



Developing an approach for evaluating epidemic decision-making in low-income and humanitarian settings

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Declaration

I, Abdihamid Warsame, 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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Firstly, I'd like to thank Allah who granted me the opportunity and the ability to undertake this work.

This PhD project has been an extraordinary and at times testing journey.

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At the end of it all, I'd like to thank my family for giving me the courage to start this journey. I would not have reached this point without their understanding and unwavering confidence in my abilities.

Finally, this project is dedicated to the memory of my mother whose undiminished love, prayers and optimism allowed me to keep going.

Acronyms

AER	Adaptive Epidemic Response ARI
Acute Respiratory Infections	CMO
Chief Medical Officer	
CSR	Communicable disease surveillance and response
DALY	Disability-Adjusted Life Year
DMF	Decision-making framework
DONS	Disease Outbreak News
ECDC	European Centre for Disease Prevention and Control
EWARN	Early Warning Alert and Response Network
GHSA	Global Health Security Agenda
GOARN	Global Outbreak Alert and Response Network
HIV/AIDS	Human immunodeficiency virus/ Acquired Immunodeficiency Syndrome
IFRC	International Red Cross and Red Crescent Movement
IDSR	Integrated Disease Surveillance and Response
IHR	International Health Regulations
JEE	Joint External Evaluations
LMIC	Low- and Middle-Income Countries
LSHTM	London School of Hygiene and Tropical Medicine
MSF	Médecins Sans Frontières
NDM	Naturalistic Decision-making
OECD	Organisation for Economic Co-operation and Development
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RECAP	Research Capacity Building Projection
SARS	Severe Acute Respiratory Syndrome
SCUK	Save the Children UK
TB	Tuberculosis
ToC	Theory of Change
UNICEF	United Nations Children's Fund
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

Abstract

Epidemics of infectious disease continue to exact a high public health toll and occur routinely in low- and middle-income countries. Populations experiencing humanitarian crises are at particular risk. In the past 20 years, large scale pandemics have focused attention on a limited number of epidemic pathogens and the preparation for emerging disease threats. However, relatively less attention has been paid to the response to smaller scale epidemics occurring within the contexts of humanitarian crises, most of which continue to be due to well-known pathogens, and as well as to the process of decision-making in these responses.

This PhD project aims to contribute to epidemic response in low-income and humanitarian settings by developing an assessment approach and related instruments to evaluate decision-making in epidemic response. Through review of public health evaluation frameworks relevant to epidemic evaluations, this thesis presents a new Adaptive Epidemic Response framework that describes the different phases and components of an epidemic response. A further systematic review of the status of epidemic evaluations in low-income and humanitarian settings demonstrates significant gaps in evaluation coverage, variability in evaluation methods and quality and highlights a pressing need for standardization. In collaboration with the Federal Ministry of Health in Somalia and the Heritage Institute for Policy Studies, a qualitative study of decision-making in the COVID-19 response within Somalia was undertaken to describe the process of decision making and the role of various internal and external factors on decision processes and outcomes. Through further collaboration with WHO Somalia and CARE Somalia, a decision-making audit tool was piloted to assess each organisation's COVID-19 response. By producing a decision scorecard and identifying shortcomings in decision-making quality, this thesis contributes insight that can improve future decision-making quality in response to epidemics.

PART ONE

Structure of the PhD thesis

This PhD thesis by publication comprises three parts and four research questions with corresponding outputs. Part one consists of an introduction to the subject of the thesis based on a brief literature review. It also outlines the aims, research questions and structure of the PhD project. Part two presents the four published research papers which comprise the core of this PhD project, as summarised in Table 1.

Part three contains an overarching discussion that attempts to link the individual research papers together. It provides a summary of the limitations of the project as a whole and offers recommendations for both further inquiry and application of findings to policy and action.

Table 1 Research papers produced as part of this PhD thesis.

#	Title	Study Design	Geographic scope	Collaborators	Year published or submitted	Journal	Link
1	Towards systematic evaluation of epidemic response during humanitarian crises: a scoping review of existing public health evaluation frameworks	Scoping Review	LMIC and humanitarian settings	n/a	2020	BMJ Global Health	https://gh.bmj.com/content/5/1/e002109
2	The practice of evaluating epidemic response in humanitarian and low- income settings: a	Systematic Review	LMIC and humanitarian settings	LSHTM	2021	BMC Medicine	https://bmcmmedicine.biomedcentral.com/articles/10.1186/s12916-020-01767-8

	systematic review						
3	Evaluating COVID-19 decision-making in a humanitarian setting: the case study of Somalia	Qualitative evaluation	Somalia	Heritage Institute of Policy Studies, Ministry of Health (Somalia)	2022	PLOS Global Health	https://journals.plos.org/globalpublichealth/article?id=10.1371/journal.pgph.0000192
4	Auditing the quality of decision-making within an epidemic response	Mixed methods evaluation	Somalia	CARE Somalia, WHO Somalia	2023	BMJ Open	https://bmjopen.bmj.com/content/13/1/e065122

1. Introduction

1.1 Epidemic-prone diseases in LMIC and humanitarian contexts

Infectious diseases continue to pose a major public health challenge globally. In 2019 alone, they accounted for approximately 27% of all deaths globally and 24.3% of DALYs (Disability Adjusted Life Years).¹ Though much of this burden is due to the endemic manifestation of infections, epidemics also remain a global threat, and most infectious agents can occur in epidemic patterns if not appropriately controlled.² Several factors such as increased globalization and climate change increase the likelihood of epidemics.³ Twenty epidemic-prone diseases including dengue, typhoid and haemorrhagic fevers have either experienced re-emergence or spread geographically in the past half century.⁴ As the global population continues to rise and the pace of movement of both people and goods continues, the threat posed by epidemics grows.

Concern exists that the global ability to respond to threat of epidemics has not kept pace with their growing threat. The failure to initially contain the Ebola pandemic in West Africa focused attention on glaring weaknesses in international public health systems and epidemic response capabilities.⁵ Nevertheless, the failure to respond appropriately and at scale is not confined to emerging infections but rather has been a long-standing weakness at national and subnational levels even with regards to well characterized epidemic-prone diseases such as measles and cholera. For these diseases, delayed recognition and declaration, decision-making based on political and economic considerations, normalization of such epidemics as routine as well as poor coordination and resourcing have all been posited as contributors to poor epidemic response.⁶

Low- and middle-income countries (LMIC) are disproportionately affected by outbreaks of epidemic-prone disease.⁷ Globally, young children are especially vulnerable with approximately 2 million deaths each year from vaccine-preventable disease, much of which manifests in epidemic patterns.^{8,9}

Humanitarian crises are events that carry a critical threat to the health, safety, security, or wellbeing of a community or other large group of people and may overwhelm local response capacity.¹⁰ They are more likely to occur and have greater impact in LMICs.¹¹ Populations affected by humanitarian crises are at increased risk of epidemics¹² due to deteriorated or collapsed health systems and disease control programs as well as limited access to health and nutrition services.¹³ Extremely high mortality rates primarily driven by epidemic diseases have been observed in a number of humanitarian settings.^{14,13} This is in part the result of heightened vulnerability of such populations who are more likely to have poor health status prior to the emergency and as a result suffer the highest rates of morbidity and mortality in the immediate aftermath of an emergency. Moreover, population displacement from low to high endemic areas, overcrowding and poor hygiene and sanitation services have also been noted as significant drivers of epidemics within these settings. In

some circumstances, large scale and poorly controlled epidemics such as that of the West African Ebola epidemic can themselves engender a humanitarian crisis.^{15,16}

1.2 Public health evaluations

Evaluations of public health programmes are key to establishing their effectiveness and to assess and improve their quality.¹⁷ Evaluations can be utilized to assess many facets of a public health programme, can be undertaken at different phases of an intervention and are recognized as key to guiding decision making.¹⁸ Well-conducted evaluations provide evidence-based information that is credible and useful for strategic as well as operational planning and organisational learning.¹⁹

Evaluations are especially critical in emergency scenarios where the risks to population health are more acute and often have a greater impact in terms of morbidity and mortality. Epidemics are one type of public health emergency in which robust evaluation of response efforts can contribute to improving response and preventing future reoccurrence. Epidemic response evaluations can be done at different phases including in preparation for an epidemic, during the epidemic itself or after its conclusion.

1.3 Epidemic response evaluation

Preparedness

Much of the focus of epidemic evaluation currently appears to centre on preparedness for future epidemics and pandemics. Over the past two decades, a landmark effort to strengthen preparedness was achieved through the formulation of the International Health Regulations (IHR), a legal framework that seeks to reduce the risk of international spread of certain highly epidemic-prone diseases. Initially limited to cholera, plague, yellow fever and smallpox, the focus has since expanded to include more contemporary threats (Figure 1) including Severe Acute Respiratory Syndrome (SARS) and Ebola Virus Disease (EVD).²⁰

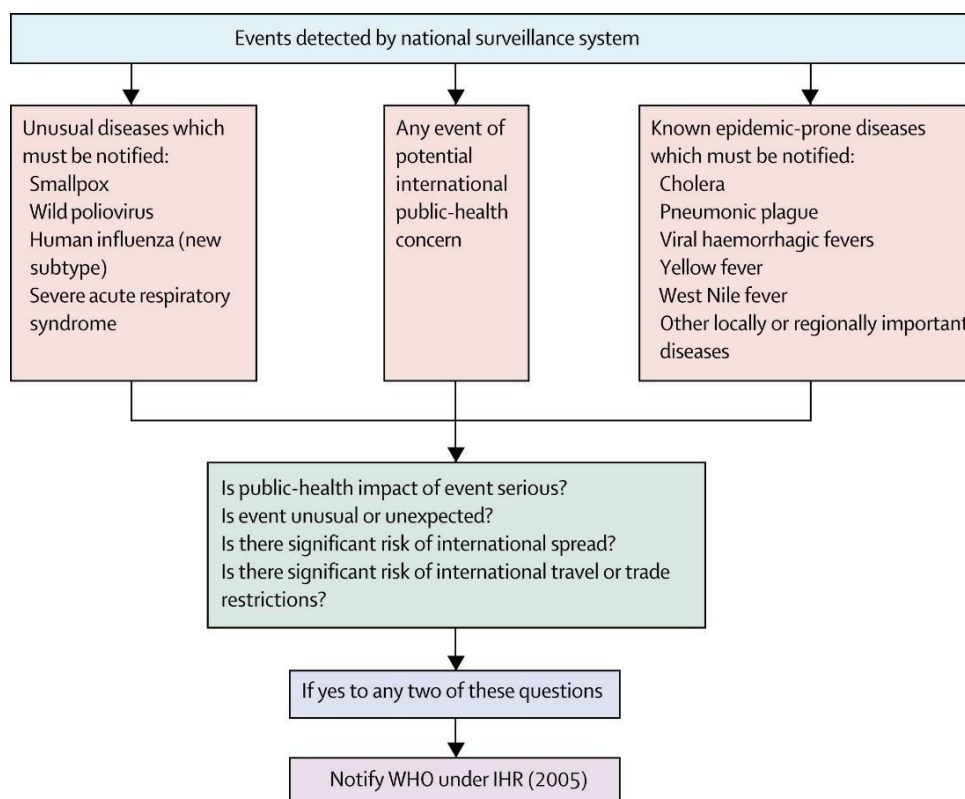


Figure 1 Summarized decision instrument for events and epidemics that potentially warrant notification under International Health Regulations (2005)²¹

However, many countries currently lack the requisite surveillance, alert and response capacities to fully implement the IHR. To address this gap, global health actors including the United States introduced the Global Health Security Agenda (GHS) to support the implementation of the IHR. The GHS utilizes Joint External Evaluations (JEE) to assess national capacity to detect, control and prevent large scale epidemics. Several complementary initiatives, such as the Epidemic Preparedness Index and the Global Monitoring Framework, have been developed to evaluate and strengthen preparedness for epidemics.^{22,23,24}

Post-epidemic evaluations

Evaluations are often thought of as an activity undertaken after the end of a programme and not as an instrument to guide immediate decision-making.²⁵ This is reflected in epidemic response by evidence of a limited number of large-scale, emerging-infection epidemics having received considerable post facto evaluative attention. In these evaluations, many of the barriers to effective

epidemic control are identified long after the conclusion of an epidemic. For example, more than 40 expert reports evaluating failures in the response were written after the West African Ebola epidemic had ended.²⁴ Pandemic influenza such as H1N1 as well as SARS have been the focus of similar retrospective reviews.^{23,26,27}

Evidence gaps in real-time evaluation

The need for real-time evaluation of emergency response has been recognized in humanitarian contexts.²⁸ Much less is known about epidemic response performance in real time, particularly as relates to diseases such as cholera and measles that, while well-characterised, are in fact frequent aetiologies of epidemics in LMICs and crisis settings.^{29–31} The need to fill this evaluation gap is arguably all the more compelling given the fact that a number of failures in response have been known for some time and continue to occur.^{32,33} Example of failures include delays in detection, insufficient resourcing, as well as poor coordination of key epidemic response activities. By addressing this critical evidence gap, such research could strengthen global health equity through focusing on improving response in low-income and humanitarian settings where populations bear a disproportionate burden. It could also further accountability and public health governance by providing an evidence base for well designed and implemented epidemic response. Through focus on evaluating epidemic response in real time or in the immediate post epidemic phase, epidemic responders could be empowered to critically assess their own performance and overcome underperformance.

