up, to get feelings of hopelessness, sitting in the apartment all day, going next door to smoke the shisha, by taking Shawarma in the corner shop, and just gets larger … and (these) aggravate the disease and hypertension, which in turn aggravate the feelings of hopelessness … '

By contrast, hope and engagement in the future, more common among Jordanians, was seen by one clinician as improving self-motivation and, therefore, clinical outcomes.

'I see some Jordanian patients their blood sugar readings are lower, their blood pressure is more controlled and most important they want to control their disease, they care to control their diseases and

that is for me the main difference. They have something to look to … . they look forward to tomorrows, but the Syrians here, they don't as much.'

Once Syrians started to settle for the longer-term in Jordan, their outcomes improved, according to another staff member.

'In the last six months maybe … maybe some patients find job or find house. And they leave the talk about the return to Syria … and they try to adapt for their new situation and to find a new solution for their life. So they want to change it now. The effect on their health.'

Seeking help from the MHPSS service and mental health beliefs

Staff's perception that patients chose not to seek help from MSF's MHPSS service was consistent with patient accounts. They perceived patients MHPSS care seeking behaviour as being influenced by awareness, sociocultural and economic factors as well as doctor-held and patient-held beliefs.

All staff, especially MHPSS staff, perceived that lack of awareness was the principal barrier to patients of both nationalities accessing MHPSS services. This was reportedly linked to a MSF national staff doctors' lack of engagement with the service. Referrals to MHPSS services were initially made only via theses doctors. In explaining the initially very low referral rates, doctors cited their distrust in the quality and effectiveness of the service. It appeared that they believed that counsellors were encroaching on a doctors' territory and that they should stick to a defined and limited role:

'It is good to have the mental health department and the counsellors but sometimes they may diagnose and they may diagnose incorrectly and I ask them many times please don't diagnose because you are not a psychiatrist, you are a counsellor and we are referring this patient to you for maybe CBT or for more psycho-social support more than diagnosing and suggesting medications.'

Doctors' beliefs about the MHPSS service appeared to be linked to the prevailing medical culture. Service supervisors, who were all international staff, underlined the fact that mental health was traditionally the preserve of hospitals and specialists in Jordan. They perceived that national doctors compartmentalised physical and mental ill health and that this may explain why a large burden of psychological morbidity among the Irbid cohort was going unrecognised.

Sociocultural factors were also at play in the low referral rates. While not overtly mentioned in patient accounts, several staff reported that there was stigma associated with mental ill health among the patients and broader society, without distinguishing by nationality. National staff doctors described their own reluctance to label patients with mental health diagnoses and perceived a referral to the MHPSS service as unacceptable to patients since it labelled them 'crazy'. Staff thus reported modifying their language around MHPSS referral ('Patients think … it's a psychiatric or something like that. We tell him it is for support'.) It appeared important to reassure patients they were not labelled as being different compared to others and that it was 'socially ok to go' to counselling services. It was notable from staff accounts that psychosocial interventions framed as "living well" with diabetes programmes, delivered by both health education and MHPSS staff who taught pragmatic skills, such as problem solving and inter-family communication, were well accepted by patients. A further influence on low referral rates may have been doctors' belief that Syrian's distress was a natural response to their circumstances, echoing patient beliefs.

Other barriers to patients' MHPSS health seeking, irrespective of nationality, were also described. These included women's limited autonomy, and need for a male family member to attend. This was noted as limiting their ability to engage around gender based violence issues. Socioeconomic factors, whereby patients would choose to spend limited household finances attending medical consultations and laboratory visits rather than attending MHPSS session were described by several staff. They perceived that patients placed less value on the MPHSS service compared to other clinical aspects of the MSF NCD service.

Staff recounted efforts made by the MSF team to address access barriers. They described running training sessions for all clinical staff and promoting dialogue between MHPSS staff and their medical colleagues. In addition, they expanded referral rights to nurses and social workers and engaged in awareness raising and promotion of self-referral through waiting room psychoeducation sessions.

Discussion

This study describes how Syrian refugees and members of the host community living with NCDs in Jordan connected their psychological and social suffering with their physical illnesses, yet most did not perceive the MSF NCD service as a space to address their mental health. We will discuss patient and provider accounts from the explanatory perspectives of the Syrian and Jordanian cultural context, social suffering and social hope. The latter are not new concepts but we apply them specifically to

the experience of Syrian refugees in Jordan and in the context of a programme for physical NCDs delivered by a humanitarian actor [27, 34, 35]. We will then discuss operational implications for the humanitarian sector, given that little is known about how humanitarian agencies should best integrate mental health care into chronic disease services in culturally relevant ways.

Interconnection of mental health, physical health and social circumstances as social suffering

There is plentiful evidence from high-income settings that the incidence of mental ill-health is higher in people with physical NCDs and vice versa. Furthermore, people with comorbid physical and mental illness experience poorer health outcomes, such as decreased medication adherence, greater functional impairment, and higher risks of complications and early mortality [14, 36, 37]. There is also an increasing body of evidence linking stressful life events or chronic perceived stress with the onset of physical NCDs, such as diabetes [38, 39]. However, what is clear from our study is how respondents also linked their physical and mental health with their social world and with social suffering specifically.

The concept of social suffering links both physical ill health with social problems and individual experience with collective experiences [26, 27]. In conflict settings, this implies that social, cultural, political, and economic issues are intertwined with matters of public health [40]. Kleinman has proposed social suffering as a "social theory of global health" with several important implications. These include the notions that socio-political and socio-economic factors are directly implicated in disease; that social or bureaucratic infrastructure, designed to manage disease, can actually cause or worsen suffering; that pain and suffering are not limited to the individual but may extend to the wider family or community network; and, finally, that conditions should be defined and addressed holistically, incorporating both health and social policy responses [26]. Consistent with this theory, participants in our study could not separate the social and political context, which was responsible for them suffering trauma, poverty and powerlessness, from their physical health [27, 41].

Patients of both nationalities and staff described psychological distress as a cause or exacerbating factor in physical ill health and vice versa. Whilst Jordanians made this link in relation to their individual circumstances, in these interviews Syrian respondents additionally linked their physical and mental health to the collective experience of their community. The Syrian experience of physical health in this setting occurred on a backdrop of structural violence linked to their displacement and refugee status in Jordan. The poverty and social disadvantage experienced by many Syrians in Jordan may have impacted *directly* on their physical NCDs, and this is echoed in findings from other contexts. For example, depression and diabetes have been found to intersect more frequently in low income populations because of the strong relationship between depression and poverty [42]. This may have been less prominent for Jordanian patients, whom staff reported were generally of higher socio-economic status and education level than Syrian patients.

The concept of social hope links resilience and well-being to social context and to access to resources, both at the individual and community level [27]. A contrast in social hope between Jordanian and Syrian patients was noted by staff and this may be linked both to Jordanian's relative wealth and their rootedness. Those Syrians who had settled in Jordan and were able to access resources, such as work and housing, were seen as demonstrating greater social hope. This in turn was perceived as positively impacting patients' NCD outcomes, through increasing motivation to change and to self-care. In contrast, many refugees were observed by staff as being in a state of entrapment, both as a result of the structural barriers to improving their health and their internal conflict about whether to accept living in Jordan or to continue to hope for eventual return to Syria despite their knowledge that their lives there had been destroyed. This 'sense of entrapment, of having nowhere to go' has been described by Hage as the enemy of social hope [43].

Hassan et al. explored the cultural context around mental health and psychosocial wellbeing of Syrians affected by the conflict [13]. The explanatory model offered by patients in our study is in keeping with the 'sociocentric' and 'cosmocentric' understandings of the person described by Hassan as common in the Syrian population [13]. From this perspective each individual is linked to every other creature created by Allah and there are two dimensions to every individual: the universal dimension governed by the will of God and the social dimensions governed by rules of conduct [13]. The patient accounts illustrate these concepts as applied to health, where health of the individual is affected by other people and events and, in turn, an individual's health affects the whole family and community, which chimes with the theory of social suffering.

Our findings suggested that beliefs about mental health were similar between the Jordanian and Syrian participants. Similarities in cultural understandings of mental health are perhaps expected given that the Syrian and Jordanian populations living either side of the border near Irbid share close historical, trade and family ties [44].

Health care seeking and uptake of MSF mental health and psychosocial services

A further key finding was that few interviewed patients of either nationality were aware the MHPSS service

existed. Our larger service evaluation found that uptake of the MHPSS service was well below the perceived need and that patients referred to MSF MHPSS services often failed to attend [45]. They appeared to value MHPSS services less than physical health consultations and financially precarious families were willing to spend time and money to attend NCD medical consultations but not MHPSS appointments [45].

Health or care seeking behaviour has been defined as any action undertaken by individuals who perceive themselves to have a health problem or to be ill for the purpose of finding an appropriate remedy. Our findings imply that neither patients nor doctors perceived that the psychological distress patients experience was a 'health problem'. Rather, it was "normal" for Syrians, in particular, to experience psychological distress given their circumstances and to attend the MHPSS service branded them as unacceptably "abnormal". Second, the biomedical setting of the clinic was an inappropriate venue to seek help for psychoscocial issues, perhaps because of a misconception as to what the service offered. Many existing psychiatric services in Jordan favour a medication based approach, which is in contrast to the talking therapies offered by the MSF MHPSS [46]. Third, the MHPSS service could not provide an 'appropriate remedy', since it had no power to address the root causes of Syrian's suffering. In contrast to MHPSS services, the physical NCD service was tangible, involving medication, medical tests and numerical results. Some patients expressed a preference for this approach, which may have offered them a sense of control in the context of a prevailing sense of hopelessness and limited control over daily life.

Hassan suggests that awareness of mental health and seeking help from MHPSS services is increasing, particularly amongst urban Syrians, and she places more emphasis on stigma as a barrier to help seeking [13]. MSF staff reports of stigma and observation of patients' desire to be seen as 'normal' and not 'crazy', are in keeping with other studies of Syrian refugees [11, 13].. Hassan's describes how emotional suffering is perceived as an inherent aspect of life in Syria, but it is the labelling of distress as 'psychological' or 'psychiatric' that is a source of shame and fear for the individual and the family [13] . A high perceived level of societal stigma and cultural beliefs about mental health were also found to negatively impact help seeking among Jordanians with mental health problems, outside of the humanitarian context. Most preferred to utilise informal resources rather than see a health professional [47, 46]. Among Jordanian communities, help-seeking is a collective rather than individual enterprise. The stigma of attending MHPSS services would therefore be felt by the whole family, which may further discourage help-seeking [48].

Jordanian doctors' own beliefs and their gate-keeping role over referral to the MHPSS service may also have contributed to low uptake. They were rooted in both the sociocultural and local medical culture, which may have explained their desire to protect patients from stigmatisation and, their initial distrust in the quality and effectiveness of MHPSS counselling services and their belief that mental illness was the domain of doctors.. The latter has been observed in other settings, where medical professionals have resisted efforts to task shift mental health care to other cadres of staff [49]. The Jordanian doctors' apparent biomedical approach may also have played a part. The MHPSS approach is relatively new in Jordan, where mental health care has traditionally been delivered by psychiatrists in hospitals [11]. No Syrian health professionals were employed by the clinic due to regulatory restrictions in Jordan. Syrian refugees in Lebanon were found to feel more comfortable receiving care from health professional staff from their own culture who have also endured displacement rather than from local staff [50]. Its is unclear how employing Syrian health professionals would impact on uptake of MHPSS services in this context.

The lack of engagement with MSF MHPSS services may also reflect both Syrians and Jordanian patients' preferring to use their own culturally-relevant coping mechanisms and resilience and/or that the offered MHPSS services were not culturally-relevant [51–54]. Perception of mental health problems may have been influenced by the Islamic teaching that people should surrender and entrust themselves to the will of an omnipotent God. Hassan notes a view widely held by Syrian Muslims that hardship provides an opportunity to grow and to strengthen one's faith, which may help them to accept and show patience in the face of harsh reality. However, the notion of human weakness is related also to the idea of *taklif* or entrusting, which she suggests can help to find motivation and drive to cope with hardship [13].

Limited references were made to differences in help seeking by gender in the patient data. This may be because it was not directly enquired about. Staff referred to cultural barriers to women who had experienced GBV accessing MHPSS services, since they were required to attend the clinic accompanied by a male relative. Other work suggests a lower uptake of mental health services by women in Jordan compared to men, despite a higher burden of depression and anxiety [48].

Implications for integrated MHPSS and NCD services in humanitarian settings

While the link between physical and psychological ill health has been well established in conflict-affected settings, we don't yet know how best to respond to this

duality in a culturally relevant and integrated way. The humanitarian sector has sought to ensure that MHPSS interventions are both evidence-based and culturally relevant by adequately recognising local forms of stress, support and healing [12, 55]. The potential benefits of integrating MHPSS and physical health services have been recognised but there is little practical evidence to guide such integration [29, 56]. Further exploration of how distress is expressed in different populations in relation to personal, cultural and social meanings is required and of how such idioms of distress intersect with physical NCD and psychological symptoms [57, 58].

Lessons learned from the MSF experience in Jordan may be useful in adapting their Irbid programme and in guiding the humanitarian sector more broadly. MSF has implemented evidence-based MHPSS approaches in this context, yet we identified the need for greater engagement with NCD patients to explore how these services could better meet their needs It may be helpful to extend the group "living well sessions", framed around physical illness, which seemed a more acceptable vehicle to foster problem solving, communication skills and peer support. MSF may also consider expanding psychosocial support services into non-clinical settings, such as community halls, women's programmes or schools to increase their acceptability and accessibility.

The daily stressors, financial precarity, the myriad barriers to accessing care experienced by Syrian refugee NCD patients in Jordan and the potentially harmful decisions they make as a result of stretched finances have been well documented in our own and others' studies [45, 59–62]. The free care provided by MSF clearly alleviated much of the NCD-related financial burden affecting their current cohort. However, while we acknowledge the high cost of delivering NCD care, MSF may consider approaches to increase coverage by decentralising aspects of care to the community level, or, indeed, by attempting to address, where possible, some of the socio-politically induced daily stressors, experienced by Syrian refugees and vulnerable Jordanians in Jordan.. Further prospective research is required to design and evaluate culturally relevant approaches to integrating physical and psychological NCD care in humanitarian settings, We advocate taking a holistic approach, addressing NCDs from both health and social policy perspectives and engaging patients in the process from the outset.

Limitations

Patient participants' lack of awareness of the MHPSS service prior to interview meant that no conclusions about the patient experience of the actual service could be drawn. As a result, the findings are predominantly characterised by patient preconceptions of what the service might entail and descriptions of their help seeking behaviour. An alternative sampling strategy could have been to purposively sample from users of the MHPSS service, but could have risked masking the wider lack of awareness about the MHPSS service. As the focus of the interviews was on broader programme implementation, using the RE-AIM framework, and not solely on mental health, we did not focus the entire interview on participants' mental health concerns. However, the framework provided enough flexibility to capture themes related to mental health and the broader socio-political humanitarian environment and served to highlight the importance participants placed on mental health in relation to their NCD management. A greater number of interviews could potentially have been performed but it was felt that theoretical saturation was achieved in relation to our key themes.

Conclusions

The findings of this study suggest that humanitarian actors must better anticipate mental health needs when designing programmes for patients with NCDs. Furthermore, healthcare providers must examine local perspectives and needs in relation to psychosocial issues and co-design effective, person-centred approaches that are culturally relevant, drawing on pre-existing coping mechanisms and that are acceptable and accessible to both providers and patients.

Supplementary information

Supplementary information accompanies this paper at https://doi.org/10.1186/s13031-020-00309-6.

Additional file 1.
Additional file 2.
Additional file 3.
Additional file 4.

Abbreviations

CBT: Cognitive Behavioural Therapy; DM: Diabetes Mellitus; HTN: Hypertension; MSF: Médecins sans Frontières; MHPSS : Mental Health & Psychosocial Support Network; NCDs: Non-Communicable Diseases; NGOs: Non-Governmental Organisations; RE-AIM: Reach, Effectiveness, Adoption, Implementation and Maintenance; UNHCR: United Nations High Commissioner for Refugees; WHO: World Health Organization

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Authors' contributions

EA, KJ, MT, PP and BR conceived of and designed the work. SE and EA collected the data. LM and EA analysed the data and drafted the work, with LM, EA and BR substantially revising it. All authors read and reviewed the final manuscript. The authors read and approved the final manuscript.

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Availability of data and materials
The datasets generated and/or analysed during the current study are not publicly available in order to protect participant confidentiality but are available from the corresponding author, with the consent of Médecins sans Frontières, and on reasonable request.

Ethics approval and consent to participate
Approval for the conduct of this study was granted by the Jordanian Ministry of Health, London School of Hygiene and Tropical Medicine Ethics Review Committee (approval number: 15868) and by the Médecins sans Frontières Ethics Review Board. All participants gave informed, written consent to particpate in this study.

Consent for publication
Not applicable.

Competing interests
EA undertook this work as part of a research fellowship funded by Médecins sans Frontières. The other authors declare that they have no competing interests.

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Publisher's Note

Appendix 1: Coding Tree

Theme	Category	Codes
Displacement	Circumstances in Jordan	Safety in Jordan
		Settling in Jordan and impact on health
Mental Health	Seeking help from mental health services	Unaware of the service
		'Normal to be anxious'
		Mental health as a private matter
		Expected solutions to their distress
		Stigma
	Mental health of the Community	High burden of psychological distress in the community
		Sources of distress
		Coping and support
		Hopelessness and fear for the future
		(Suicidality and gender-based violence)
Physical Health	Interaction between mental health and physical health	Interconnectedness in explanatory model
		Being unable to engage in NCD care due to psychological distress
		Burden of psychological distress on patients and impact on NCD care

Appendix 2: Language describing mental health

There was some consistency in the language used to describe distress. Anger, tiredness and pressure were all similar language to that recorded by Hassan. However, the authors were unable to assess the consistency of the translation from the original Arabic transcripts. At times, participants could also be seen to be responding to questions by using the same language as the interviewer.

Anger	'*I can be angry maybe 20 times if I face something, I will get angry so these things can't be accepted'* *'We are humans and we can't stop getting mad'*
Comfortable or unable to be comfortable	*'we are psychologically comfortable here'* *'we do not feel comfortable in our situation, and our country situation'* *'but for us here in Jordan we feel comfortable'* *'But I can't be comfortable but I have to be part of it'* *'nobody is comfortable'*
Tired	'*I'm tired and mentally exhausted… we are all tired as Syrians'* *'I really felt tired the most when I came to Jordan because I had no work. I didn't feel tired but when I came to Jordan and didn't do anything, I started to feel tired'*
Life is not worth living or wanting to die	'*I don't like this life. I would like to die and get rid of it… Every time I come here, they advise me to take care of yourself and I always tell them to die is better for me'*
Pressure	'there is so much pressure.. I mean the simplest thing is what we faced, it was not easy.'
Anxiety and somatisation	'my stomach pain caused by anxiety' 'when I am upset I have trembles in my body'

Paper 4: Delivering a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: a descriptive costing study.

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Primary Supervisor	Professor Pablo Perel		

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Delivering a primary-level non-communicable disease programme for Syrian refugees and the host population in Jordan: a descriptive costing study

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Abstract

The Syrian conflict has caused enormous displacement of a population with a high non-communicable disease (NCD) burden into surrounding countries, overwhelming health systems' NCD care capacity. Médecins sans Frontières (MSF) developed a primary-level NCD programme, serving Syrian refugees and the host population in Irbid, Jordan, to assist the response. Cost data, which are currently lacking, may support programme adaptation and system scale up of such NCD services. This descriptive costing study from the provider perspective explored financial costs of the MSF NCD programme. We estimated annual total, per patient and per consultation costs for 2015–17 using a combined ingredients-based and step-down allocation approach. Data were collected via programme budgets, facility records, direct observation and informal interviews. Scenario analyses explored the impact of varying procurement processes, consultation frequency and task sharing. Total annual programme cost ranged from 4 to 6 million International Dollars (INT$), increasing annually from INT$4 206 481 (2015) to INT$6 739 438 (2017), with costs driven mainly by human resources and drugs. Per patient per year cost increased 23% from INT$1424 (2015) to 1751 (2016), and by 9% to 1904 (2017), while cost per consultation increased from INT$209 to 253 (2015–17). Annual cost increases reflected growing patient load and increasing service complexity throughout 2015–17. A scenario importing all medications cut total costs by 31%, while negotiating importation of high-cost items offered 13% savings. Leveraging pooled procurement for local purchasing could save 20%. Staff costs were more sensitive to reducing clinical review frequency than to task sharing review to nurses. Over 1000 extra patients could be enrolled without additional staffing cost if care delivery was restructured. Total costs significantly exceeded costs reported for NCD care in low-income humanitarian contexts. Efficiencies gained by revising procurement and/or restructuring consultation models could confer cost savings or facilitate cohort expansion. Cost effectiveness studies of adapted models are recommended.

Keywords: Non-communicable disease, diabetes, hypertension, cardiovascular disease, humanitarian, conflict, cost, economic analysis, refugee, Syria, Jordan, programme

Key Messages

- Non-communicable disease (NCD) care is assumed to be expensive but studies of the costs of delivering primary-level NCD care are lacking in humanitarian settings and in low- and middle-income countries more broadly.
- This descriptive analysis of NCD care delivered in a humanitarian setting found that per patient per year cost ranged from INT$1424 to 1904, while cost per consultation ranged from INT$209 to 253.
- Costs were primarily driven by recurrent costs, especially drug and human resource costs, which increased in line with increasing programme complexity.
- Efficiency may be gained through adopting context-adapted drug procurement practices and via human resource redistribution.

Background

Non-communicable diseases (NCDs) have been responsible for the majority of deaths worldwide for more than three decades, causing 71% (or 40.5 million) of the 56.9 million global deaths in 2016 (World Health Organization, 2018). NCDs accounted for 77% of mortality in pre-conflict Syria, led by cardiovascular disease (CVD; WHO, 2011). Following the prolonged conflict in Syria, now in its ninth year, almost 6.6 million refugees have fled, mainly into neighbouring countries; 670 000 refugees registered with the United Nations High Commissioner for Refugees (UNHCR) fled to Jordan. Irbid, Jordan's second largest city, hosts over 165 000 refugees, the largest concentration after Amman (UNHCR, 2018a). Most live in urban settings, amongst the host community (UNHCR, 2018a). Previous studies confirmed the high burden of NCDs amongst Syrian refugees in Jordan (Doocy *et al.*, 2015, 2016) and Jordan's public health system has been challenged to respond to this additional burden. Chronic diseases have traditionally been the remit of secondary and tertiary care in Jordan but national policy has more recently sought to increase primary care NCD capacity. Meanwhile, the humanitarian health system has supported the public health system response, adapting traditional camp-based care provision to serve urban-dwelling refugees (UNHCR *et al.*, 2014; UNHCR, 2018b; Akik *et al.*, 2019).

Médecins sans Frontières (MSF), a humanitarian medical organisation, supported the Jordanian health system in providing primary-level NCD care to Syrian refugees and the vulnerable host population in Irbid since 2014. Their programme involved a multidisciplinary primary care model, which used context-adapted clinical guidelines; medications from the World Health Organization (WHO) Essential Medicines list; and task sharing, whereby tasks are redistributed to optimise staff and skill allocation. The service evolved to include specific mental health and psychosocial support (MHPSS) and a humanitarian support worker, who linked refugees to available social and protection services.