1.4 Decision-making in epidemic responses

The study of decision-making in emergency scenarios is well established but has been largely limited to the 'emergency management' field, which predominantly focuses on a narrow typology of mass casualty incidents in high income contexts.³⁴ However, a recent review of decision-making processes in wider humanitarian response has reiterated the criticality of sound decision-making for improving outcomes in these contexts.³⁵ The same review found a great deal of variability in the approaches

utilized to frame decision-making, with two broad typologies^{36,37}: (i) an analytical-oriented approach and (ii) a process-oriented approach, each underpinned by different concepts of rationality.³⁶ In the analytical decision-making approach, decision-making is seen as an exercise in rational thinking. Accordingly, this is a prescriptive approach underpinned by the concept of substantive rationality in which the decision-maker attempts to identify the best or most rational decision. Decision-making is framed as a problem-solving approach in which multiple options are considered in an effort to arrive at a choice that maximizes utility. In this approach, similar to the dominant approach in economic theory, the decision-maker is viewed as a perfectly rational being. Emergency settings present a number of potential advantages and limitations to the analytical approach. Such an approach promotes transparency, as evidence for and against various options is required to be made explicit. As a result, the analytical approach is considered well suited for group decision-making as it seeks to overcome individual and group biases by mandating the presentation of transparent evidence. However, this approach is limited by the substantial amount of information required to fairly consider and weigh decision options. Additionally, significant analytical capacity and time is required of decision-makers rendering it less suitable for acute emergency contexts where information and time are limited, and the context is highly fluid.

The process-oriented approach to decision-making, on the other hand, focuses on describing *how* decisions are made within a specific context. Proponents argue that due to complex decision-making environments and limitations in analytical capacity, decision-makers cannot be perfectly rational and must in fact use bounded rationality, supplementing limited analysis with previous experience and intuition to arrive at acceptable, if not optimal decisions. Examples of process-oriented approaches include naturalistic decision-making (NDM) in which decisions are based on intuition and heuristics. Furthermore, the process-oriented approach rests on the concept of procedural rationality, namely a focus on the rules or procedures followed to reach a decision, rather than whether the right evidence has been analysed correctly to reach the optimal decision. These rules or

procedures may be based on previous best practices or socially accepted principles such as transparency or inclusivity.

Within epidemic response, the challenge for responders to make effective decisions in the midst of an evolving epidemic has been recognized.^{38,39} Limited research has attributed poor epidemic response (starting with delayed epidemic declaration) to decision-making based on political and economic considerations.⁴⁰ However, this has not been widely and rigorously tested in the context of an ongoing or recently concluded epidemic.

COVID-19 Decision-making

The global emergence of COVID-19 has represented an unprecedented escalation of the ongoing threat of epidemics with over half a billion cases and over 6 million deaths reported.⁴¹ Due to its pervasive impacts on almost all facets of daily life, the pandemic has generated an intense amount of public discourse and scrutiny of policy decisions taken in response. There has additionally been a deluge of research generated.⁴² Epidemic responders in a variety of settings have produced a wide array of guidelines to support response efforts. Within humanitarian settings a number of guidelines were produced to support COVID-19 response, primarily for adapting existing programs.^{43–46}

In the two years since the emergence of the COVID-19 pandemic, decision-making in response to COVID-19 has been widely acknowledged as being challenging. In particular, decision-making in COVID-19 responses has been acknowledged to be in need of strengthening in a number of dimensions, including transparency⁴⁷, gender equity⁴⁸ and flexibility.⁴⁹ In response to these identified shortcomings, a growing call for more critical evaluations of COVID-19 response has emerged.^{50,51} A number of initiatives, such as the COVID-19 Global Evaluation Coalition, have been initiated to support the generation and dissemination of more COVID-19 response evaluations including in both humanitarian⁵² and development settings.⁵³

The ubiquity of the COVID-19 epidemic underscores the need to strengthen epidemic response in general and decision-making in particular. Addressing this evidence gap is critical to designing improved evaluation instruments and ultimately strengthening epidemic response.

While the conventional expectation of evaluations is that they are undertaken at the end of project by somewhat independent actors (not infrequently external consultants) focused primarily on assessing outcomes and impacts⁵⁴, this PhD project focusses instead on exploring real-time evaluations of decision-making for the immediate benefit of epidemic responders. The project was not limited to any specific infectious diseases but rather to the epidemic manifestation of infectious disease in low income and humanitarian contexts. COVID-19 emerged in the midst of this thesis. For this reason, COVID-19 was not included in the first two research papers of this thesis but was the focus of the last two.

1.5 Epidemic response in Somalia

Somalia, with a population of 15 million, is one of the least developed countries in sub-Saharan Africa. A decades long civil war, subsequent collapse of the public health system and frequent humanitarian crises have meant that the population has some of the lowest population health metrics globally.⁵⁵ Access to health services is limited with significant proportion of the population displaced due to acute and protracted emergencies while much of the health system is sustained through support by international actors⁵⁶.

Epidemics of infectious disease continue to be a major driver of morbidity and mortality in Somalia with Somalia ranking near last in the Global Health Security Index⁵⁷ as well as in the Epidemic Preparedness Index ranking amongst low-income countries.⁵⁸

Since 2008, several different systems for infectious disease surveillance have been in use with varying levels of success including EWARN (Early Warning Alert and Response Network) and CSR (Communicable disease Surveillance and Response system). A number of constraints have been

noted in these systems including limited coverage, financial and human resources shortages as well as late and incomplete reporting all of which negatively impact on timely detection and response.^{59–61}

In 2018, a comprehensive IHR assessment has shown that Somalia has a very limited capacity to prevent, detect or respond to outbreaks scoring just 31 out of 100 in the measurement of core IHR capacity.⁶² The assessment scored Somalia as having limited capacity in key areas of response including emergency response operations, deployment of medical countermeasures and health personnel and immunization coverage whilst national IHR coordination and communication were scored as low.

Health authorities and actors in Somalia have taken some steps to improve on epidemic detection and response including the adoption of the Integrated Disease Surveillance and Response (IDSR) strategy as the framework to strengthen surveillance and address some of the shortcomings identified in the IHR capacity assessment. However, an ongoing multiyear epidemic of cholera⁶³ as well as recurrent measles outbreaks⁶⁴ continue to demonstrate the need for further strengthening of epidemic response in Somalia.

Given the significant burden of infectious disease epidemics within Somalia, the recurring humanitarian crises as well as the PhD candidate's Somali origin, Somalia was considered a promising setting for this thesis work. The epidemic of COVID-19 in Somalia, ongoing since March 2020, presented a further opportunity to study the response to a disease that, although it had already reached pandemic status, was unfamiliar to health actors in Somalia.

2. Thesis Aim and Research Questions

2.1 Aim

The aim of this PhD project is to improve epidemic response in low-income and humanitarian settings by developing an approach and related instruments to evaluate decision-making in epidemic response.

2.2 Research Questions

- 1) What public health evaluation frameworks are available to evaluate epidemic response and what is their suitability to evaluate response within humanitarian settings?
- 2) To what extent are epidemics in low and middle income and humanitarian settings evaluated and what are the strengths and gaps in evaluation practices in these settings?
- 3) How did epidemic responders tackling the COVID-19 epidemic in Somalia formulate and implement response decisions?
- 4) What is the utility and feasibility of a decision-making quality audit tool among epidemic response organisations in Somalia?

2.3 Summary of approach and linkages across research papers

The four research questions comprising this PhD project are summarized along with their respective methods, outputs, and linkages (Figure 2).

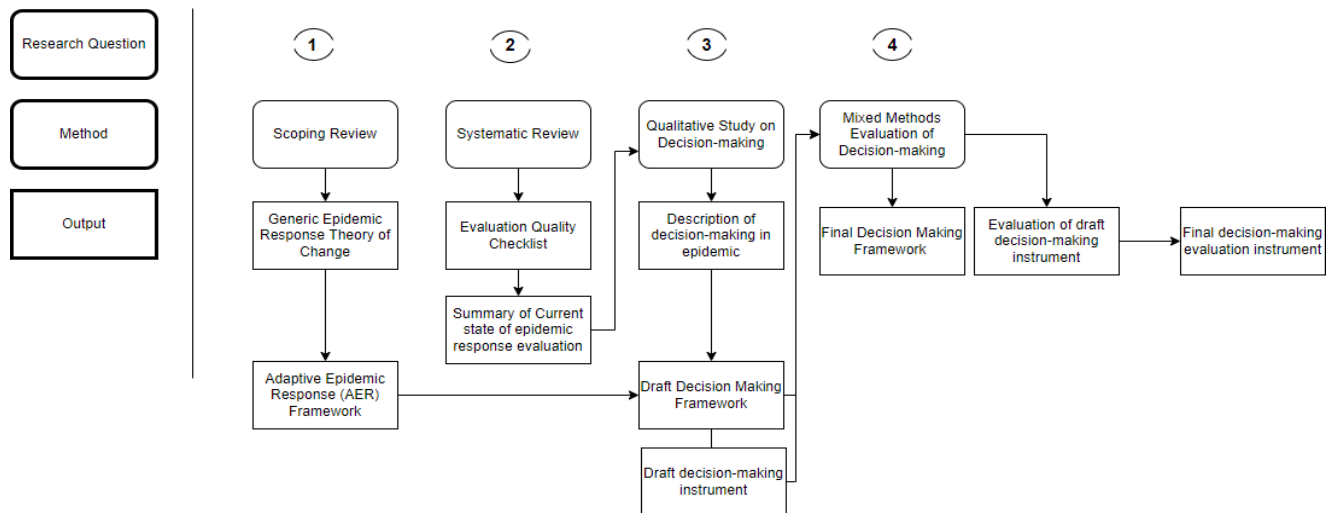


Figure 2 PhD Project Summary including methods and expected outputs.

Research question one was undertaken through a scoping review of the published and grey literature. The resulting paper compiled contemporary public health evaluation frameworks published since 2010 and considers their suitability for evaluating the response to epidemics in low-income and humanitarian settings. A Theory of Change was developed to guide the search and assess the various frameworks. The review and assessment of the frameworks resulted in the development of a new Adaptive Epidemic Response (AER) evaluation framework. This framework provided a theoretical understanding of the key dimensions of epidemic response evaluations, including the types of possible analyses that could be undertaken at various points in a response evaluation.