While there is a wealth of evidence on cost-effective, primary care-based clinical management of NCDs in stable high-income countries, there is limited evidence to guide the delivery of such interventions in low- and middle-income countries (LMICs), particularly for conflict-affected and forcibly displaced populations. The MSF institutional experience regarding NCD programming in humanitarian settings is equally limited (Miranda *et al.*, 2008; Ebrahim *et al.*, 2013).

Moreover, there has been limited focus on economic evaluations of health intervention in humanitarian crises (Makhani *et al.*, 2020). The sparse evidence on costs of NCD care from a patient perspective in humanitarian settings has largely been derived from self-reported household surveys rather than formal costing analyses. In Jordan, household surveys of urban-based Syrian refugees reported cost as the main barrier to accessing care for their NCDs (Doocy *et al.*, 2015; Rehr *et al.*, 2018). MSF provided free NCD consultations, medications and investigations; but patient accounts recorded as part of a programme evaluation corroborated the cost barriers faced when seeking NCD care for NCD conditions not covered by MSF or for specialist referral. Transport was reported as a barrier to accessing NCD care in several surveys, but MSF patients were reportedly willing to pay transport costs in order to access free care (Doocy *et al.*, 2015).

In addition, little is known about the costs from the *provider perspective* of delivering NCD care in humanitarian settings. Broad commentary on the expensive nature of NCD care has highlighted the perceived high cost of life-long and potentially complex management, and the immense strain placed on national healthcare systems by the influx of refugee populations with a high NCD burden (Spiegel *et al.*, 2010; UNHCR, 2014, 2015; Slama *et al.*, 2017; Boulle *et al.*, 2019). UNHCR has sought to address this by supporting NCD care at primary level and by exploring health insurance schemes for refugees (Guterres and Spiegel, 2012; UNHCR, 2014). To our knowledge, no costing studies describing provider or patient costs of NCD care in humanitarian settings have been published to date (Bischoff *et al.*, 2009; Spiegel, 2010; Spiegel *et al.*, 2010, 2014; Guterres and Spiegel, 2012; Demaio *et al.*, 2013; Jobanputra *et al.*, 2016; Slama *et al.*, 2017).

Limited available studies have focused on the high cost of statins to patients in the Eastern Mediterranean and its likely negative impact on adherence (Isma'eel *et al.*, 2012; UNRWA, 2018). Costing studies of NCD care in both LMICs and high-income countries point to drugs as high drivers of costs at community level (American Diabetes Association, 2013; Subramanian *et al.*, 2018), while the MSF experience across various settings confirms that human resources (HR) and medications tend to be the most expensive components of any programme. While there is a growing body of literature on market shaping strategies to contain rising healthcare costs, such as regional- or disease-specific pooled procurement mechanisms, there is little available evidence on the procurement practices of international non-governmental organisations (NGOs) (Huff-Rousselle and Burnett, 1996; WHO, 2007; Ewen *et al.*, 2014; USAID, 2014; Seidman and Atun, 2017; The Global Fund, 2017). This area may warrant exploration as these organisations engage further in the provision of chronic NCD care.

To contribute to evidence guiding humanitarian actors in tackling NCDs in complex settings, MSF undertook a mixed methods

evaluation of the NCD programme in Irbid, north Jordan. Using the *RE-AIM* framework, we examined the programme's Reach, Effectiveness, Adoption (and acceptance) by patients and staff, and its Implementation and Maintenance over time, including the costs and fidelity of implementation. (Glasgow *et al.*, 2019). This article presents the costing component, describing the annual financial costs and major drivers of cost from the provider perspective. We also present sensitivity and scenario analyses performed around the major cost drivers (drug procurement and staffing) to explore optimisation of financial resources. Such data may help humanitarian organisations and other healthcare providers to design or adapt cost-effective interventions, and may have implications for the broader Jordanian health system response and scale up of primary-level NCD care.

Methods

Study context and intervention

MSF developed an NCD service for Syrian refugees and vulnerable members of the Jordanian host population at a Ministry of Health primary care clinic in Irbid in December 2014. Due to space limitations, a second city-centre site was opened within a local NGO clinic in April 2015. Both sites provided the same vertical services, i.e. they were not integrated into pre-existing activities at either site. They had the same staffing makeup, covered the same catchment area and shared the same management, training and supervision teams. In fact, both sites were amalgamated in 2019. By the end of the study period (the end of December 2017), 5045 patients had been enrolled; 30% were Jordanian, in keeping with government requirements.

The programme focused on NCDs and NCD risk factors responsible for the greatest mortality in pre-war Syria: hypertension, established CVD (angina, myocardial infarction, ischaemic stroke, transient ischaemic attack, peripheral vascular disease, congestive heart failure), diabetes types I and II, asthma and chronic obstructive pulmonary disease (COPD). It targeted those with pre-established relevant diagnoses or with new diagnoses made by MSF or referring services. Cancer care was excluded. MSF screened patients for other target NCDs and engaged in primary/secondary prevention via cardiovascular risk management, offering healthy living advice and drug therapy as appropriate. Among patients active by the end of 2017, ~67% had hypertension, 60% had diabetes type II, 24% had CVD, 6% had asthma, 4% had diabetes type I and 2% had COPD, while over 70% had two or more target NCDs (internal MSF data).

Clinic-based care was initially provided by generalist doctors with the support of nurses, a health educator, a pharmacist and reception staff. In 2015, the service evolved with the addition of a family medicine specialist at each site and a home visit service with a dedicated doctor, nurse and driver. The home visit service was expanded and MHPSS counsellors and a humanitarian liaison officer were added in 2016, followed by a physiotherapist in 2017. Clinical staff were supported by an MSF project team in Irbid and a coordination team, including an epidemiologist, in Amman. Both included national and international administrative, logistical, management and clinical supervisory staff. The programme guidance stated that patients with uncontrolled disease should attend consultations monthly until stabilised and 3-monthly thereafter. Doctors performed most consultations. Task sharing to nurses of review appointments for stable patients was introduced in 2016, but nurses were performing only 6% of follow-up consultations by the end of 2017. Doctors continued to manage prescribing since nurses were not permitted to initiate or adjust medications by Jordanian law. Referrals were not funded by MSF and were excluded from cost calculations. Emergency cases were referred to the Jordanian public health service. Non-urgent referrals (most frequently ophthalmology, cardiology and nephrology) were made to public, private or other humanitarian providers. Referral patterns varied greatly over time as the availability of services, e.g. NGO-provided cardiac catheterisation, depended on short donor funding cycles. MSF capped the total cohort size at ~4000 active patients to contain costs.

In many MSF settings, medications and supplies are imported via European-based procurement units e.g. Amsterdam Procurement Unit (APU). These command great purchasing power and can obtain NCD medications at competitive prices. Jordanian regulation, however, required international NGOs to purchase from the local market. MSF approved a number of Jordanian wholesale suppliers, which met MSF's strict quality control criteria (MSF, 2016). Three MSF operational centres (Amsterdam, Paris and Barcelona) active in Jordan at the time of the study each procured medications separately, typically in 3–6 monthly order cycles. For drugs unavailable locally or with an excessive lead time, importation exceptions could potentially be granted by the Jordan Food and Drug Administration (Karir *et al.*, 2018).

Cost analysis

This retrospective costing study was undertaken from the provider perspective, considering MSF as the provider. We used a combination of standard step-down and ingredients-based costing approaches, previously used in economic evaluations of health interventions in LMIC settings (Creese and Parker, 1994; UNAIDS, 2000; Terris-Prestholt *et al.*, 2010; Sweeney *et al.*, 2014). Given the detailed expenditure data available from MSF, we principally used step-down costing. This allocates overhead costs or resources in a step-wise fashion to all overhead departments and then to final cost centres (a unit that produces output and has a record of resource consumption, in this case, a clinical consultation) (Pavignani and Colombo, 2009). Ingredients-based costing requires the identification and specification of each resource component or input, used for delivering an individual service and the unit cost of each in order to calculate a total endpoint cost. In this case, we estimated how many minutes staff spent with patients during consultations, the time taken for supervision and on-job training and we utilised drug consumption data and unit costs.

Annual financial costs, i.e. those costs resulting from actual expenditure on goods and services, were calculated for the study period 2015–17. Economic costs (costs used by a programme that could have been productively used elsewhere) were not calculated, as there was no volunteer time or donated items, and the analysis took into account all resources used in delivering the programme. Thus, economic and financial costs would have been very similar.

Data collection and management

A project timeline was developed with input from management staff. Information relating to the nature, location and mode of delivery of the NCD services was collected during a field visit in August 2017 by the lead investigator and was supplemented by informal interviews with medical supervisory staff. A data analysis tool was designed to collate and calculate the relevant financial costs by cost centre. Cost data were collected for the study period from the management and drug supply chain, including itemised annual expenditure data (Supplementary File S1).

Table 1 Overview of clinic outputs (number of active patients and consultations)

Year	2015	2016	2017
Total number of active patients at end of year (% increase from previous year)	2954	3656 (+24%)	3540 (−3%)
Number of consultations per year (% increase from previous year)	20 130	25 912 (+29%)	26 592 (+2%)

Note: The number of active patients and consultations increased as the clinic expanded to a second site to increase the service capacity. There was little change from 2016 to 2017 as the number of active patients was capped for operational reasons.

Costs were categorised by service level (coordination, project and clinic level) and by programme output (Table 1). Overheads incurred at coordination level were allocated using a factor of 30%, derived from the mean estimate of the time coordination staff devoted to the Irbid NCD programme. Overheads from project and clinic level were allocated at 100%.

Coordination-level costs, involving the management team in Amman, were categorised into (1) capital, (2) recurrent (other than HR) and (3) HR costs. Project-level costs, involving the management team with administration and supervision functions in Irbid, and clinic-level costs, involving the combined costs of delivering clinical care at both clinic sites, were also classified into capital and recurrent costs and coded into specific categories. Specific start-up costs were not included. We considered that there were no administrative start-up costs since the pre-existing coordination team in Amman already had structures and supply chains in place. At project level, there was a 4-month lead-in period, involving the international team setting up the service and starting to enroll patients while gradually recruiting national staff. Costs incurred during this period were included as capital and recurrent costs, as appropriate.

Capital costs included building works and purchase of biomedical equipment, office equipment, furnishings and vehicles whose nominal cost was >100 Euro (Creese and Parker, 1994). Capital costs were annualised using straight-line depreciation and given a lifespan of 20 years for building, 5 years for vehicles and 3 years for equipment (Creese and Parker, 1994).

Recurrent costs included HR (contracted staff salaries and insurance; temporary workers' fees; experts' visits); logistics (building rent, maintenance and operation; office supplies and furnishings); vehicle maintenance and operation; biomedical equipment and consumables; external laboratory costs; and drugs. *Ad hoc* training of clinical and administrative staff was included as a HR cost and was generally delivered by MSF supervisory staff and/or visiting experts from headquarters (Supplementary File S1). There was no formal start-up or refresher training. International staff salary, per diem and travel costs were attributed to the project personnel budget; international staff accommodation costs were attributed to project-level logistics costs. The MSF salary scales, activity data (e.g. operational reports) and discussion with management and clinical staff were used to understand costs regarding HR and activities.

Drug costs were analysed as a separate input, as they were anticipated to be a major driver of cost and thus a focus of sensitivity and scenario analyses. We used drug purchase inventories, clinic-level consumption data, average unit purchase prices provided by the MSF logistic team (available for 2016 and 2017 only) and the MSF standard procurement list of drug prices, the 'Green List'. For 2016 and 2017, missing prices were substituted with the other year's price, after appropriate inflation or deflation; deflated 2016 prices were used to calculate 2015 drug costs. Items categorised as drugs included medications and drug delivery systems dispensed to patients (e.g. spacer devices, glucometers, lancets, glucometer strips, insulin needles).

Descriptive cost analysis

Data were analysed in Microsoft Excel. Costs were incurred in both Jordanian Dinar (JOD) and Euro (for non-drug items imported via APU and international staff costs). They were inflated to the base year 2017 and then converted to International Dollars (INT$) by dividing JOD by the general purchasing power parity (PPP) rate of 0.32 and Euro by 0.747 (OECD/Eurostat, 2012; OECD, 2017; World Bank 2018). The PPP index is recommended for comparing costs across countries as it adjusts for differences in relative prices between economies (Kanavos and Mossialos, 1999). The total annual cost of NCD clinical care was calculated for each year (2015, 2016 and 2017) by adding the allocated capital and recurrent costs incurred at clinic, project and coordination level. Major cost drivers were identified. Annual total drug cost and cost per drug were calculated. Endpoint costs were expressed as cost per patient active at the end of each year, and cost per consultation per year (using 'total annual new and follow up medical consultations per year' as the denominator).

Scenario analyses

Multifactorial scenario analyses were performed around drug and personnel costs, the key drivers of total cost, to explore areas where greater cost efficiency might be gained. All were performed around 2017 base case costs.

We explored three hypothetical drug cost scenarios. The first involved importing all medications and related equipment from Europe via the APU, since this reflects the practice of MSF programmes in most other settings. We acknowledge its limited feasibility given strict regulation and import restrictions in Jordan (Supplementary File S2). Using the MSF Green list, specific items on the Irbid project medication list were substituted with clinically equivalent alternatives, and, in cases where multiple formulations were used in Irbid but only a single formulation was available from APU, we proposed purchasing the equivalent number of milligrams consumed in 2017 from APU (Supplementary File S3). The second, more feasible scenario, involved MSF negotiating the right to import a limited number of high-cost items. Focusing on the programme's 20 most costly drug items (Supplementary File S4), we considered importing only items whose exact formulations were available from APU ($n = 10$). In both importation scenarios, 16% was added to cover international and national transport, taxes, import fees and storage costs (including cold chain, cargo release fees and rent of port storage), based on MSF logistics data and expert opinion (Karir *et al.*, 2018). A sensitivity analysis was performed to examine the impact of applying a minimum of 5% and maximum of 40% to this handling charge, using figures based on MSF expert opinion. The third, and likely most feasible, scenario involved leveraging potential purchasing power to negotiate competitive pricing with local suppliers. We estimated that a 20% price reduction could be achieved by: (1) joining with other MSF operating sections active in Jordan; (2) reducing order cycles to 6-monthly; and (3) working with a reduced number of suppliers.

Additional scenario analyses determined the impact on clinical staff salary costs of redistributing consultation activity among

medical and nursing staff. These involved varying: (1) the proportion of follow-up consultations for stable patients that were task-shared to nurses from 6% (the level in December 2017) to 100%; (2) the proportion of the cohort classified as 'stable' from 60% (based on 2017 cohort data analysis) to 70% or 80%; (3) the size of the active cohort from 3540 (total active patients at the close of 2017) to a maximum of 5000. We did not assess the impact on *total* cost of increasing cohort size (i.e. the cost implications of purchasing and dispensing more medications). Each of the additional scenarios used the review frequency recommended in MSF guidelines: patients achieving clinical control were reviewed 3-monthly (4 times per year); new and uncontrolled patients were reviewed monthly (12 times per year). Based on data from other MSF NCD programmes, we assumed doctors reviewed all new and uncontrolled patients, while nurses performed consultations for controlled patients, referring an estimated 10% back for doctor review (Ansbro, 2018). Since nurses in Jordan are not permitted to initiate or adjust medications, we assumed 90% of patients reviewed by nurses remained stable and continued the same doctor-prescribed medication regime.

The Ethics Review Committee (Reference 12239) and the Ethics Review Board of the authors' institutes granted ethical approval for the conduct of this study.

Results

The total annual financial cost of the MSF Irbid NCD programme was 4–6 million INT$ with the absolute value increasing annually by 52% from INT$4 206 481 in 2015 to INT$6 400 611 in 2016 and by a further 5% to INT$6 739 438 in 2017 (Table 2). The large increase from 2015 to 2016 partly reflects the increasing number of patients enrolled during that period, facilitated by the addition of a second clinic site (Table 1).

The main cost drivers each year were drugs (38.4–47.0%) and HR (35.1–37.9%). Together, these accounted for 73.6–83.4% of total expenditure (Table 2). Most costs were recurrent (98.4–98.8%). Most cost categories accounted for a similar proportion of annual expenditure across years, although drug costs increased by 9% from 2015 to 2016. As expected, the majority of biomedical equipment expenditure occurred in the first year of operation, accounting for 6.4% of total costs in 2015 but only 0.1% in 2016 and 2017. The top 20 most costly medication and related equipment items are presented in Supplementary File S2. The most expensive item was Mixtard insulin, accounting for 14% of the total drug budget. Underlying data (Supplementary File S2) show that insulin products and related equipment accounted for 34% of the total drug budget while statins contributed 15% and inhalers and spacers 8%.

The per patient per year (PPPY) cost increased by 23% from 2015 to 2016 (INT$1424 to $1751). PPPY increased by a further 9% to INT$1904 in 2017 (Table 2). Similarly, the cost per consultation increased by 18% from 2015 to 2016 (INT$209 to INT$247) and by a further 3% to INT$253 in 2017.

The majority of costs were incurred at clinic level (75.2–77.2% of total costs each year), while field and coordination level costs accounted for a much lower proportion (14.8–17.4% and 5.6–8.1%, respectively) (Figure 1 and Supplementary File S5). Salaries,

Table 2 Annual cost per cost category and endpoint costs for Irbid NCD Programme for 2015, 2016 and 2017

Year of programme		2015		2016		2017	
Type of cost		INT$[a]	Annual total (%)	INT$	Annual total (%)	INT$	Annual total (%)
Capital costs	Coordination-level capital investment[b]	2872	0.1	8029	0.1	10 160	0.2
	Clinical equipment and drug storage	22 883	0.5	29 105	0.5	33 447	0.5
	Building work and furnishings[c]	22 852	0.5	31 069	0.5	30 961	0.5
	Vehicle purchase[d]	0	0.0	32 166	0.5	32 166	0.5
	Total capital	48 606	1.2	100 369	1.6	106 733	1.6
Recurrent costs	Coordination costs (excl. HR[e])	102 815	2.4	85 514	1.3	150 485	2.2
	Drugs	1 615 967	38.4	3 008 539	47.0	3 049 381	45.3
	Laboratory	360 054	8.6	478 186	7.5	445 169	6.6
	Biomedical equipment[f]	270 516	6.4	7272	0.1	6177	0.1
	Building rent, maintenance, utilities	260 254	6.2	313 152	4.9	370 681	5.5
	Recurrent transport costs[g]	65 379	1.6	129 515	2.0	40 076	0.6
	Staff costs including expert visit	1 477 885	35.1	2 269 379	35.5	2 553 894	37.9
	Human resources training	5006	0.1	8684	0.1	16 841	0.2
	Total recurrent	4 157 874	98.8	6 300 242	98.4	6 632 704	98.4
Total annual costs		4 206 481		6 400 611		6 739 438	
Endpoint costs							
Cost per patient per year[h]		1424		1751		1904	
Cost per consultation[i]		209		247		253	

[a]Costs are presented in 2017 International Dollars (using PPP to convert JOD and Euro nominal costs into INT$).

[b]Coordination capital investment includes purchase of office furnishings, IT equipment and vehicles; some remodelling work on the rented office in Amman.

[c]Building work and furnishings includes office furnishings, IT equipment and other large items, furniture, large building work costs for the project office and both clinic sites in Irbid.

[d]Vehicle purchase at project level.

[e] Includes all recurrent costs at coordination level (building rent, maintenance, transport, etc.) except for human resources (included in the human resources category).

[f]Recurrent biomedical equipment used in clinic, e.g. swabs, gloves, glucometer strips.

[g]Recurrent transport costs: vehicle operation and maintenance, fuel, taxi hire (other than to the international airport, which is included as an international staff cost).

[h]Cost per patient per year: based on total annual cost divided by total active number of patients at end of relevant year (see Table 1).

[i]Cost per consultation: based on total annual cost divided by total new plus follow-up medical consultations per year. It excludes individual health education or mental health sessions and group sessions.

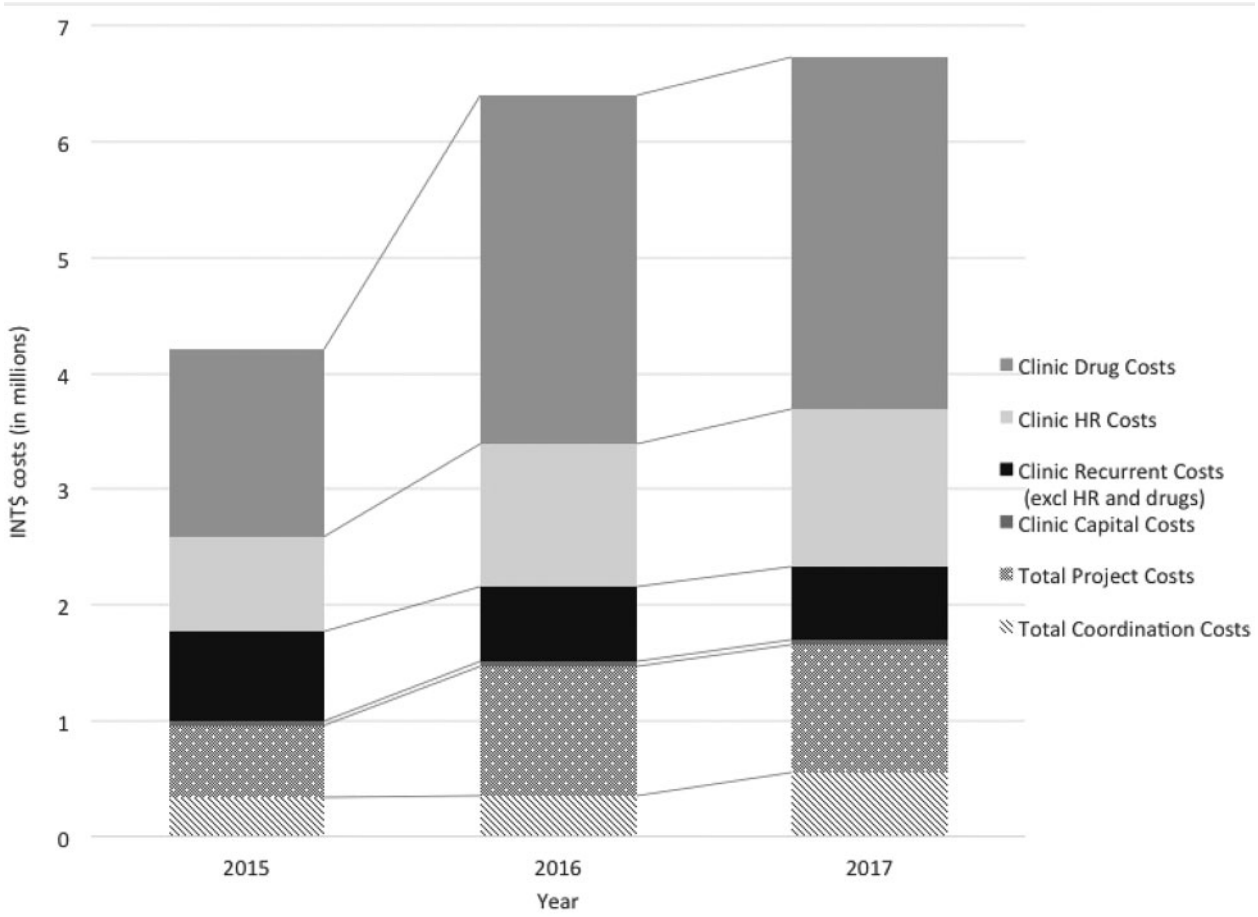

Figure 1 Annual cost per cost level for Irbid NCD Programme for 2015, 2016 and 2017, in International dollars.