To answer research question two, a systematic review of scientific databases as well as the published and grey literature was undertaken. This exploration of the real-world practice of epidemic evaluations complemented the theoretical focus of paper 1. The review considered

regional, national, and subnational epidemic evaluations undertaken in response to recent epidemics (2010-2019). Reports in the English and French languages were reviewed within low-income and humanitarian settings. An evaluation quality checklist was developed and used to score evaluations based on their reported scope, methodology, findings, and recommendations. From this systematic review and quality assessment, an understanding was gained of the current status of epidemic response evaluations, including strengths and limitations.

The limited number of evaluations on decision-making prompted research question three. A qualitative case study of the ongoing COVID-19 epidemic response in Somalia was undertaken with a deep dive into contextual politics. The rationale for the selection of the Somali national response to COVID-19 was based upon considerations described previously and, opportunistically, interest in this research expressed by different Somali response actors that the PhD candidate was already in touch within the context of other work. Review of documents, individual key informant interviews and group interviews were used to test an a priori draft decision-making framework. This framework drew upon the AER in paper 1 and is further refined through data collected in the course of addressing this third research question. The draft decision-making framework and the results of key informant interviews also provided an impetus for the development of a decision-making audit tool.

A mixed methods evaluation of decision-making in the context of the COVID-19 response in Somali sought to answer research question four. The focus in this study was on decision-making of operational agencies within which the audit tool was piloted. For the purpose of this PhD thesis, operational agencies were defined as agencies who directly implemented health services. After piloting of the audit tool and completing the post-pilot key informant interviews, the decision-making audit tool was finalised and is presented here as an additional output of the thesis.

3. Research Organization

3.1 Ethics

No ethics approval was required for reviews of the literature (papers one & two). For papers three and four, ethics approval was obtained from the ethics review committee of the London School of Hygiene and Tropical Medicine (Ref: 22778 /RR/21778, Ref: 26369 /RR/2516226) and by the Ministry of Health and Social Services of the Federal republic of Somalia (Ref: MOH&HS/DGO/0994/Aug/2020)) as well as the National Institute of Health, Federal Republic of Somalia (Ref: NIHS0102208).

Written informed consent was received from all participants. All ethics certificates, participant information sheets and informed consent forms can be found in Annex 10.5 Ethical Approval.

3.2 Collaboration

Colleagues at the London School of Hygiene and Tropical Medicine screened articles for relevance as part of the systematic review (paper 2). The Chief Medical Officer (CMO) of Somalia, the Federal Ministry of Health and the Heritage Institute for Policy Studies, a think-tank in Mogadishu, Somalia, provided logistical and research support for paper 3. The Heritage institute hosted the PhD candidate in Mogadishu and provided transportation and introduction to key informants. The CMO provided introductions to key informants within the federal government of Somalia. In paper 4, WHO Somalia and CARE Somalia agreed to collaborate on the piloting of the decision audit tool. They hosted the PhD candidate in Mogadishu and Garowe respectively and provided access to key documents and staff necessary for the pilot.

3.3 Funding

The open access publication fees of all four research papers, as well as field costs and travel for research papers three and four were covered by UK Research and Innovation as part of the Global

Challenges Research Fund (grant number ES/P010873/1). Additional support was received by the candidate through a personal Rotary Global Scholar grant. The candidate conducted PhD research while employed full-time at the London School of Hygiene and Tropical Medicine on different unrelated projects.

PART TWO

4. Research Papers

4.1 Research Paper 1: Towards systematic evaluation of epidemic response during humanitarian crises: a scoping review of existing public health evaluation frameworks

This scoping review highlights the lack of an existing comprehensive epidemic response evaluation framework. A theory of change is presented to guide the literature search and review. The compiled public health evaluations are assessed for their suitability for epidemic response evaluation. While no single existing framework was found to be suitable for epidemic response evaluation, aspects of some frameworks were useful for the development of the Adaptive Epidemic Response (AER) framework.

This paper is supplemented in annex 10.1 Supplementary Material for Paper 1 by the scoping review, extraction table and search strategy.



RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

SECTION A – Student Details

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Thesis Title	Developing an approach to evaluating epidemic decision-making in low resource and humanitarian settings		
Primary Supervisor	Professor Francesco Checchi		

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?	BMJ Global Health		
When was the work published?	January 2020		
If the work was published prior to registration for your research degree, give a brief rationale for its inclusion			
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SECTION E

Student Signature	[Redacted]
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Supervisor Signature	[Redacted]
Date	20/09/2022

Towards systematic evaluation of epidemic responses during humanitarian crises: a scoping review of existing public health evaluation frameworks

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ABSTRACT

Epidemics continue to pose a significant public health threat to populations in low and middle-income countries. However, little is known about the appropriateness and performance of response interventions in such settings. We undertook a rapid scoping review of public health evaluation frameworks for emergency settings in order to judge their suitability for assessing epidemic response. Our search identified a large variety of frameworks. However, very few are suitable for framing the response to an epidemic, or its evaluation. We propose a generic epidemic framework that draws on elements of existing frameworks. We believe that this framework may potentially be of use in closing the gap between increasing global epidemic risk and the ability to respond effectively.

INTRODUCTION

Despite progress in reducing the impact of infectious diseases, they still account for between a quarter and a third of global mortality.¹ Epidemics of these diseases disproportionately affect those in low and middle-income countries.² Populations affected by humanitarian crises are also at increased risk of epidemic-driven excess mortality and morbidity.³ In the past half century, 20 epidemic-prone diseases including dengue, typhoid and haemorrhagic fevers have either re-emerged or spread geographically. As the world's population continues to grow and international travel intensifies, so does the threat of epidemics.⁴

There is concern that the global ability to respond to epidemic has not kept pace with their growing threat. The failure to initially contain the Ebola pandemic in west Africa focused attention on weak international public health systems and epidemic response capabilities.⁵ The failure to respond appropriately and at scale is not confined to epidemics

Key questions

What is already known?

- Effective epidemic response continues to be hampered by a number of factors. Systematic evaluations of epidemic response are a means of improving response in ongoing and future epidemics.

What are the new findings?

- No comprehensive epidemic response-specific evaluation framework was identified in the literature. Aspects of existing public health evaluation frameworks can be used to construct a new epidemic response evaluation framework.

What do the new findings imply?

- The proposed adaptive epidemic response framework constitutes a basis on which to construct a novel evaluation approach specific to epidemics. Improved evaluations support improved response.

of international concern, but has also been a long-standing weakness at national and subnational levels, even with regard to commonly occurring pathogens such as measles, cholera and malaria.⁶ Delayed detection and declaration, decision-making based on political and economic considerations, normalisation of epidemics as routine and poor coordination and resourcing have all been posited as contributors to poor epidemic response.⁶ However, such factors are typically identified during post-response evaluations. Therefore, there remains a need to support the actors involved in epidemic response in the real-time identification and mitigation of constraining factors that reduce the effectiveness of the response itself.

The development of an epidemic response evaluation approach should be based on a comprehensive evaluation framework, which should in turn be underpinned by a clear

theory of change (ToC). The latter should map how a timely epidemic response effort can lead to decreased mortality and morbidity and ultimately better health for the population, in an ideal scenario. The proposed framework should identify both the critical steps/activities/processes in a response and the various evaluation dimensions on which these can be assessed. A ToC is important in developing an evaluation framework as it provides a clear depiction of the various pathways an intervention may take towards a set of outcomes while explicitly articulating implicit assumptions. To inform the development of a robust epidemic response evaluation framework, we defined a ToC and reviewed the characteristics of existing public health emergency frameworks for both real-time and post-response evaluations. We focused our review on public health frameworks that could potentially address the design, process, output and outcome of an epidemic response rather than those focused on impact, for which epidemiological studies are usually required, and may generate findings too late to influence in time the response. Furthermore, we excluded frameworks relating to resilience to or recovery from emergencies, as our focus was on the immediate response to an epidemic.

METHODS

Search strategy

We undertook a scoping review of the public health evaluation literature (both peer reviewed and grey) in emergency settings. A scoping review is a type of review whose primary purpose is to map the existing literature in a field of interest in terms of the volume, nature and characteristics of the primary research.⁷ The MEDLINE, EMBASE, Global Health and Web of Science databases were searched between 2008 and 2019. The following keywords were used: ‘Public health’ OR ‘health’ OR ‘nutrition’ OR ‘WASH’ OR ‘Water sanitation’ or ‘Hygiene’ AND ‘evaluation’ OR ‘assessment’ OR ‘appraisal’ AND ‘Framework’ OR ‘structure’ OR ‘Conceptual framework’ AND ‘humanitarian’ OR ‘emergency’ OR ‘disaster’ (table 1). A search of the grey literature was undertaken

using Google and Google Scholar with the same search terms with results extracted from the first 100 hits. The full database-specific search strategy can be found in the online supplementary material.

As this was a scoping review to build a framework rather than systematically synthesise evidence, we omitted steps characteristic of systematic reviews including hand searching of reference lists and relevant journals, consultation with experts and bias/quality grading.

Inclusion and exclusion criteria

We included any document published in the period 2008–2019 in the English language and focused on 2018 World Bank-classified low and middle-income countries. We considered any study design but excluded evaluations of biomedical interventions (eg, drugs or medical devices), hospital-based evaluations, opinion pieces, magazine and newspaper articles.

Data extraction and analysis

We developed an epidemic response ToC for the purpose of this review as a means of identifying the various activities in an epidemic response, their linkages across the response and the potential avenues to impact (figure 1). A ToC is a model that explains how activities in an intervention can contribute to results that lead to impacts, given certain assumptions.⁸ It is useful in conceptualising programme logic and is critical for framing the monitoring and evaluation of an intervention. We used this ToC as a basis to select and assess public health evaluation frameworks identified during the literature review. Specifically, frameworks were considered for narrative synthesis when they satisfied the following criteria:

1. Can the framework be used in exploring any dimension of the ToC?
2. Does the framework encompass domains or concepts that would be useful for responders and decision-makers during an active response and/or evaluators after the response?
3. Is the framework useful for exploring the design, process, output and outcome stages of an epidemic response (ie, not focused on resilience, recovery or impact)?

In applying criterion 2, we further categorised frameworks based on their intended audience:

- A. Project managers and responders and primarily a guide on how to respond.
- B. Academics and primarily aiming to describe and deconstruct a complex situation.
- C. Evaluators and suggesting what to evaluate.

An extraction table listing key domains of interest was created and populated.

Patient and public involvement

As this was a review of the literature, no patients were involved in the design of the study.