Table 3 Scenario analyses exploring options to reduce drug costs (INT$2017)[a]

	Base case (2017) (Table 2)	Scenario 1			Scenario 2			Scenario 3
		Import all drugs from Amsterdam Procurement Unit with various associated import costs (%)			Import 10 of most costly drugs items, available from MSF Essential Drugs List, with associated import costs (%)			Pooled procurement scenario[b]
		Min. (5%)	Expected (16%)	Max. (40%)	Min. (5%)	Expected (16%)	Max. (40%)	
Drug costs	3 049 381	870 845	962 076	1 161 127	2 116 757	2 155 316	2 239 444	2 439 505
Non-drug costs	3 688 844	3 688 844	3 688 844	3 688 844	3 688 844	3 688 844	3 688 844	3 688 844
Total annual cost	6 739 438	4 559 689	4 650 920	4 849 971	5 805 601	5 844 160	5 928 288	6 128 349
% Change vs base	0	−32%	−31%	−28%	−14%	−13%	−12%	−9%

[a]Costs are presented in 2017 International Dollars (using PPP to convert JOD and Euro nominal costs into INT$).

[b]The pooled procurement scenario involved pooling with other MSF sections active in Jordan, reducing the number of suppliers and reducing frequency of order cycles to 6-monthly.

insurance and other costs required when employing Jordanian staff accounted for a fifth of the total budget.

Table 3 presents several scenarios exploring alternative drug procurement arrangements. Scenario 1 outlines a hypothetical situation importing all medications and relevant equipment from the APU, which reflects the procurement model of many MSF programmes in other contexts. The total drug cost using this scenario was INT$962 076 (range: 870 845–1 161 127), representing a 68% saving on the base-case drug cost (62% at maximum import costs) or 31% of total costs.

Scenario 2 reflects a more realistic possibility for this specific context, whereby MSF would negotiate permission to import 10 of the top 20 most costly drug items. Significant savings of 29% of drug costs vs the base case (INT$894 065 or 13% of total costs) were still possible with this scenario, and were largely retained (27%; INT$809 937) at our estimated maximum import cost. For Scenario 3 we estimated, based on local expert opinion, that savings of 20% could be made compared with the local purchase prices obtained in 2017. This would result in potential savings of 9% of total programme costs.

Table 4 Scenario analysis varying work pattern and patient load

Variables	Base case	Scenarios			
	Current patient load and staffing	Scenario 1 Task sharing	Scenario 2 Task sharing with 70% controlled	Scenario 3 Task sharing with 70% controlled & cohort of 4500	Scenario 4 Task sharing 80% controlled and cohort of 5000
Cohort size	3540[a]	3540	3540	4500	5000
Proportion at clinical control	60%[b]	60%	70%	70%	80%
Specialist doctors[c]	2	1	1	1	1
Non-specialist doctors[c,d]	2	2.5	1.5	2	2.5
Nurses[c]	0.2	1.5	2	2.2[e]	2.8
Total annual salary cost[f] (INT$ 2017)	307 528	288 208	246 376	311 387	302 457
% Change in cost vs base case	n/a	−6.3	−19.9	+1.3	−1.6

[a]Total number of active patients at end of 2017.

[b]Proportion of active cohort that is stable based on cohort analysis.

[c]Full-time equivalent.

[d]Figures rounded up to the nearest 0.5 of FTE.

[e]This scenario allowed for the dedication of an additional 0.2 FTE nurses to consultations vs Scenario B, who could be redeployed from other activities, such as triage and patient education.

[f]Annual total salary costs of doctors and nurses required to perform new and follow-up medical consultations.

Scenario analyses varying factors affecting work pattern are displayed in Table 4 (see also Supplementary File S6). The base case described patient load (3540 active patients) and staffing patterns as of the end of 2017, using salaries of currently employed doctors (two specialists and two non-specialists) and nursing time required for follow-up consultations of stable patients at 2017 rates (6%).

Scenario 1 described the implications of adhering to guideline review intervals for the current cohort, categorising 60% as controlled. In this case, assuming only one specialist doctor was employed to manage the especially complex patients, 3.5 FTE (full-time equivalent) doctors and 1.5 FTE nurses were required, resulting in savings of 6.3% of clinical staff costs. Scenario 2 assumed all Scenario 1 parameters remained, but the proportion of controlled patients was increased to 70%, shifting more patients to 3-monthly nurse-led appointments. Thus, one FTE non-specialist doctor could be removed, while 0.5 FTE nursing time was added, resulting in clinical staff cost savings of 19.9% (INT$41 822). Scenario 3 proposed that the cohort could be increased by 1000 for almost the same cost as the base case (INT$311 387 vs 307 528) using the conditions of Scenario 2. Scenario 4 suggested that if the control rate could be increased to 80%, thereby shifting even more patients to 3-monthly nurse-led reviews, an almost 1500 extra patients could be added to the cohort for a slightly lower clinical salary cost than current base-case cost (−1.6%; INT$302 457 vs 307 528). Thus, clinical salary costs were most sensitive to the assumption that 70% of patients were achieving clinical control and were reviewed by a nurse on a 3-monthly basis. Clinical salary cost savings could be made with a similar sized cohort or, as in Scenarios 3 and 4, the cohort could be increased at a salary cost similar to the current 2017 base-case cost. Note, in these scenarios, we did not include the increased cost of drugs that would be incurred if the cohort size was increased.

Discussion

To our knowledge, this is the first study to provide a detailed description of the costs of providing primary-level NCD care to Syrian refugees and the local population in the Middle East region, and one of the few to describe the costs of delivering NCD care in humanitarian settings globally. Our findings showed that total costs were primarily driven by drug and human resource costs and that most costs were incurred at the clinic level. Our scenario analyses indicated that the greatest cost efficiency could be gained by importing all medications from Europe, then by importing the top 10 most expensive items and, finally, by pooling procurement (in this case, between the various MSF operational centres). Less significant cost savings could be made through greater use of task shifting.

The total annual financial cost of delivering the MSF NCD programme in Irbid increased yearly from 2015 to 2017. This was due to increasing numbers of active patients over time but also to the delivery of a more complex programme requiring greater HR inputs. The year 2015 saw a gradual addition of staff and services, including the home visit service, the mental health service and additional counselling, pharmacy, medical and nursing staff (Ansbro, 2018). While a greater number of consultations was performed in 2017, they involved a smaller number of active patients, so fewer patients were seen more often, thereby reducing efficiency (Table 1).

From a cost structure perspective, costs other than drugs and HR contributed only one-fifth of the total. Of these, most were recurrent costs. Capital costs were minimal since MSF rented office and warehouse premises and space within pre-existing clinics.

Drugs were the major cost driver each year. As discussed, Jordan legislation requires NGOs to purchase drugs locally, unlike in many humanitarian contexts where NGOs can import drugs. The costs involved in insulin therapy (insulin, glucose reagent strips and lancets) featured prominently, despite insulin being prescribed at only 23% of visits in 2017. Atorvastatin accounted for 15% of the total drug budget in 2017, despite potential under-prescribing (only 25% of eligible patients were actually prescribed it) (Ansbro, 2018).

The majority of costs were incurred at clinic level, since the drug budget and clinical staff costs were allocated to this level. The costs associated with the highly qualified Jordanian medical, paramedical and support staff (salaries, insurance, medical costs) contributed approximately two-thirds of the HR budget. The total annual cost could be reduced by almost 25% (INT$1 657 960 in 2017) if the costs of MSF's operational, logistical and medical supervisory support at central and local level were removed, reflecting potential savings if such a service were scaled up within a public healthcare system.

According to our scenario analyses, the total annual drug cost would be reduced by over two-thirds if MSF were to import all drugs from Europe at MSF warehouse prices (including import

costs), potentially saving 31% (INT$2 087 305) of total programme costs. A more realistic scenario importing a limited number of costly items still resulted in drug cost savings of 12% of total costs. A 9% reduction in total costs (INT$609 876), obtained via the pooled procurement scenario, offered the least cost savings but may represent the most feasible option in the current regulatory environment.

Three pharmaceutical originator companies control 96% of the global insulin market. Significant work has been done to illuminate the global barriers and challenges in accessing affordable insulin (Beran *et al.*, 2016; Gotham *et al.*, 2018). Some humanitarian organisations have recently negotiated a reduced price per vial of human insulin from one originator company, which has introduced differential pricing for least developed countries, averaging 2.9 USD per vial in 2019 (Novo Nordisk, 2019). However, there is still significant advocacy and policy work to be done by WHO, humanitarian actors, governments, the research community and advocacy groups to address global disparities in insulin pricing and availability. In our analysis, underlying data show that MSF paid 9.81 JOD per vial in 2017 to local suppliers (30 INT$ using PPP or 13.83 USD using a direct currency conversion). Clearly, significant savings may be possible, either through negotiation with local insulin suppliers in Jordan or via importation. Echoing findings from other contexts, we also underline the significant additional costs associated with insulin therapy (glucometers, strips and lancets), which may also be amenable to negotiation with manufacturers or suppliers (Beran and Yudkin, 2010).

Our consultation delivery model scenario analyses demonstrated that these costs were more sensitive to frequency of patient review rather than to a change from doctor- to nurse-delivered consultations. As a greater proportion of patients were categorised as stable, incrementally greater cost efficiencies resulted, which could be translated into cost savings or to an expansion of the cohort within the same budget. Reducing review frequency of stable patients further still to 6-monthly would clearly result in further cost savings. These scenarios did not account for the time of other personnel directly involved in care delivery, such as pharmacists, health educators, triage nurses and reception staff, nor the increase in drug costs that would be incurred if the cohort size was increased (amounting to 861.41 INT$ annual per patient drug cost at 2017 base-case prices). Any reduction in HR costs, as demonstrated, would require significant restructuring of the programme, staff training and acceptance by patients, staff, within the local health system, legal and policy environment.

To our knowledge, there are no available published data to compare endpoint costs of primary-level NCD care delivery either in the Middle East region or in other humanitarian settings. Unpublished MSF data report *incremental* PPPY costs of INT$222 (2015) and INT$441 (2016), respectively, associated with adding diabetes care to pre-existing services in a chronic conflict setting in Mweso, Democratic Republic of Congo and with integrating NCD care with HIV and general outpatient services in Swaziland. However, comparisons must be made cautiously given different programme and procurement structures and local HR costs. A recent Kenyan study described patient-level direct annual costs of treatment for NCDs (hypertension, diabetes, asthma, COPD) at a quasi-public health facility (including data from MSF-Operational Centre Belgium Kibera Health Facility). Consultation fees, costs of medications and of admissions for acute exacerbations were included with total annual per patient costs ranging from $25.64 to $372.45 (USD 2015) (Subramanian *et al.*, 2018). The limited data on NCD care available from countries affected by the Syrian crisis focus on secondary- or tertiary-level care. A Turkish study showed that annual per patient cost for outpatient drugs and follow-up was 553.48 Lira (USD 121.38, 2015) for heart failure patients but the cost ingredients used were not reported (Aras *et al.*, 2016).

There are very limited available data to allow comparison of costs structures in the delivery of NCD care in LMIC or humanitarian settings. However, the unpublished MSF studies referred to above are consistent with this study in that HR and drugs accounted for the bulk of costs. The relatively high cost of insulin and related equipment has been found in previous studies. A review of medicine procurement processes and prices for drugs provided in UNRWA (United Nations Relief and Works Agency for Palestinian Refugees in the Near East) primary care clinics in 2010, prompted by budget constraints and the increasing demand for NCD drugs, underscored the high cost of anti-hypertensive and anti-diabetic medications, including insulin.