RESULTS

Search output

A total of 2113 records were identified (figure 2). After full-text reviews, a total of 41 documents were selected for

Table 1 Search terms		
Health domains	Evaluation	Humanitarian
Public health	Assessment	Emergenc*
Health	Appraisal	Disaster*
Nutrition	Framework*	Cris*s
WASH	Structure	
Water sanitation	Conceptual framework*	
Hygiene	Program* evaluation*	
	Evaluation framework*	
	evaluation* ADJ3 method*	
	Evaluation ADJ3 model*	
	Service* ADJ2evaluation*	

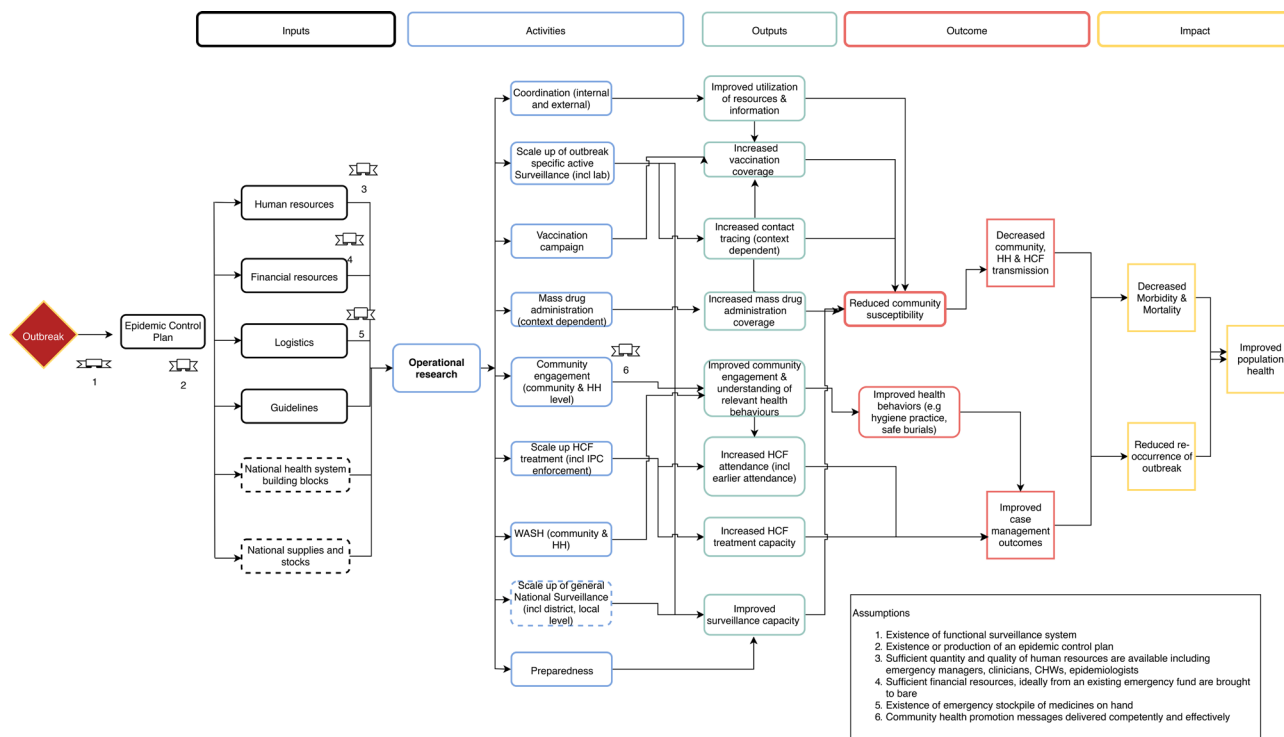


Figure 1 Theory of change of generic epidemic response. CHW, Community Health Worker; HCF, Health Care Facility; HH, Household; IPC, Infection Prevention & Control; WASH, Water, Sanitation and Hygiene.

full analysis. Among the 41 records, 39 presented or used an explicitly named framework. A further two records did not specifically name a framework but did present some

evaluation criteria and dimensions that could be extracted. Of these 39 records, 1 was an epidemiological study, 6 were guidelines, 15 evaluated an intervention, 7 described an intervention but did not provide an assessment while the remainders were policy documents, guidelines or reviews of a specific health topic in emergency settings (table 2).

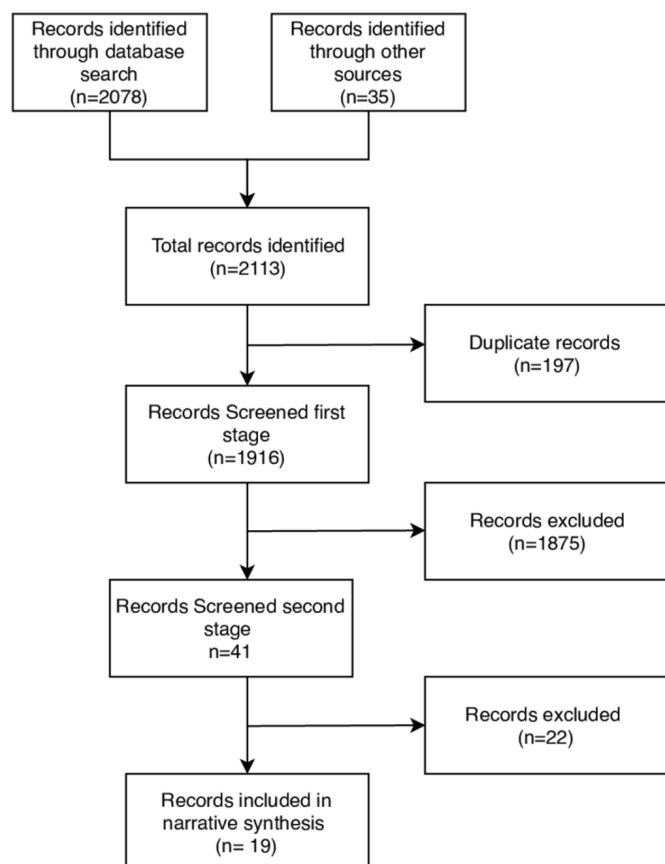


Figure 2 Records identified and screened in this review.

Key characteristics and common dimensions

The interventional studies had a wide geographical coverage with half of studies (n=12) focusing on a specific emergency-affected country or population in sub-Saharan Africa, the Middle East or South East Asia. Many of the studies also listed specific subpopulations as the targets of the intervention being studied such as internally displaced populations, refugees or victims of a natural disaster. Many of the non-interventional studies did not mention specific humanitarian contexts or populations but had a broader focus. A substantial number of records (n=16) did

Table 2 Types of record included in the review

Type of record	Count
Epidemiological study	1
Guideline	6
Intervention study (descriptive)	7
Intervention study (evaluation)	15
Policy study	4
Review study	8
Total	41

reference an epidemic as a type of emergency with cholera and Ebola as the most common pathogens.

Approximately one-third (n=14) of studies with explicitly named frameworks used both primary and secondary methods with roughly equal numbers using either mainly primary or secondary methods. Many studies (n=17) relied on mixed methods data for their findings while a similar number (n=16) relied mainly on qualitative data, with few (n=6) relying exclusively on quantitative data. Only half of the reports (n=19) presented indicators to be used alongside the evaluation framework: of these, 2 presented input indicators, 11 presented output indicators, 5 presented process indicators, 17 presented outcome indicators and 3 presented impact indicators.

Description of short-listed frameworks

Table 3 lists frameworks assessed against the eligibility criteria for narrative synthesis (note that instances of similar frameworks being used across different reports have been combined into a single row).

After applying the vetting criteria in table 3, a total of 13 frameworks from 19 records were brought forward for narrative synthesis. The results show that there are a wide variety and range of frameworks for public health programmes in emergencies. These range from generic conceptual frameworks for framing an approach to disaster response to very detailed, prescriptive frameworks for evaluating specific programmes. A short description of each of the frameworks is included below grouped according to the primary target audience.

Responder-focused frameworks

Humanitarian Analysis and Intervention Design framework

This model by Heyse *et al*⁹ was developed to support humanitarians in rapid, evidence-based programming in humanitarian response. It purports to do this by building understanding of the problem, possible interventions and, finally, appropriate, feasible and safe interventions given the context. The authors describe this framework as a meta-model as it draws on and synthesises elements of existing analytical and humanitarian diagnostics frameworks. The authors propose specific tools for analysing each of the three core elements: crisis contexts, interventions and stakeholders. The underlying logic of the framework is that practicable and appropriate humanitarian interventions can only be identified by linking proper contextual understanding with potential interventions and stakeholder analysis.

Decision-making framework for vaccination in acute humanitarian emergencies

This framework developed by the WHO and used in South Sudan¹⁰ provides guidance on selection of vaccination strategies in humanitarian crisis settings. It has three core components: (1) assessing the risk of vaccine-preventable disease in the local population, (2) vaccine selection and characteristics to consider, and (3) local contextual constraints that impact on timely decision-making. It is

intended to be applied in both short-term and protracted crises with the outcome of saving lives and reducing the burden of disease.

Integrated complexity-information flow impediment framework

This framework developed by Altay and Labonte¹¹ describes the complexity and resultant challenges in humanitarian information flow during the Haiti earthquake response. In it, the authors analyse the implications of these barriers on effective humanitarian response and offer recommendations on overcoming them. They propose an integrated complexity-information flow impediment framework which is an amalgamation of two concepts: complex systems and information flow impediments. Complex systems such as might be found in the inception of a humanitarian response refer to 'the evolution of new structures and non-linear patterns arising from the inter-relationships and interconnectivity among and between elements located within a system and between that system and its environment' while information flow impediments refer to those elements that might impede the effective flow or usage of information.

Kapiriri and Martin's priority setting evaluation framework

Initially developed to identify successful priority setting in low and middle-income countries, Kapiriri and Martin's framework was applied to priority setting with regard to tackling several disease epidemics in Uganda. The framework comprised five dimensions: (1) priority setting context, (2) prerequisites (elements, such as resource allocation, necessary for successful priority setting), (3) priority setting process (processes such as stakeholder consultation that need to be undertaken), (4) implementation, and (5) outcome and impact. The framework also provides means of verification and indicators for each of the dimensions. The framework was able to identify successful drivers of epidemic priority setting in the Ugandan context including reliable evidence collection, stable sociopolitical context and credible institutions. It also provided recommendations on areas in need of strengthening in order to better drive successful prioritisation and control of epidemics.

de Jong's public health prioritisation framework

Proposed in the context of addressing the mental health burden of youth in humanitarian settings, the framework provides a means of translating programme assessments into priority activities. It comprised 10 factors to be considered in selecting and prioritising response activities: (1) locally perceived needs and concerns; (2) prevalence and incidence; (3) severity of problems and disorders; (4) treatability and feasibility; (5) expertise, knowledge and availability of practitioners; (6) ethical applicability; (7) political acceptability (eg, in managing human rights violations); (8) cultural sensitivity; (9) programme sustainability; and (10) cost-effectiveness.

Table 3 Description of frameworks derived from reports that have progressed beyond the first stage screening

Reference	Name of framework, if any	Relevant to theory of change?	Useful for responders or evaluators?	Encompasses design to outcome stages?	Progressed to narrative synthesis?
Heyse <i>et al</i> ⁹	Humanitarian Analysis and Intervention Design (H-AID) framework	Yes	Yes—responder focused	Yes	Yes
Wong <i>et al</i> ²⁵	Framework for the longitudinal phases of disasters	Yes	No—academic focused	Yes—covers all stages of a response	No
Puri <i>et al</i> ²⁹	Stages of emergency framework	No	No—academic focused	No—focused on impact	No
OECD/DAC ³⁰	Organisation for Economic Co-operation and Development (OECD) framework for evaluating complex emergencies	Yes—can be used to explore how response outputs are performing	Yes—evaluator focused	Yes—focused on outcomes	Yes
Murphy <i>et al</i> ²¹	RE-AIM framework	Yes	Yes—evaluator focused	Yes—focused on implementation of activities and potential impact	Yes
Moore <i>et al</i> ²³	Framework for process evaluation of complex intervention	Yes—can be used to explore if activities are implemented as intended and relationship to outcome	Yes—evaluator focused	Yes—focused on processes	Yes
Ciglene <i>et al</i> ¹⁰	Decision-making framework for vaccination in acute humanitarian emergencies	Yes—can be used in one key epidemic response activity (vaccination)	Yes—responder focused	Yes	Yes
Altay and Labonte ¹¹	Integrated complexity-information flow impediment framework	Yes—information generation and flow (surveillance)	Yes—responder/decision-makers focused	Yes—process and outcome of information	Yes
Huicho <i>et al</i> ³¹	Framework for measuring efforts to increase access to health workers in underserved areas	No	Yes—evaluator focused	Yes—covers from design to impact	No
Oppenheim <i>et al</i> ³²	Epidemic Preparedness Index framework	Yes—response activities	No—academic focused	No—preparedness focused	No
Burnham <i>et al</i> ; Dobai and Tallada; Fogden <i>et al</i> ; IFRC; Lam and Ly; Thormar; Darcy <i>et al</i> ^{14–18 33–35}	IFRC and UNICEF frameworks	Yes	Yes—evaluator focused	Yes—covers all stages of a response	Yes
Nickerson <i>et al</i> ³⁶	Health systems framework	Yes—can be used to explore input and impact of epidemic response	No—academic focused	Yes	No
Fitter <i>et al</i> ³⁷	CDC's Essential Package of Health Services framework for Haiti	Yes—can be used to explore how research underlays response	Yes—evaluator/academic focused	No—focused primarily in resilience	No
Heitzinger <i>et al</i> ³⁸	Unnamed framework	Yes—evidence-based decision-making	Yes—responder focused	Yes—process	Yes
Jordans <i>et al</i> ³⁹	Care utilisation model	No	No—academic focused	Yes—focused feasibility in design and implementation of package of service	No
Chung and Chung ⁴⁰	CBR framework	No	Yes—evaluator focus	No—focused on impact	No
Checchi <i>et al</i> ^{41 42}	Conceptual framework of public health information domains in crises	Yes—can be used to understand chain of causality that affects epidemics	No—academic focused	No—focused on impact of drivers on mortality	No
Seeger <i>et al</i> ¹⁹	Emergency risk communication (ERC) conceptual model	Yes—can be used to explore community outreach	Yes—evaluator focused	Yes—focused on outcomes of ERC and processes	Yes
Khan <i>et al</i> ⁴³	Resilience framework for public health emergency preparedness	No	No—academic focused	No—resilience focused	No
Campbell <i>et al</i> ⁴⁴	Framework for assessment of the role of the global strategy in supporting the joining of organisations in Myanmar	No	No—academic focused	No	No
Tumilowicz <i>et al</i> ⁴⁵	Implementation research framework	No	No—academic focused	Yes—process of implementation	No