In the past, MSF and other humanitarian actors have tended to match their Essential Drug Lists to the WHO Essential Medications List and to set up parallel procurement systems, principally by importation from Europe and elsewhere. In addition, MSF has historically been less health system focused, and its exacting drug quality assurance (QA) standards can put it out of step with host country health systems. However, humanitarian NGOs, including MSF, increasingly provide services that are integrated within national health systems, especially in protracted crises. Thus, it may be more effective and ease procurement to match what is available in the local setting and to align with national health system procurement processes, especially when working in contexts with well-functioning health systems, such as the Middle East. Humanitarian NGOs may, therefore, need to modify their QA standards or to agree on a mutually acceptable QA approach with Ministries of Health. Furthermore, aligning with local prescribing practices, formulations and presentations (e.g. using individually boxed and branded medicines) may confer an added advantage in terms of acceptability to patients and local providers, as experience has shown that Syrian patients prefer to use drugs that are familiar to them (Ansbro, 2018; Garry *et al.*, 2018).

UNRWA procures most medications via central tender from prequalified suppliers (mostly located in Europe or the Middle East), while a minority of drugs are procured locally. In the review described earlier, UNRWA concluded that cost savings could be made through regular review of medication prices, competitive negotiation with a larger list of pre-qualified suppliers from a greater number of regions and via selective participation in Jordan's Joint Procurement Department or the Gulf Cooperation Council effective pooled procurement tender processes (Ewen *et al.*, 2014; Seidman and Atun, 2017). MSF has also recently undertaken an in-depth assessment of access and affordability of NCD medications in Jordan and the region, which this article drew on, and concluded that savings could be made through pooled procurement by all MSF operational centres present in Jordan, by negotiation with local suppliers and by selective importation of expensive items . Perhaps the key lesson is that, given the high costs of providing chronic NCD drugs, humanitarian actors should undertake analyses of the pharmaceutical supply sector and should incorporate context-specific approaches to cost-effective procurement when designing or adapting NCD services.

Limitations

This analysis did not examine direct costs from a patient perspective or indirect costs of NCDs in this population. Patient-level data were not examined in terms of service use. Each patient was treated the

same regardless of diagnosis, date of entry to the cohort, duration of follow-up or whether an active or defaulting patient. Thus, costs could not be disaggregated by type of NCD or number/type of comorbidities, which may be an area for future research. Human resource costs for cadres other than doctors were based on staff estimates, rather than on formal staff time observation, which may have reduced the accuracy of these estimates. We did not include costs of external referral, which are not paid by MSF. In addition, given the specific Irbid programme model, separate start-up costs were not included but internal MSF training and epidemiologist support were. Wastage was not factored into drug costs. Other actors would need to take these elements into account if planning a similar programme.

Our scenario analyses around drugs are specific to the Jordan drug market and regulatory environment and may not be generalisable. However, we have illustrated that cost savings may be made by adapting procurement strategies to the local market. The HR-related scenario analyses include assumptions based on the local context or on other humanitarian contexts and may need to be adapted as appropriate. Finally, choosing to present costs in INT$ using PPP inflates the nominal JOD cost by a factor of three. Thus, costs may appear greater than if presented using the direct currency conversion of 1.41.

We suggest that future research should focus on (i) cost analyses from the patient perspective; (ii) prospective studies exploring provider costs on a per patient rather than aggregate basis, and (iii) on patient adherence and beliefs about medicines. We echo other authors' suggestion that the WHO Regional Office for the Eastern Mediterranean would establish a regional procurement price database similar to that developed elsewhere (Ewen *et al.*, 2014).

Conclusion

Cost estimates regarding the delivery of primary-level NCD care in humanitarian settings, and in LMICs more broadly, are lacking. Our study indicates that efficiency may be gained through adopting context-adapted procurement practices and via human resource redistribution. Our costing estimates will inform humanitarian actors in adapting this programme and in planning future NCD programmes in similar contexts. They may also have broader implications for the Jordanian health system response to the Syrian crisis and may inform policy makers scaling up primary-level NCD care in resource-constrained or crisis settings elsewhere.

Supplementary data

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

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Appendix 1: Summary cost data

for the study period January 2015 to December 2017

Year of purchase	Type of cost	Level	Category	Description	Cost (JOD)	Cost (Euro)	Life expectancy / duration
2014	Capital	Clinic Level	Drug storage	Fridges and temp control	0.00	1552.39	3
		Project Level	Office equipment	Computers	0.00	2642.00	3
2015	Capital	Coordination Level	Office equipment	Furniture, office equipment, cold chain	24668.17	0	3
			Vehicle purchase & maintenance	Vehicle purchase and parts	233.56	0	5
		Project Level	Building and maintenance	Building construction and renovation	0	0	20
			Vehicle purchase & maintenance	Vehicle purchase and parts	0	0	5
			Furnishings	Chairs, desks, tables and filling cabinet, air con, fans, heating, curtains	9632.04	0	3
			Office supplies	Computers, media, routers, screens and printers, long life batteries, curtains, cables	364.00	5565	3
		Clinic Level	Building and maintenance	Construction and renovation	5806.00	0	20
			Furnishings	Chairs, examination table, file cabinet, extension cables, air con, fans, heating	6844.20	0	3
			Clinical equipment	BP cuff, stethoscope, otoscope, ECG machine, wheelchair, scale, spirometer, oxymeter, ophthalmoscope, defibrillator, cold chain	19348.50	2802.12	3
2015	Recurrent	Coordination Level	Coordination recurrent	All recurrent coordination activities (excluding HR)	0	75911.09	
			HR	HR costs	0	169689.79	
		Project Level	Training*	All costs associated with training, international and national staff	1543.44	0	
			Transport	All transport costs, except that directly associated with training	17203.55	2794.58	
			Office	All supplies for international staff house and office incl stationary, phones, clothes, utilities	17394.05	1579.31	
			Expert visit	Expert international visit	391.30	0.00	

			Staff costs	International staff costs - including relocation, per diem, medical costs, work permits	15037.68	105469.63	
				National staff salaries: domestic staff, coordination, admin, translator, logistics, driver, data operator	68822.34	0	
				Additional national staff costs: eg health insurance	3126.25	0	
			Building rent and maintenance	All building rental & maintenance costs – international staff house & office	18725.30	0	
		Clinic Level	Transport	Transporting patients only	1788.50	0	
			Drugs	All meds	494348.78	0.00	
			Biomedical equipment	Equipment used in clinic - e.g. swabs, gloves, glucometer strips	82753.12	1577.87	
			Lab	All lab tests (external)	111020.50	0	
			Office	Stationary and other supplies	5745.60	0	
			Building rent and maintenance	All building rental and maintenance costs - clinic	37723.40	0	
			Staff costs	National staff costs: eg health insurance	12500.01	0	
				Non-clinical salaries: registrar, health promotor, psychosocial	50079.09	0	
				Clinical salaries (pharmacists & assistants, nurses)	110716.82	0	
				Clinical salaries (doctors)	80110.62	0	
2016	Capital	Coordination Level	Office equipment	Furniture, office equipment, cold chain	55074.91		3
			Vehicle purchase & maintenance	Vehicle purchase and parts	126.41		5
		Project Level	Building and maintenance	Building construction and renovation	4118.00	0	20
			Vehicle purchase & maintenance	Vehicle purchase and parts	49200.00	0	5
			Furnishings	Chairs, desks, tables and filling cabinet, air con, fans, heating, curtains	2745.24	0	3
			Office supplies	Computers, media, routers, screens and printers, long life batteries, curtains, cables	706.00	6078.13	3
		Clinic Level	Building and maintenance	Construction and renovation	3300.00	0	20
			Furnishings	Chairs, examination table, file cabinet, extension cables, air con, fans, heating	464.98	0	3

			Clinical equipment	BP cuff, stethoscope, otoscope, ECG machine, wheelchair, scale, spirometer, oximeter, ophthalmoscope, defibrillator, cold chain	3570.96	5176.14	3
2016	Recurrent	Coordination Level	Coord recurrent	All recurrent coordination activities (minus HR)	0	63290.16	
			HR	HR costs	0	196090.80	
		Project Level	Training*	All costs associated with training, international and national staff	2656.48	0	
			Transport	All transport costs, except that directly associated with training	39254.98	884.36	
			Office	All supplies for international house and office incl stationary, phones, clothes, utilities	26688.11	734.45	
			Expert visit	Expert international visit	0	0	
			Staff costs	International staff costs - including relocation, per diem, medical costs, work permits	27721.16	214039.69	
				National staff salaries: domestic staff, coordination, admin, translator, logistics, driver, data operator	114038.89	0	
				Additional national staff costs: e.g. health insurance	5298.36	0	
			Building rent and maintenance	All building rental & maintenance costs – international staff house & office	19196.48	0	
		Clinic Level	Transport	Transporting patients only	0	0	
			Drugs	All meds	920357.99	0.00	
			Biomedical equipment	Equipment used in clinic - e.g. swabs, gloves, glucometer strips	2067.75	379.79	
			Lab	All lab tests (external)	146284.50	0	
			Office	Stationary and other supplies	4229.55	0	
			Building rent and maintenance	All building rental and maintenance costs - clinic	45380.25	0	
			Staff costs	National staff costs: eg health insurance	20384.98	0	
				Non-clinical salaries: registrar, health promotor, psychosocial	61750.59	0	
				Clinical salaries (pharmacists & assistants, nurses)	174166.96	0	
				Clinical salaries (doctors)	121354.94	0	
2017	Capital	Coordination Level	Office equipment	Furniture, office equipment, cold chain	15944.86	0	3
			Vehicle purchase & maintenance	Vehicle purchase and parts	489.92	0	5
		Project Level	Building and	Building construction and renovation	6154.90	0	20

			maintenance				
			Vehicle purchase & maintenance	Vehicle purchase and parts	0	0	5
			Furnishings	Chairs, desks, tables and filling cabinet, air con, fans, heating, curtains	2096.85	120.02	3
			Office supplies	Computers, media, routers, screens and printers, long life batteries, curtains, cables	3203.30	0	3
		Clinic Level	Building and maintenance	Construction and renovation	2344.00	0	20
			Furnishings	Chairs, examination table, file cabinet, extension cables, air con, fans, heating	0	0	3
			Clinical equipment	BP cuff, stethoscope, otoscope, ECG machine, wheelchair, scale, spirometer, oximeter, ophthalmoscope, defibrillator, cold chain	4727.25	266	3
2017	Recurrent	Coordination Level	Coord recurrent	All recurrent coordination activities (minus HR)	0	112412.64	
			HR	HR costs	0	287851.61	
		Project Level	Training*	All costs associated with training, both international and national staff	5389.20	0	
			Transport	All transport costs, except that directly associated with training	12295.32	67.50	
			Office	All supplies for international staff house and office incl stationary, phones, clothes, utilities	26365.78	1867.72	
			Expert visit	Expert international visit	388.00	0	
			Staff costs	International staff costs - including relocation, per diem, medical costs, work permits	27070.22	205634.74	
				National staff salaries: domestic staff, coordination, admin, translator, logistics, driver, data operator	138372.40	0	
				Additional national staff costs: e.g. health insurance	4124.27	0	
			Building rent and maintenance	All building rental & maintenance costs – international staff house & office	35827.00	0	
		Clinic Level	Transport	Transporting patients only	500.00	0	
			Drugs	All meds	975801.77	0	
			Biomedical equipment	Equipment used in clinic - e.g. swabs, gloves, glucometer strips	1976.75	0	
			Lab	All lab tests (external)	142454.05	0	
			Office	Stationary and other supplies	3341.25	0	

			Building rent and maintenance	All building rental and maintenance costs - clinic	52283.65	0	
			Staff costs	National staff costs: e.g. health insurance	14513.04	0	
				Non-clinical salaries: registrar, health promotor, psychosocial	44241.62	0	
				Clinical salaries (pharmacists & assistants, nurses)	229728.42	0	
				Clinical salaries (doctors)	147408.47	0	

**Training: This category included transport, per diem and accommodation costs for Irbid project staff to attend internal MSF language, administrative and clinical training courses in Irbid or in Amman. In 2015, training costs included a 4-day health education course and a 3-day NCD clinical management course, each attended by 2 staff members. In 2016, UNHCR hosted a 6-day NCD management course attended by 3 MSF staff. In 2017, training costs included travel for 2 national staff to attend training in Amsterdam.*

Appendix 2: Drug and equipment item cost ranking

& proportion of total costs in 2017, in 2017 International Dollars.