Continued

Table 3 Continued

Reference	Name of framework, if any	Relevant to theory of change?	Useful for responders or evaluators?	Encompasses design to outcome stages?	Progressed to narrative synthesis?
Kapiriri and Be LaRose ⁴⁶	Kapiriri and Martin's priority setting evaluation framework	Yes—prioritisation of interventions and of diseases to respond to	Yes—responder/decision-making focused	Yes—process of prioritisation	Yes
Figueroa ⁴⁷	Ideation model and pathways framework	No	No—academic focused	No	No
Desie and Ismail ⁴⁸	Accountability to Affected Population (AAP)	Yes—can be used to explore community outreach intervention	No—academic focused	Yes—used in process	No
Task Force on Quality Control of Disaster Management ⁴⁹	Longitudinal framework	No	No—academic focused	No	No
VM <i>et al</i> ⁵⁰	Predictive evaluation framework	No	No—academic focused	No	No
de Jong <i>et al</i> ⁵¹	de Jong's public health prioritisation framework	Yes—can be used to explore prioritisation of alternative epidemic control interventions	Yes—responder/academic focused	Yes—focused on programme design	Yes
Abramson <i>et al</i> ⁵²	Resilience activation framework	No	No—academic focused	No—resilience focused	No
Savoia <i>et al</i> ²⁰	Risk Communications Evaluation (RICE) framework	Yes—can be used to explore community outreach intervention	No—academic/evaluator focused	Yes	Yes
Sambala <i>et al</i> ⁵³	Standardised checklist	Yes—can be adapted to explore activities and process in ongoing epidemic	Yes—responder focused	No—preparedness focused	No
Lin <i>et al</i> ⁵⁴	Unnamed framework	Yes—can be used to explore the structure of the response	Yes—evaluator	Yes—impact	Yes
Van Beurden <i>et al</i> ⁵⁵	Cynefin framework	No	No—academic focused	No	No
D'Ostie-Racine <i>et al</i> ⁵⁶	Wholey's (2004) framework	No	No—academic focused	No	No

CBR, community-based rehabilitation; CDC, US Centers for Disease Control and Prevention; IFRC, International Federation of Red Cross and Red Crescent Societies; RE-AIM, Reach, Efficacy, Adoption, Implementation and Maintenance.

Evaluator-focused frameworks

OECD/DAC framework

The Organisation for Economic Co-operation and Development/Development Assistance Committee (OECD/DAC) framework¹² has served as a basis for a large number of evaluations,¹³ and, though meant for development settings, has been referred to in several emergency evaluations.^{14–18} The main elements in the OECD/DAC framework include relevance (degree to which the activity is suited to the priorities and policies of the target group, recipient and donor), efficiency (the measurement of outputs relative to their inputs), effectiveness (the measurement the extent to which activities achieve their purpose), impact (including the wider effect of the programme on the lives of beneficiaries) and sustainability (the extent to which the programme or impact of the programme is likely to continue after donor funding has been withdrawn).

International Federation of Red Cross and Red Crescent Societies and UNICEF frameworks

Our search identified several public health programme and epidemic response evaluations done by the International Federation of Red Cross and Red Crescent Societies. Although the frameworks used were not explicitly

named, they did consistently consider the same core evaluation elements and were largely analogous to those first proposed by the OECD/DAC. These include 'relevance and appropriateness, effectiveness, efficiency and sustainability'. Some evaluations included impact, coverage and coherence, as additional distinct elements. The same set of core evaluation elements was used by the UNICEF to evaluate a response to cholera in Yemen, with the inclusion of an additional element of connectedness (the extent to which a response contributes to long-term preparedness and prevention of a future epidemic).¹⁸ In evaluations specific to epidemic response, both organisations mapped out relevant activities such as social mobilisation, contact tracing, case management, coordination and surveillance onto the primary evaluation elements listed above.

Risk Communications Evaluation frameworks

The emergency risk communication (ERC) conceptual model framework by Seeger *et al*¹⁹ focuses on evaluating ERC in public health emergencies. It is composed of three primary stages: inputs, ERC message development and dissemination process, as well as ERC outcomes. Inputs are drawn from experience of relevant parties including US Centers for Disease Control and Prevention, partners

and audiences. ERC message development and dissemination process stage includes elements which are important for assessing ERC on audiences including types of messaging, sufficiency of messaging and timeliness of messaging. The framework then illustrates how these elements interact to produce short, medium and long-term outcomes in the last stage.

The Risk Communications Evaluation framework developed by Savoia *et al*²⁰ also focuses on evaluating risk communication in public health emergencies. Through a systematic review of the literature, the authors identified outcomes for ERC. These include information environment-level outcomes such as message content, population-level outcomes such as information-seeking behaviours, as well as system-level outcomes such as policies and mitigation strategies. They then identified processes contributing to outcomes through use of key informant interviews. Together with macro context, mission and structural capacity, the authors presented a framework which highlights potential levels of evaluations and illustrates the complexity of ERC processes through use of feedback loops.

Reach, Efficacy, Adoption, Implementation and Maintenance framework

A qualitative study by Murphy *et al*²¹ attempted to assess a new model of diabetes healthcare implemented by Médecins Sans Frontières in a hospital in the eastern Democratic Republic of Congo. The study sought to understand patient and provider perspectives on the new model in order to determine factors that could strengthen or impede implementation. The study used the RE-AIM framework,²² which observes Reach (proportion of the population affected by the programme), Efficacy (negative and positive outcomes), Adoption (degree of participation), Implementation (degree to which the programme is implemented as intended) and Maintenance (institutionalisation of the programme).

Framework for process evaluation of complex interventions

Developed as part of the Medical Research Council's guidance on process evaluation,²³ this framework elucidates the causal mechanisms within complex interventions that link inputs with the outcome. Complex interventions are those that contain several interacting components and are characterised by unpredictability, emergence and non-linear outcomes. Emergence refers to the appearance of complex patterns from relatively simple interactions while non-linear outcomes refer to causal steps in an outcome that are more complex than a single linear chain and include, for example, feedback loops. The importance of undertaking process evaluations is premised on the need to capture how implementation occurred in practice in order to avoid type 3 error (dismissing sound implementation theory due to a failure to implement an intervention appropriately).

Unnamed frameworks

Two unnamed frameworks made it to the synthesis stage of this scoping review. They include a framework developed by Lin *et al* conceptualising the response to the 2008 Sichuan earthquake. The framework is based on four domains of emergency response: leadership, medical response, public health response and societal response with each domain in turn comprised of subdomains consisting of relevant response activities. Additionally, an unnamed framework used by Heitzinger *et al* was presented as a means of assessing the success of operational research in the midst of an epidemic. Used in the 2017 Madagascar plague response, it puts forward four outcome dimensions: dissemination of results, peer-reviewed publication, changes to policy and practice, and improvements in programme performance and health.

DISCUSSION

In the past three decades there has been an significant surge in the production of evaluations in emergency settings.²⁴ However, as previous studies have noted and our results have confirmed, there remains a wide variability in these evaluations in scope, content and audience.^{25 26} Due to time and resource constraints, our review focused on more recent frameworks in the published literature and may have missed earlier possibility relevant frameworks. Additionally, our decision to limit the search of the grey literature may also have minimised the number of relevant frameworks acquired. We have attempted to offset these limitations by intentionally opting for a broad search approach within the review time frame (2009–2018) in order to compile a wide range of frameworks from which to draw. This decision, in addition to the rapid nature of the review, provided ample variety in the frameworks compiled from both grey and peer-reviewed literature in a relatively short time frame. Nevertheless, there were some important trends that emerged. In keeping with the acknowledged importance of context in evaluation methodology,²⁷ most frameworks in this review emphasised the importance of context in designing an intervention and assessing its performance. However, this often resulted in evaluation approaches that were narrowly focused on the setting in which they were used. As a result, insufficient attention was given to the potential applicability of the proposed frameworks in alternative settings and circumstances. Evaluations are cyclical and recurring process meant to assess and improve intervention performance in a stepwise fashion.²⁸ Few studies in this review however explicitly mentioned the need for an iterative approach to applying their proposed frameworks but rather presented the application of the framework as a single event. Few frameworks provided any information on redesigning an intervention particularly in the event of failure to achieve outcomes or in light of unintended consequences. This is a particularly large gap given the

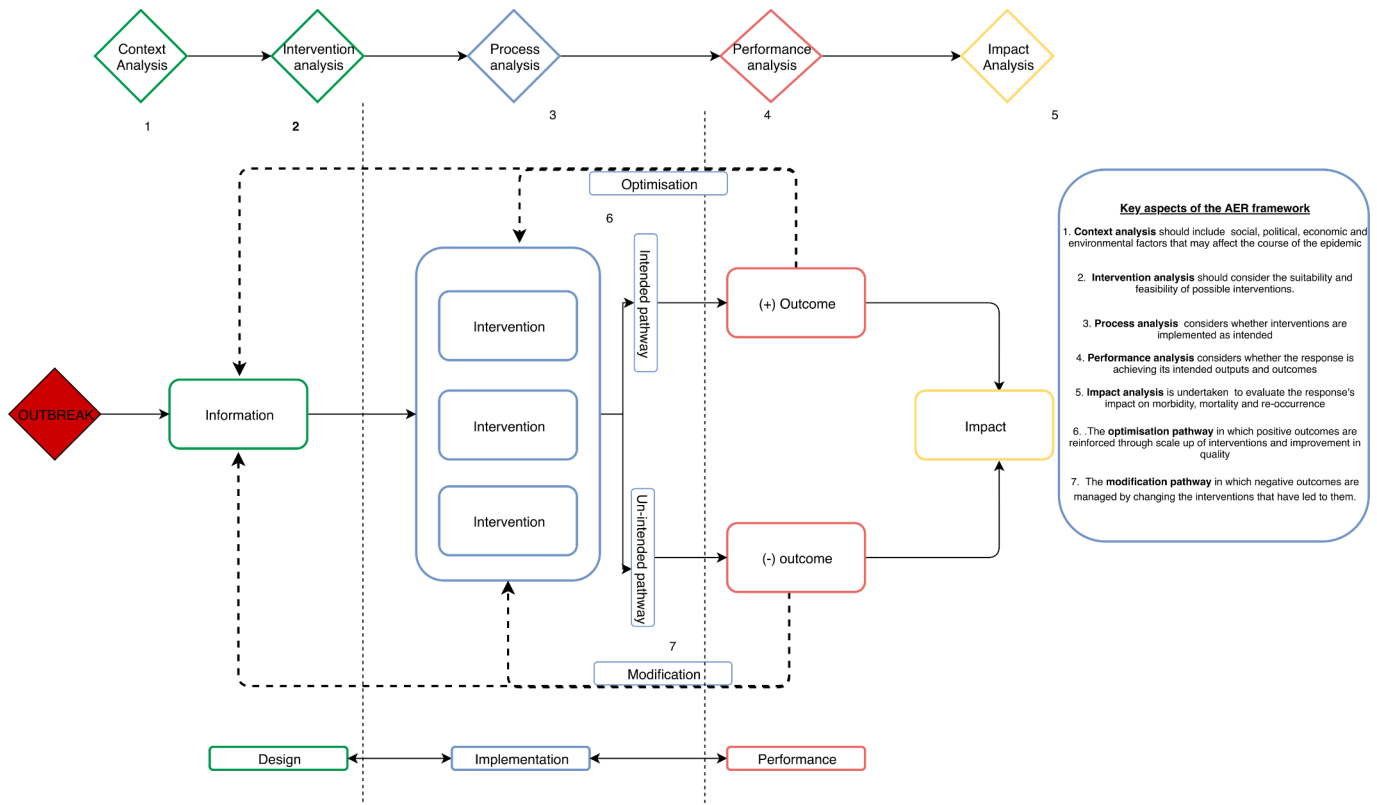


Figure 3 The adaptive epidemic response (AER) framework. AER, adaptive epidemic response.

complex and fluid nature of public health provisioning in emergency settings.¹¹

Lastly, frameworks captured as part of this scoping review tended to focus on a narrow segment of an intervention’s lifespan. Many frameworks, for example, focused on the design of suitable interventions or on priority setting within the implementation phase or in many cases some aspect of performance. No framework provided a holistic all-encompassing approach to evaluating all phases of an intervention’s life cycle. Without such a framework, it is difficult to make an overall judgement of an emergency public health intervention.

With respect to epidemic response evaluation, no single overarching framework was found. Although no single framework in this review captures all potentially relevant dimensions and approaches for evaluating the response to epidemics, taken together our review provides ample material from which to construct an epidemic-specific one.

We therefore propose the adaptive epidemic response (AER) framework as a means of filling this gap (figure 3). The AER framework presents key elements and activities that are primarily relevant to responders and decision-makers in the midst of an epidemic but may also be used to guide postresponse evaluations.

It is divided both vertically and horizontally. Vertically it comprised of the three interlinked components of a response: design, implementation and performance. These components do not occur linearly but are iterative and their cyclical nature is represented through

double-headed arrows. Horizontally, the top of the framework presents the thread of analyses that can and should be conducted and for which specific instruments may be developed. The bottom of the framework illustrates the flow of information and activities.

As adapted from the Humanitarian Analysis and Intervention Design, the AER framework suggests that at the outset of an epidemic (1), a context analysis should be undertaken to gain understanding of social, political, economic and environmental factors that may affect the course of the epidemic. The next step (2) is to undertake an intervention analysis in which suitable and feasible interventions are considered and a package of interventions, collectively known as the response, is decided on. Possible interventions include establishing coordination mechanisms, surveillance, preventive measures (eg, vaccination, health promotion, Water Sanitation and Hygiene) and case management. In this stage, elements of de Jong’s public health prioritisation framework as well as Kafiriri and Martin’s priority setting evaluation framework can be used to undertake a structured intervention analysis and prioritise key interventions.

In the implementation phase, the selected interventions are rolled out. Here (3) a process analysis can be undertaken to explore whether these interventions are implemented as intended. Interventions may then follow two paths: that intended by responders/decision-makers and that not intended by responders. The intended pathway leads to positive outcomes such as reduction in transmission, improved health behaviour and improved

case management while the unintended pathway leads to negative outcomes such as increased community hostility, increased resistance to contact tracing and as a result increased transmission.

At this stage, a performance analysis (4) may be undertaken using both quantitative and qualitative methods to describe the extent to which the response is achieving its intended outputs or outcomes, and understand reasons for the measured performance. Here the evaluator-focused frameworks can be drawn from to develop specific performance assessment instruments. Lastly, an impact analysis (5) can be done to explore impact on morbidity, mortality and reoccurrence. Both negative and positive outcomes generate information which can then be used to adapt or optimise the response. This portion of the framework (adopted from the WHO decision-making framework for vaccines in emergencies as well as framework for operational research effectiveness) is illustrated by adaptation feedback pathways going back to the design and implementation dimensions. In the case of interventions leading to positive outcomes, the response is optimised (6) through actions such as increasing the geographic accessibility of selected interventions and improving quality. In the case of interventions leading to unintended negative outcomes, the response is modified (7) through actions such as selection of different sets of interventions and/or other adjustments to the response (eg, improving coordination, better engagement with beneficiaries, and so on). The proposed framework is intended to support responders and decision-makers during an epidemic, as well as evaluators. It is meant to be sufficiently generic to be adapted to different pathogens, country settings and stages of an epidemic. Both quantitative and qualitative approaches can be used in exploring its facets in order to provide diverse but ultimately complementary information.

In order to build on the findings of this study, we intend to further refine the proposed framework through a follow-up systematic review of published epidemic response evaluations. The broad and wide approach used in this scoping review will be complimented by the depth and focused approach from the planned systematic review. Furthermore, we propose that the resulting framework be used as a starting point to develop specific analysis instruments. Lastly, we recommend that the framework and resultant analysis instruments be piloted in a variety of settings to assess the response to both ongoing and concluded epidemics.

Contributors All authors contributed to the design of the study. AW carried out the search and wrote the first draft. All authors read and approved the final manuscript.

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4.2 Research Paper 2: The practice of evaluating epidemic response in humanitarian and low-income settings: a systematic review

This systematic review highlights the significant gap in epidemic response evaluations with limited numbers of epidemic responses having a published evaluation report. A quality assessment of the evaluation reports found a high degree of variability limiting comparability and utility of evaluation findings. The review concludes with a need to standardize epidemic response evaluations, improve coverage and quality of evaluations in order to strengthen future epidemic response.

This paper is supplemented in annex 10.2 by the search strategy, extraction table, list of compiled epidemics and evaluation reports as well as an evaluation quality checklist.



RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

SECTION A – Student Details

Student ID Number	296802	Title	Mr
First Name(s)	Abdihamid		
Surname/Family Name	Warsame		
Thesis Title	Developing an approach to evaluating epidemic decision-making in low resource and humanitarian settings		
Primary Supervisor	Professor Francesco Checchi		

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

SECTION B – Paper already published

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RESEARCH ARTICLE

Open Access

The practice of evaluating epidemic response in humanitarian and low-income settings: a systematic review



Abdihamid Warsame* , Jillian Murray, Amy Gimma and Francesco Checchi

Abstract

Background: Epidemics of infectious disease occur frequently in low-income and humanitarian settings and pose a serious threat to populations. However, relatively little is known about responses to these epidemics. Robust evaluations can generate evidence on response efforts and inform future improvements. This systematic review aimed to (i) identify epidemics reported in low-income and crisis settings, (ii) determine the frequency with which evaluations of responses to these epidemics were conducted, (iii) describe the main typologies of evaluations undertaken and (iv) identify key gaps and strengths of recent evaluation practice.

Methods: Reported epidemics were extracted from the following sources: World Health Organization Disease Outbreak News (WHO DON), UNICEF Cholera platform, Reliefweb, PROMED and Global Incidence Map. A systematic review for evaluation reports was conducted using the MEDLINE, EMBASE, Global Health, Web of Science, WPRIM, Reliefweb, PDQ Evidence and CINAHL Plus databases, complemented by grey literature searches using Google and Google Scholar. Evaluation records were quality-scored and linked to epidemics based on time and place. The time period for the review was 2010–2019.

Results: A total of 429 epidemics were identified, primarily in sub-Saharan Africa, the Middle East and Central Asia. A total of 15,424 potential evaluations records were screened, 699 assessed for eligibility and 132 included for narrative synthesis. Only one tenth of epidemics had a corresponding response evaluation. Overall, there was wide variability in the quality, content as well as in the disease coverage of evaluation reports.

Conclusion: The current state of evaluations of responses to these epidemics reveals large gaps in coverage and quality and bears important implications for health equity and accountability to affected populations. The limited availability of epidemic response evaluations prevents improvements to future public health response. The diversity of emphasis and methods of available evaluations limits comparison across responses and time. In order to improve future response and save lives, there is a pressing need to develop a standardized and practical approach as well as governance arrangements to ensure the systematic conduct of epidemic response evaluations in low-income and crisis settings.

Keywords: Epidemic, Evaluation, Outbreak, Humanitarian, Low-income

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Background

Infectious disease epidemics continue to pose a substantial risk globally [1]. Epidemics routinely occur in low-income and humanitarian settings [2]. Populations in these settings often do not have the resources to effectively respond to epidemics [3] and as a result are at higher risk of increased morbidity and mortality [4]. Globally, more than 700 million people live in low-income countries [5], while 2 billion live in fragile or conflict-affected settings [6]. Responses to large-scale epidemics or epidemics of newly emergent pathogens tend to generate global attention and corresponding responses incur scrutiny [7–9]. However, evidence on responses to smaller-scale epidemics or epidemics involving well-known pathogens (e.g. measles, cholera) for which effective control measures exist is thought to be limited [10]. Evidence from some limited contexts points to weaknesses in responses ranging from detection, investigation to effective and timely response [11, 12]. However, the practice of epidemic response evaluation has not been systematically assessed in low-income and humanitarian settings. Within public health programming, effective evaluations generate critical evidence and allow for systematic understanding, improvement and accountability of health action [13]. We sought to review the extent to which evaluations of epidemic responses are actually conducted in low-income and crisis settings and describe key patterns in evaluation practice. Specifically, we aimed to (i) identify epidemics reported in low-income and crisis settings, by aetiologic agent, over a recent period; (ii) determine the frequency with which evaluations of responses to these epidemics were conducted; (iii) describe the main typologies of evaluations undertaken; and (iv) identify key gaps and strengths of recent evaluation practice, so as to formulate recommendations.

Methods

Scope of the review

This review (PROSPERO registration CRD42019150693) focuses on recent epidemics in low-income settings, defined using the 2018 World Bank criteria [14], as well as epidemics occurring in settings with ongoing humanitarian responses, as reported in the United Nations Office for the Coordination of Humanitarian Affairs' annual Global Humanitarian Overview. Our search focused on epidemic-prone pathogens commonly occurring in low resource or humanitarian settings and which presented an immediate threat to life. For this reason, our search excluded HIV [15], tuberculosis [16] and Zika [17]. Epidemics occurring within healthcare settings only or within animal populations were considered outside the scope of this review. In order to capture recent trends

and assess contemporary reports, we focused on the period 2010–2019.

Epidemics

Search strategy

The following sources were reviewed in order to compile a list of reported epidemics: World Health Organization Disease Outbreak News (WHO DON) [18], UNICEF Cholera platform [19], Reliefweb [20], PROMED [21] and Global Incidence Map [22]. In line with WHO guidance on infectious disease control in emergencies [23], one suspected case of the following was considered to be an epidemic: acute haemorrhagic fevers (Ebola, Lassa fever, Rift valley fever, Crimean-Congo haemorrhagic fever), anthrax, cholera, measles, typhus, plague and polio. For the remainder of the pathogens, we defined an epidemic as an unusual increase in incidence relative to a previously established baseline in a given setting.