Rank (2017)	Description	2017 Total Consumption	2017 INT$ cost	% total drug costs
1	INSULIN (MIXTARD) 100 IU, vial	14399	441639.83	14.48
2	STRIP, (glucometer accu check, blood glucose)	361227	304164.42	9.97
3	ATORVASTATIN, 20 mg, tab.	453786	243895.79	8.00
4	SYRINGE, s.u., Luer, insulin, 100 IU/1 ml + fixed needle	461650	198495.07	6.51
5	VALSARTAN, 80 mg, tab.	501630	194115.13	6.37
6	ENALAPRIL, 10 mg, tab.	437117	164451.61	5.39
7	SALMETEROL, 50mcg/FLUTICASONE 250mcg , 60 doses, diskus	1496	148233.12	4.86
8	AMLODIPINE, 5 mg, tab.	304833	134345.62	4.41
9	ATORVASTATIN, 80 mg, tab.	47993	109484.03	3.59
10	ATORVASTATIN, 10 mg, tab.	315412	108422.88	3.56
11	SALMETEROL, 50mcg/FLUTICASONE 500mcg , 60 doses, diskus	695	93935.05	3.08
12	OMEPRAZOLE, 20 mg, gastro-resistant caps.	204397	83036.28	2.72
13	GLIBENCLAMIDE, 5 mg, breakable tab.	742992	78432.09	2.57
14	ATENOLOL, 50 mg, tab.	232239	57580.76	1.89
15	METFORMIN hydrochloride, 850 mg, tab.	639820	54564.65	1.79
16	HYDROCHLOROTHIAZIDE, 25mg, tab.	229850	47112.07	1.54
17	ENALAPRIL maleate, 20 mg, tab.	75596	45709.59	1.50
18	VALSARTAN, 160 mg, tab.	108345	45034.28	1.48
19	ENALAPRIL maleate, 5 mg, tab.	149569	44211.66	1.45
20	RANITIDINE, 75 mg, tab.	202588	35934.05	1.18
21	BISOPROLOL fumarate, 5 mg, tab.	164055	35271.83	1.16
22	ACETYLSALICYLIC acid (aspirin), 100mg, tab	578274	33160.40	1.09
23	INSULINE Pen 30-70, flex pen , 300 IU	1359	30959.72	1.02
24	FUROSEMIDE, 40 mg, tab.	180360	28000.89	0.92
25	FERROUS SULFATE, 80 mg, tab.	102110	25527.50	0.84
26	INSULIN HUMAN, ISOPHANE (NPH) 100 UI/ml, 10 ml, vial N	776	23789.25	0.78
27	AMLODIPINE, 10 mg, tab.	85912	21547.80	0.71
28	METFORMIN hydrochloride, 500 mg, tab.	297500	19188.75	0.63
29	AMOXICILLIN 875mg / CLAVULANIC acid 125mg, tab.	9976	16271.17	0.53
30	SALBUTAMOL sulfate, eq.0.1mg base/puff, 200 puffs, aerosol	3069	16121.07	0.53
31	PARACETAMOL (acetaminophen), 500 mg, tab.	252982	15811.38	0.52
32	ISOSORBIDE DINITRATE, 20 mg, tab.	78285	12895.01	0.42
33	GLUCOMETER, Accu Check blood glucose monitor	192	10546.24	0.35
34	THYROXINE 50 mcg tab	165647	10057.88	0.33
35	ALLOPURINOL, 100 mg, tab.	80562	9727.86	0.32
36	SPIRONOLACTONE, 25 mg, tab.	26755	9202.88	0.30
37	METRONIDAZOLE, 500 mg, tab.	1460	9033.75	0.30
38	INSULIN HUMAN, RAPID 100 IU/ml, 10 ml, vial N	257	7882.59	0.26
39	AMITRIPTYLINE hydrochloride, 25 mg, tab.	41840	7391.30	0.24
40	CLOPIDOGREL 75 mg, tab.	21970	7084.64	0.23
41	AUTOINJECTOR NEEDLE, 31G, 0.25 x 6mm	12940	6584.03	0.22

42	RANITIDINE, 300 mg, tab.	14350	6247.18	0.20
43	FLUTICASONE, 50mcg, 120 doses, Evohaler	263	6056.75	0.20
44	SPACER, 155 ml with mask 6yrs- adult + mouthpiece	42	5775.00	0.19
45	BECLOMETASONE dipropionate, 0.25mg/puff, 200 puffs, aerosol	206	5401.06	0.18
46	AZITHROMYCIN, 250 mg, caps.	1326	4696.64	0.15
47	MICONAZOL nitrate, 2%, cream, 30 g, tube	1048	3867.78	0.13
48	IPRATROPIUM INHALER 20 MCG/PUFF (AS BROMIDE) 200 DOSE PER BOTTLE	205	3680.05	0.12
49	BLOOD LANCET for lancing device	69160	3468.81	0.11
50	WARFARIN 5 mg	23855	2981.88	0.10
51	DIGOXIN, 0.25 mg, tab.	17348	1984.72	0.07
52	FLUCONAZOLE, 50 mg, caps.	266	1857.20	0.06
53	CIPROFLOXACIN hydrochloride, eq. 500 mg base, tab.	3380	1816.64	0.06
54	CEFIXIME, 400 mg, tab.	550	1770.31	0.06
55	AMOXICILLIN, 500 mg, caps.	6450	1420.21	0.05
56	BISACODYL, 5 mg, tab.	9880	1345.22	0.04
57	ISOSORBIDE DINITRATE, 5 mg, sublingual tab.	21330	1333.13	0.04
58	NEOMYCIN and BACITRACIN, 5 MG + 25 IU cream	309	1289.87	0.04
59	PREDNISOLONE, 5 mg, tab.	17375	1077.25	0.04
60	HYDROCORTISONE acetate, 1%, ointment, 15 g, tube	320	1020.00	0.03
61	CHLORPHENAMINE maleate, 4 mg, tab.	16308	1019.25	0.03
62	HYOSCINE BUTYLBROMIDE (scopolamine butylbromide), 10 mg,	2560	935.60	0.03
63	IBUPROFEN, 400 mg, tab.	9728	635.99	0.02
64	SPACER, 155 ml with mask 18m-5yrs + mouthpiece	3	412.50	0.01
65	COTRIMOXAZOLE, 400 mg / 80 mg, tab.	650	125.78	0.00
66	NYSTATIN, 100,000 IU/ml, oral susp.	12	79.24	0.00
67	SODIUM chloride, 0.9%, 500 ml, flex. bag, PVC free	12	78.93	0.00
68	SALBUTAMOL, solution for nebulizer, 20ml	5	51.32	0.00
69	PARACETAMOL (acetaminophen), syrup, 125 mg/5ml, 100ml	6	48.00	0.00
70	SODIUM chloride, 0.9%, 100 ml, flex. bag, PVC free	9	29.60	0.00
71	IPRATROPIUM bromide, 250mcg/ml, 5ml, vial	10	8.28	0.00
72	DEXTROSE (GLUCOSE), 5%, 500 ml, flex. bag, PVC free	2	6.58	0.00
73	HYDROCORTISONE sodium succinate, eq.100mg base,	7	5.84	0.00
74	DICLOFENAC sodium, 25 mg/ml, 3 ml, amp.	0	0.00	0.00
75	METOCLOPRAMIDE hydrochloride, 5 mg/ml, 2 ml, amp.	0	0.00	0.00
76	AMOXICILLIN 500 mg / CLAVULANIC acid 125 mg, tablet	0	0.00	0.00
77	CARBAMAZEPINE, 200 mg, tab.	0	0.00	0.00
78	CEFIXIME, 200 mg, tab.	0	0.00	0.00
79	FLUOXETINE hydrochloride, eq. 20 mg base, caps.	0	0.00	0.00
80	HALOPERIDOL, 5 mg, tab.	0	0.00	0.00
81	LPV 200 mg / r 50 mg, tab.	0	0.00	0.00
82	METOCLOPRAMIDE HYDROCHLORIDE, 10 mg, tab.	0	0.00	0.00
83	METHYLDOPA, 250 mg, tab.	0	0.00	0.00
84	PAROXETINE, 20 mg, breakable tab.	0	0.00	0.00
85	PHENOXYMETHYLPENICILLIN, 1000 mg, tab.	0	0.00	0.00
86	RISPERIDONE, 1 mg, tab.	0	0.00	0.00

87	TDF 300 mg / 3TC 300 mg, tab.	0	0.00	0.00
88	VALPROATE SODIUM, 200 mg, gastro-resistant tab.	0	0.00	0.00
89	AZT 300 mg / 3TC 150 mg, tab.	0	0.00	0.00
90	GABAPENTIN, 400 mg, cap.	0	0.00	0.00
91	VACCINE HEPATITIS B, 1 adult dose, monodose vial	0	0.00	0.00
92	GABAPENTIN, 100 mg, cap.	0	0.00	0.00
93	CALCIUMcarbonate,eq.500mgCa,tab	0	0.00	0.00
94	Pantoprazole 20 mg tab.	0	0.00	0.00
95	CHLORAMPHENICOL, 0.5%, eye drops, sterile, 10 ml, bot.	0	0.00	0.00
96	TETRACYCLINE hydrochloride, 1%, eye ointment, ster, 5g, tube	0	0.00	0.00
97	CEFTRIAXONE sodium, eq. 1 g base, powder, vial	0	0.00	0.00
98	EPINEPHRINE (adrenaline) tartrate, eq.1mg/ml base,1ml amp	0	0.00	0.00
99	FUROSEMIDE, 10 mg/ml, 2 ml, amp.	0	0.00	0.00
100	CHLORPHENIRAMINE MALEATE, 10 mg/ml, 5 ml amp.	0	0.00	0.00
101	SALBUTAMOL, solution for nebulizer, 20ml	0	0.00	0.00
102	CLARITHROMYCIN 125mg/5ml, granules for susp, 60 ml bot	0	0.00	0.00
	Total Drug Cost		**3049380.53**	**100**
	Total insulin		504271.39	16.54
	Total insulin AND related equipment		1027529.97	33.70
	Total statin		461802.70	15.14
	Total inhaler and spacer device		258092.47	8.46

Appendix 3: Scenario analysis re drug importation

Decisions made re importing all drugs from Amsterdam Procurement Unit

Item on Jordan OCA Mission drug list	Replaced with Item on MSF Green List 2017	Equivalent dosage
Bacitracin/ Neomycin 5g cream	Chloramphenicol eye drops	(1 x10 ml bottle)
Insulin mixtard 100 unit vial	Insulin (30/70) / ml 10 ml vial	1 vial for 1 vial
Ferrous sulphate 80 mg	Ferrous salt 65 mg	1 tablet for 1 tablet
Pen V 1000 mg	Pen V 250mg x 4	4 tablets for 1 tablet
Ranitidine 75 mg	Ranitidine 100 mg (but purchase equivalent total mgs)	Purchase equivalent number of mg from MSF
Clarithromycin suspension 1 bottle	Azithromycin suspension 1 bottle	1 bottle
Valsartan 80 mg	Losartan 50 mg	1 tablet for 1 tablet
Metformin 850mg	Metformin 500mg	Purchase equivalent number of mg from MSF
Atrovent nebuliser	Atrovent nebuliser	5ml nebuliser = 2 x 2ml nebuliser
Chlorphenamine IV	Promethazine IV	1 vial for vial