We reviewed WHO DON narrative reports to extract metadata on location (country), year, month and pathogen. Reliefweb was searched for reported epidemics using the search engine and the disaster type filter. For the PROMED database, only epidemics rated as 3 or higher in the 5-point rating system (which reflected a higher degree of certainty in the scale of the epidemic and its potential severity) and in which incident cases and deaths were reported were considered for inclusion. The Global Incident Map database was searched utilizing the inbuilt search function filtering results that were out of scope (wrong location, pathogen, etc.) at the source.

We collated all epidemic records into a single database and removed duplicate reports of the same epidemic based on first date and location of occurrence; duplicated included multiple reports within any given database (e.g. an update on an earlier reported epidemic) and reports of the same epidemic in multiple databases. As phylogenetic or spatio-temporal reconstructions of epidemics were mostly unavailable, we assumed that reports of the same pathogen from within the same country and 4-month period referred to the same single epidemic. We decided to split cross-border epidemics (e.g. the West Africa 2013–2016 Ebola epidemic) into one separate epidemic for each country affected, recognizing that responses would have differed considerably across these countries.

Screening and data extraction

We compiled epidemic reports from various sources into one database. For each epidemic, information on location (country), year, month and pathogen was extracted using a standardized form (see Additional file 1). For each evaluation record, information was extracted on a number of variables including type of evaluation,

location (country), year, month and pathogen using a standardized form (see Additional file 2).

Evaluations

Search strategy

To determine the availability and quality of epidemic response evaluations within recent epidemics, we undertook a systematic review using PRISMA criteria including peer-reviewed and grey literature. We identified peer-reviewed reports by consulting the MEDLINE, EMBASE, Global Health, Web of Science, Western Pacific Region Index Medicus, PDQ Evidence and Cumulative Index to Nursing and Allied Health Literature (CINAHL) Plus databases. We utilized Google, Google Scholar and Reliefweb, to undertake a comprehensive search of the grey literature. Given previously described challenges in using such search engines [24], we reviewed results from the first 150 hits only. We searched the webpages of major humanitarian and health organizations including the World Health Organization (WHO), United Nations Children's Fund (UNICEF), Save the Children, International Federation of Red Cross and Red Crescent Societies (IFRC) and Médecins Sans Frontières (MSF) for evaluation records and contacted these organizations to source non-public evaluations identified through this webpage search. Overarching conceptual search terms synonymous with outbreaks, evaluations and humanitarian crises were utilized. The full search strategy can be found in Additional file 3.

We cross-referenced the reported epidemics with the evaluation reports, matching on date (month and year) and location.

Inclusion criteria

We limited our search to any record that met the following criteria: any document published in the period 2010–2019 in the English and French languages that examined epidemics within low-income countries and humanitarian settings, as defined above. There were no restrictions on study design.

We excluded records relying exclusively on mathematical models of potential responses as the review was focused on responses that were operationally implemented. We also excluded evaluations of a novel diagnostic or treatment; evaluations that focussed on preparedness, resilience or recovery from an epidemic, as opposed to the epidemic period itself; records addressing other health issues (e.g. reproductive health) in the context of an epidemic; epidemiological studies of the epidemic (e.g. transmission patterns, risk factors) that did not explore the response; records classified as clinical research, opinion or news pieces; and abstracts for which full records could not be accessed.

In assessing the eligibility of records for narrative synthesis, we used a broad definition of epidemic evaluation as one in which:

- I. An epidemic was reported to have occurred
- II. The intervention(s) being evaluated began after the start of the epidemic and were specifically implemented in response to the epidemic
- III. The intervention(s) were assessed on at least one specified criterion (i.e. the report was not merely a description of activities).

Screening and data extraction

After removing duplicates, two reviewers independently assessed the relevance of all titles and abstracts based on the inclusion criteria. We retrieved the full text of each article initially meeting the criteria. Two researchers then independently confirmed that full-text records met inclusion criteria. Any disagreements were resolved through discussion and consensus with a third reviewer.

We used the following definitions to classify the type of evaluations retrieved in this search:

- *Formative evaluation*: Evaluation which assesses whether a program or program activity is feasible, appropriate and acceptable before it is fully implemented
- *Process evaluation*: Evaluation which determines whether program activities have been implemented as intended
- *Output evaluation*: Evaluation which assesses progress in short-term outputs resulting from program implementation
- *Outcome/performance evaluation*: Evaluation which assesses program effects in the target population by measuring the progress in the outcomes or outcome objectives that the program is meant to achieve
- *Impact evaluation*: An evaluation that considers 'positive and negative, primary and secondary long-term effects produced by a development intervention, directly or indirectly, intended or unintended.' [25]

Analysis

We undertook a narrative synthesis of the findings and tabulated key characteristics of evaluations. We created an evaluation quality checklist derived from existing standards to grade the quality of the evaluation records. Reference standards included the United Nations' Evaluation Group (UNEG) Quality Checklist [26], the European Commission Quality Assessment for Final Evaluation Reports [27] and the UNICEF-Adapted UNEG

Quality Checklist [28]. We derived 13 evaluation criteria grouped into 4 equally weighted categories: scope, methodology, findings and recommendations. The checklist can be found in Additional file 3.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation or writing of the report. The corresponding author had full access to all the data in the study and had final responsibility for the decision to submit for publication.

Results

Epidemics

A total of 429 epidemics were identified across 40 low-income and crisis affected countries during the study period (Table 1). The most common pathogens reported were *Vibrio cholerae*, measles, poliovirus and Lassa virus.

Epidemics were reported primarily in sub-Saharan Africa, the Middle East and Central Asia. Generally, the more populous countries in each region experienced the highest number of epidemics including Nigeria and the Democratic Republic of Congo in the AFRO region and Pakistan and Sudan in the EMRO region.

Evaluations

A total of 15,124 records were identified and screened based on title and abstract (Fig. 1). The full text of 699 records was assessed for eligibility. A final tally of 132 records was carried forward for cross referencing against reported epidemics and for narrative synthesis [29–160]. See Additional file 2 for full list of included evaluations.

Evaluation characteristics

More than half of the evaluation records assessed outcome of the response, with a substantial number of

Table 1 Number of epidemics by outbreak pathogen and World Health Organization regional office

Disease	Number of epidemics by WHO regional office					Total
	AFRO ^a	EMRO ^b	EURO ^c	PAHO ^d	SEARO ^e	
Anthrax	7	4	2	1	0	14
Brucellosis	0	1	0	0	0	1
CCHF	2	5	1	0	0	8
Chikungunya	2	2	0	1	0	5
Cholera	145	36	3	10	14	208
Dengue	6	11	1	2	11	31
Diphtheria	0	1	0	2	0	3
Ebola	16	1	0	0	1	18
Hepatitis E	2	0	0	0	0	2
Japanese Encephalitis	0	1	0	0	4	5
Lassa Fever	17	0	0	0	0	17
Leishmaniasis	3	0	0	0	0	3
Malaria	10	2	0	1	0	13
Marburg	1	0	0	0	0	1
Measles	20	6	0	1	0	27
Meningitis	8	1	0	0	0	9
Meningococcal disease	11	1	0	0	0	12
Plague	7	0	0	0	0	7
Polio	12	11	2	0	1	26
Rift Valley Fever	3	2	0	0	0	5
Typhoid	0	1	0	0	0	1
Yellow fever	11	2	0	0	0	13
Grand Total	283	88	9	18	31	429

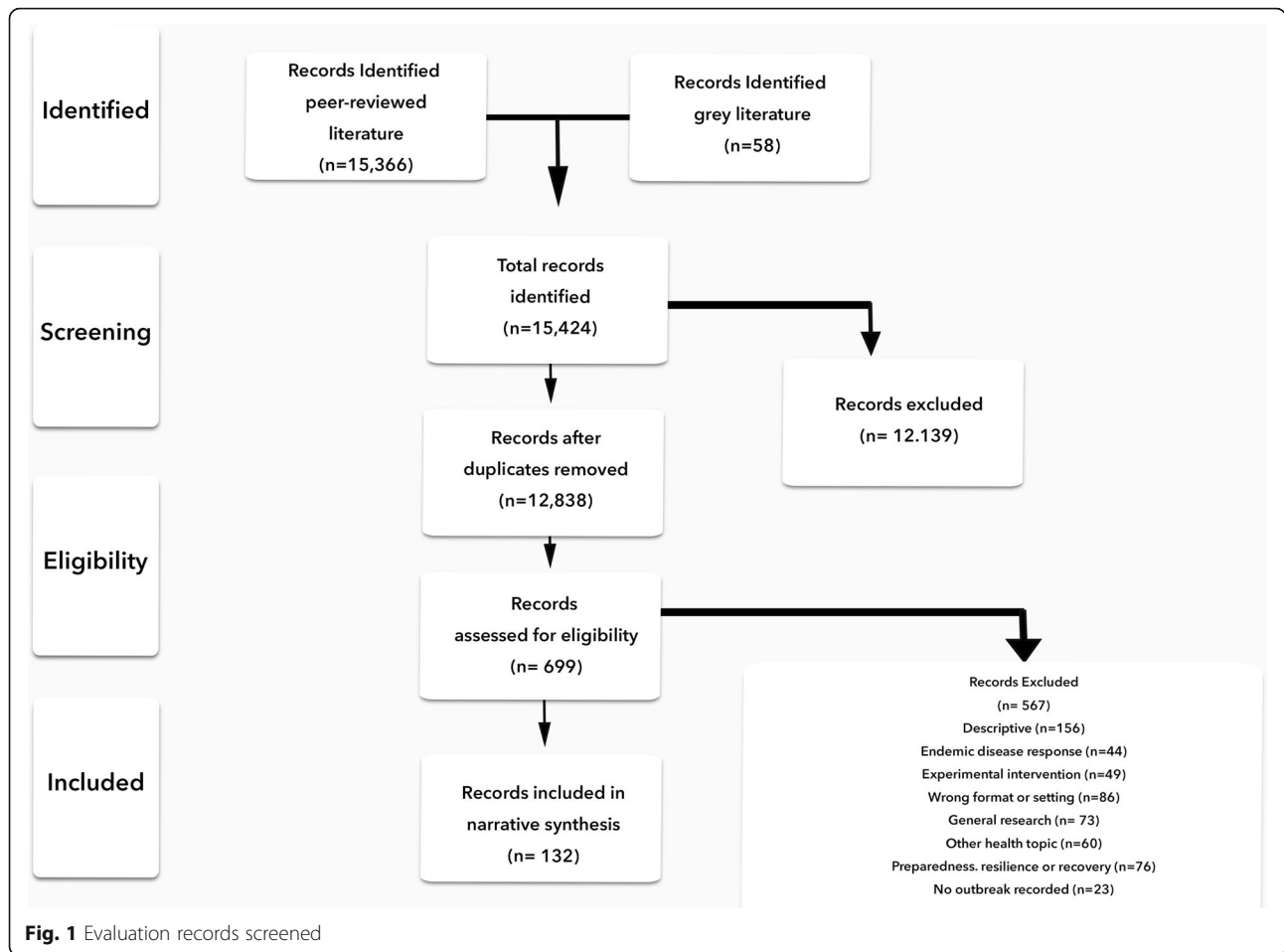
^aWHO African Regional Office

^bWHO Eastern and Mediterranean Regional Office

^cWHO European Regional Office

^dWHO Pan American Regional Office

^eWHO South East Asia Regional Office



process and output evaluations (Table 2). Very few evaluations could be classified as impact or formative evaluations while 4 studies were considered to be of mixed typology. Half of the evaluations reported ($n = 66$) utilizing a mix of primary and secondary data while approximately a quarter of evaluations utilized either mainly primary ($n = 36$) or secondary data ($n = 30$). Additionally, more than half of evaluations ($n = 78$) collected a mixture of quantitative and qualitative data while a smaller proportion relied on either qualitative