- If the same drug was not available, then a clinically equivalent drug and dose was selected (as listed in the table above).
- If the same drug but different formulation/dose was available for a particular drug, the general rule was to purchase the equivalent number of mg from MSF stores. If the dose was lower on the Irbid drug list, then we purchased the same number of milligrams of the drug (i.e. higher MSF dose x lower consumption figure to equivalent number of milligrams consumed). If dose is higher on Irbid list, multiplied dose available on MSF list to give equivalent number of mg (and therefore multiply the price proportionally) e.g. Metformin 850 mg on Irbid list x consumption = number mg to purchase from MSF; divide by 500 = number of MSF tabs to purchase.
- If the item on the Jordan Mission drug list was a suspension, we changed the antibiotic to a clinically appropriate replacement and purchased the equivalent of a bottle (i.e. one course).
- The same was done for combination inhalers. We purchased the clinical equivalent of a monthly course of the separate inhaled ingredients. For a single ingredient inhaler, we purchased a monthly course at clinically equivalent steroid dose.
- Allopurinol was not available nor any equivalent on the MSF Green List. This was replaced with a price from WHO International Drug Price Indicator Guide online and was converted into EUR from US$ (2015) mshpriceguide.org for the original calculations.
- Insulin pen. The closest available to Insulin 30/70 3ml autoinjector pen on the Jordan Mission Drug List was the Insulin Lispro 25/75 autoinjector 3 ml pen on the MSF Green List.

Appendix 4: Top 20 most costly drug items

and proportion of total costs in 2017 (2017 INT$[1])

Item	Drug class	Consumption[2]	Annual cost (2017 INT$)	% Total 2017 drug cost
1. INSULIN (MIXTARD) 100 IU, VIAL	Insulin	14,399[3]	441,640	14
2. STRIP, (GLUCOMETER ACCU CHECK, BLOOD GLUCOSE)	Diabetes Equipment	361,227	304,164	10
3. ATORVASTATIN, 20 MG, TAB.	Statin cholesterol lowering	453,786	243,896	8
4. SYRINGE, S.U., LUER, INSULIN, 100 IU/1 ML + FIXED NEEDLE	Diabetes Equipment	461,650	198,495	7
5. VALSARTAN, 80 MG, TAB.	Antihypertensive	501,630	194,115	6
6. ENALAPRIL, 10 MG, TAB.	Antihypertensive	437,117	164,452	5
7. SALMETEROL, 50MCG/FLUTICASONE 250MCG, 60 DOSES, DISKUS	Asthma/COPD combination inhaler	1496[4]	148,233	5
8. AMLODIPINE, 5 MG, TAB.	Antihypertensive	304,833	134,346	4
9. ATORVASTATIN, 80 MG, TAB.	Statin cholesterol lowering	47,993	109,484	4
10. ATORVASTATIN, 10 MG, TAB.	Statin cholesterol lowering	315,412	108,423	4
11. SALMETEROL, 50MCG/FLUTICASONE 500MCG , 60 DOSES, DISKUS	Asthma/COPD combination inhaler	695[4]	93,935	3
12. OMEPRAZOLE, 20 MG, GASTRO-RESISTANT CAPS.	Anti-acid/reflux disease	20,4397	83,036	3
13. GLIBENCLAMIDE, 5 MG, BREAKABLE TAB.	Oral hypoglycaemic	742,992	78,432	3
14. ATENOLOL, 50 MG, TAB.	Antihypertensive	232,239	57,581	2
15. METFORMIN HYDROCHLORIDE, 850 MG, TAB.	Oral hypoglycaemic	639,820	54,565	2
16. HYDROCHLOROTHIAZIDE, 25MG, TAB.	Antihypertensive	229,850	47,112	2
17. ENALAPRIL MALEATE, 20 MG, TAB.	Antihypertensive	75,596	45,710	1
18. VALSARTAN, 160 MG, TAB.	Antihypertensive	108,345	45,034	1
19. ENALAPRIL MALEATE, 5 MG, TAB.	Antihypertensive	149,569	44,212	1
20. RANITIDINE, 75 MG, TAB.	Anti-acid/reflux disease	202,588	35,934	1
TOP 20 DRUG ITEMS TOTAL			2,632,798	86
TOTAL 2017 DRUG COSTS			3,049,381	100

Notes:

[1]**Costs are presented in 2017 International Dollars [using Purchasing Power Parity (PPP) to convert JOD and Euro nominal costs into INT$]**

[2]**Consumption refers to the annual consumption of tablets for each item and reflects the amount of medication dispensed by the pharmacy. It does not necessarily reflect the number of doses prescribed or the number of doses taken by patient, nor does it include wastage.**

[3]**Insulin consumption refers to the number of vials dispensed per year. Each vial may contain several doses; the total number of doses will depend on the number of units of insulin prescribed to the individual patient.**

[4]**Combination inhalers for asthma/ COPD contain a month-long course**

Appendix 5: Annual costs and total financial costs

for Irbid NCD Programme for 2015, 2016, 2017, in International dollars.

Year		**2015**		**2016**		**2017**	
Cost Level		INT $[1]	% of total INT $ costs	INT $	% of total INT$ costs	INT$	% of total INT$ costs
Clinic Level	Capital	31,223	0.7%	38,491	0.6%	43,199	0.6%
	Recurrent (excl HR and drugs)	777,345	18.5%	647,627	10.1%	626,737	9.3%
	HR	821,830	19.5%	1,234,517	19.3%	1,362,161	20.2%
	Drugs	1,615,967	38.4%	3,008,539	47.0%	3,049,381	45.2%
	Total Clinic	**3,246,365**	**77.2%**	**4,929,175**	**77.0%**	**5,081,478**	**75.4%**
Project Level	Capital	14,512	0.3%	53,849	0.8%	53,374	0.8%
	Recurrent (excl HR)	185,132	4.4%	289,182	4.5%	253,420	3.8%
	HR	424,957	10.1%	769,915	12.0%	805,177	11.9%
	Total Project	**624,600**	**14.8%**	**1,112,946**	**17.4%**	**1,111,971**	**16.5%**
Coordination Level	Capital	2,872	0.1%	8,029	0.1%	10,160	0.2%
	Recurrent (excl HR)	102,815	2.4%	85,514	1.3%	150,485	2.2%
	HR	229,830	5.5%	264,947	4.1%	385,344	5.7%
	Total Coordination	**335,516**	**8.0%**	**358,491**	**5.6%**	**545,989**	**8.1%**
Total Annual Cost		**4,206,481**		**6,400,611**		**6,739,438**	

Notes:

[1]Costs are presented in 2017 International Dollars [using Purchasing Power Parity (PPP) to convert JOD and Euro nominal costs into INT$]

Appendix 6: Consultation model scenario analysis

Assumptions and cost inputs used for

Data/assumptions	Base case	Data source/ notes
Potential total cohort	4000.0	NCD Advisor report; interviews with management
Active patients end of 2017	3540.0	Epi results for evaluation
Potential extra capacity in the system at end of 2017	460.0	
Duration new appt minutes	30.0	
Duration f/u appt minutes	15.0	
Available doctor f/u appointment slots per day (15 min)	52.0	(4 MD x 13 slots @15 min.s);NCD advisor report
Available doctor new appt slots per day (30 min)	6.0	NCD advisor report
Total available doctor 15 minute slots per day	64.0	
Theoretical number of slots available per month @24 working days/month	1536.0	
Currently		
Actual average follow up consultations per month in 2017	2197.375	MMR 2017 July
Actual avg total nurse f/u per month	122.0	MMR 2017 July
Actual avg total Dr f/u per month	1956.0	MMR 2017 July
Actual avg Dr f/u per month per doctor	489.0	
Stable proportion of active cohort	0.6	Based on cohort analysis results
Unstable proportion	0.4	
Number of stable patients in 2017	2124.0	Epi results for evaluation
Visits / yr unstable pt - in theory	12.0	NCD Guideline
Proposed visits / yr stable pt - in theory	4.0	NCD Guideline
Estimates of workload based on task shifting of stable pts to nurses		
Required number of quarterly visits/yr current stable pts	8496.0	
% DNAs - require rebooking	0.05	NCD advisor report
Required number of 3 monthly visits/month current stable pts	743.4	
Estimate of proportion stable monthly nurse visits potentially referred to doctor	0.1	
Unstable patients in 2017	1416.0	
Number of monthly visits/yr current unstable pts.	16992.0	
Required number monthly f/u visits/month current unstable pts. including DNA	1486.8	
Current rate of new patients per month	5.0	
Required Dr 15 min appt slots for new pts/ month	10.0	
Required Dr 15 min appt slots for pt.s referred from nurse	74.3	Based on estimate c26
Total Dr 15 min slots required per month to see unstable + 10% stable + new pts	1571.1	
Work Pattern and Salaries		
Working days per month	25.0	
Unspecialised Dr annual salary per person	17568.0	JOD; HRCo email
Specialised Dr annual salary per person	28212.0	JOD; HRCo email
Annual insurance per person	1036.7	JOD
Total annual per person unspecialised doctor costs	18604.7	
Total annual per person specialised doctor costs	29248.7	

Nurse monthly salary per person	9805.609615	JOD
Nurse annual insurance per person	1036.7	JOD
Total annual per person nurse costs	10842.3	
Per FTE doctor appointment capacity		
Bank holidays per year	15.0	online
Annual leave weeks per year	4.0	assumption
Average sick leave weeks taken per doctor	1.0	assumption based on interviews with management
Annual working weeks if annual leave = 4 weeks/sick leave = 1 week	47.0	
Working days per week	6.0	
Total working days per year	267.0	
Average total working days per month	22	accounting for leave and bank holidays
Working hours per day minus 30 minutes' break time	5.5	based on observation
15m. appt slots per working hour	4.0	
15m. appt slots per working day per doctor/nurse incl. 30 min break	22.0	
Doctors		
Theoretical 15m. appt slots per month per FTE doctor	489.5	
Current number of specialist doctors	2.0	
Current number of non-specialist doctors	2.0	
Total monthly doctor 15m. slots available	1958.0	
Total monthly doctor 15m. slots used currently	1966.0	
No. FTE Drs needed to manage theoretical total Dr 15 slots required	3.2	
Round to the nearest 0.5 of a doctor	3.5	
Minimum of one specialist	1	
Remaining number of doctors required	2.5	
Nurses		
f/u appt slots per month per FTE nurse	489.5	
Number of nurses	1.0	
Total monthly nurse f/u slots	489.5	
Total monthly nurse 15m. Review slots used currently	122.0	
No. FTE nurses needed to manage current nurse f/u slots required	0.2	
No. FTE nurses needed to manage theoretical task shifted nurse f/u slots required	1.5	
Round to nearest 0.5 of a nurse	2	
Salary costs for providing consultations (JOD)	**Current Model@ current patient load and stability**	
Annual cost for specialist doctor	58,497	
Annual cost for non-specialist doctor	37,209	
Annual cost for nurses	2,702	
Total annual cost per consultation model (JOD)	98,409	
Total annual cost per consultation model (INT$)	307,528	

KEY: Avg=average; DNA=Did Not Attend; FTE=Full Time Equivalent; F/U=Follow Up; HRCO=Human Resources Coordinator; INT$=International Dollar; JOD=Jordanian Dinar; MD=Medical Doctor: MMR=Monthly Medical Report; NCD=Non-Communicable Disease; No.=Number; Pt=patient; Yr=year.

END