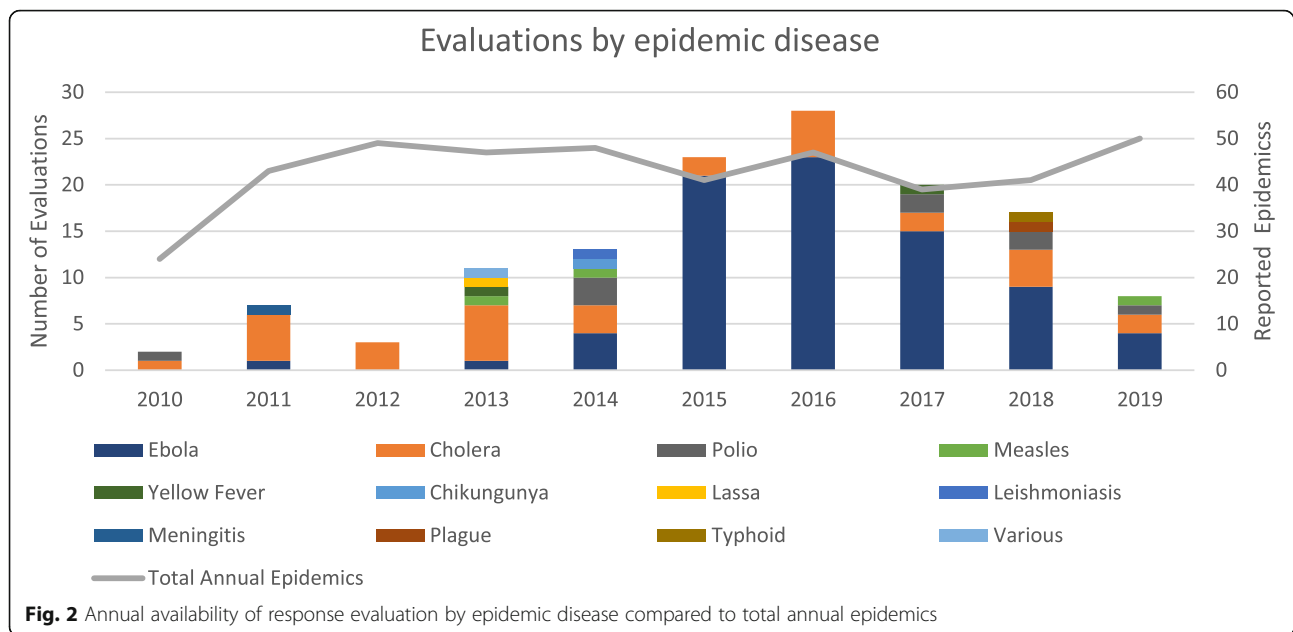
Table 2 Distribution of response evaluations by type

Type of evaluation	Number of evaluations
Formative	4 (3.0%)
Process	27 (20.5%)
Output	14 (10.6%)
Outcome	74 (56.0%)
Impact	9 (6.8%)
Mixed	4 (3.0%)
Total	132 (100%)

data ($n = 18$) and quantitative data ($n = 37$). Few records ($n = 9$) had no explicit evaluation framework or criteria while the majority ($n = 123$) did refer to some evaluation criteria including the OECD evaluation criteria. However, only few ($n = 10$) presented an explicitly named framework which anchored the evaluation approach. Effectiveness was the most widely used evaluation criterion while the most widely evaluated activities included coordination, vaccination, contact tracing, case management and community sensitization. See Additional file 2 for full results. There was an improvement in the availability of evaluation reports over time with fewer evaluations in the first 3 years of the decade ($n = 10$) compared to the last 3 years ($n = 43$) (Fig. 2). Lastly, where evaluations were published, there was an average of 2 years between the onset of an epidemic and publication of the response evaluation.

Quality findings

Quality scores of evaluation reports ranged from 31 to 96 on a 100-point scale. The average quality score of



evaluations in low-income settings was 76 compared to 68 in middle-income countries. The average quality scores of evaluations undertaken in humanitarian versus non-humanitarian settings did not differ substantially (76.7 vs 75.2) nor between mid-epidemic versus post epidemic (74.4 vs 76.9). Quality scores ranged amongst disease pathogens with the highest average quality scores for evaluation of measles epidemics (88.4) and the lowest for evaluations of leishmaniasis epidemics (57.6). Additionally, there appeared to be an improvement in the quality of evaluation reports over time with reports in the first 3 years of the decade averaging a score of 64 compared to a score of 80 in the last 3 years. Although the majority of evaluations ($n = 104$) did identify and utilize existing information and documentation, few ($n = 28$) provided an appraisal of quality or reliability of these data sources. For the most part, evaluation studies did score well in presenting the rationale of the evaluation (average score = 0.88), providing the contextual information (average score 0.92) and clarifying the evaluation timeline (average score 0.82). They scored less well in providing sufficient detail on the methodological approach suitable to the scope (average score 0.77) as well as detailing limitations of the evaluation (average score 0.61).

Evaluation coverage

We were able to link approximately 9% ($n = 39$) of epidemics with one or more response evaluations (Table 3). Some evaluation reports ($n = 18$) covered responses in multiple countries. A large number of evaluations focused on the same epidemic; for example, 47 evaluations were undertaken to assess the West Africa

Ebola epidemic (2013–2016). There were approximately equal numbers of post-epidemic (56%) and mid-epidemic evaluations (44%). The majority of epidemic response evaluations (87%) were undertaken in countries which had experienced humanitarian emergencies during the study period. Furthermore, 83% of response evaluations were undertaken in the WHO Africa region, 8% in the Eastern Mediterranean region and the remainder in the Americas region. Two evaluations could not be linked to an epidemic as the epidemic occurred outside of the study period (prior to 2010).

Coverage of response evaluations varied by disease (Fig. 3). Ebola epidemics had the highest coverage of response evaluations with 64% of reported epidemics having a response evaluation with Lassa fever epidemics having the lowest coverage (6%). No response evaluations were found for epidemics of anthrax, brucellosis, diphtheria, hepatitis E, Japanese encephalitis, malaria, Marburg haemorrhagic fever, Meningococcal disease and Rift Valley fever epidemics.

Discussion

To our knowledge, this is the first study to systematically explore the coverage and characteristics of epidemic evaluations in low resource and humanitarian settings. The low proportion of epidemics with evidence of evaluations in settings with low resources and high needs suggests an inequity [3] requiring urgent addressing. The lack of evaluations also points to a deficit in the accountability to affected populations, a key principle in humanitarian response [161]. Without the

Table 3 Number of epidemic evaluations by pathogen, country, year and whether the evaluation was performed during or after the epidemic

Disease	Country	Year	Evaluations	During epidemic	Post epidemic	Average quality score	Average publication delay (years)
Cholera	Benin	2012	1	0	1	42.3	2.0
Cholera	Chad	2010	1	1	0	69.2	1.0
Cholera	DRC	2012	1	1	0	61.5	2.0
Cholera	Guinea	2012	1	0	1	73.1	1.0
Cholera	Haiti	2010	8	6	2	77.4	2.8
Cholera	Haiti	2012	2	2	0	92.3	3.5
Cholera	Haiti	2013	1	0	1	88.5	4.0
Cholera	Malawi	2015	2	1	1	88.5	1.0
Cholera	Nigeria	2010	1	1	0	69.2	2.0
Cholera	Nigeria	2015	1	0	1	96.2	0.0
Cholera	Sierra Leone	2012	2	1	1	76.9	1.0
Cholera	Somalia	2016	1	1	0	84.6	2.0
Cholera	Somalia	2017	1	0	1	92.3	2.0
Cholera	South Sudan	2014	1	1	0	92.3	0.0
Cholera	South Sudan	2015	1	1	0	96.2	1.0
Cholera	Uganda	2015	1	0	1	46.2	1.0
Cholera	Yemen	2016	3	2	1	76.9	2.3
Cholera	Yemen	2017	2	0	2	96.2	1.0
Ebola	DRC	2012	1	0	1	73.1	5.0
Ebola	DRC	2018	1	1	0	88.5	1.0
Ebola	Guinea	2014	23	10	13	76.7	2.6
Ebola	Liberia	2014	36	13	23	73.2	2.2
Ebola	Mali	2014	1	0	1	34.6	2.0
Ebola	Nigeria	2014	11	5	6	51.3	1.4
Ebola	Sierra Leone	2014	47	24	23	77.2	2.1
Ebola	Uganda	2012	3	0	3	69.2	1.0
Ebola	Uganda	2012	2	0	2	53.9	2.0
Lassa Fever	Nigeria	2012	1	0	1	65.4	1.0
Measles	Ethiopia	2011	1	0	1	92.3	3.0
Measles	Madagascar	2018	1	0	1	92.3	1.0
Plague	Madagascar	2017	1	0	1	65.4	1.0
Polio	Chad	2011	1	0	1	84.6	3.0
Polio	Ethiopia	2013	1	0	1	88.5	5.0
Polio	Nigeria	2010	1	1	0	92.3	4.0
Polio	Nigeria	2018	1	1	0	65.4	1.0
Polio	Somalia	2013	2	0	2	65.4	2.5
Polio	Ukraine	2015	1	0	1	80.8	2.0
Yellow fever	DRC	2016	1	0	1	84.6	1.0
Yellow fever	Uganda	2010	1	0	1	84.6	3.0

availability of rigorous, high quality and standardized response evaluations, affected populations are unable to hold responders to account and have no recourse to redress [29].

The 2-year delay between the onset of an epidemic and the publication of an evaluation report is a barrier to efficient dissemination of response findings. Reducing this delay can potentially be of use in addressing existing

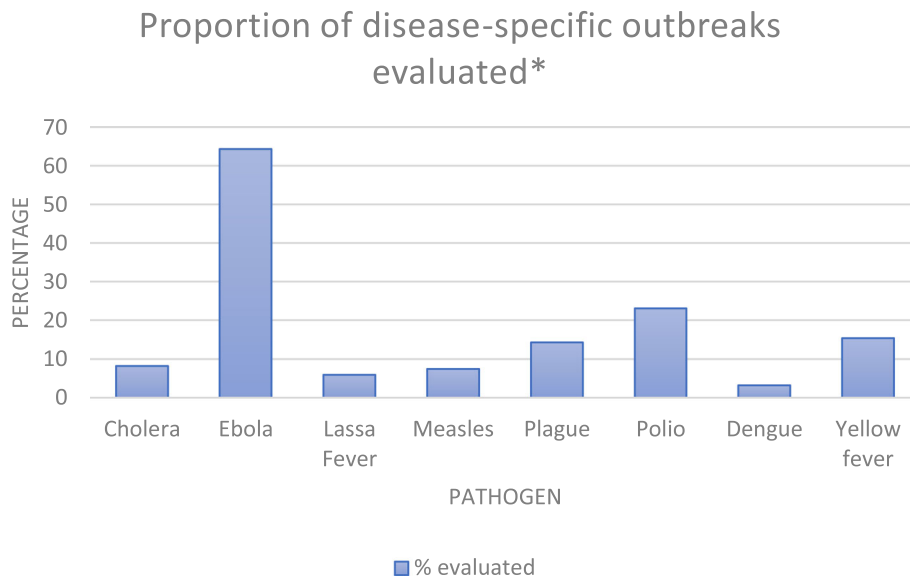


Fig. 3 Proportion of outbreaks evaluated for each disease. Asterisk indicates no evaluation reports were found for outbreaks of anthrax, brucellosis, diphtheria, hepatitis E, Japanese encephalitis, malaria, Marburg haemorrhagic fever, Meningococcal disease and Rift Valley fever

delays in global disease response [162]. More importantly, it represents a missed opportunity to enact changes in a timely manner.

There was considerable variability in the criteria considered by the evaluations, including quality, coverage, efficiency, effectiveness, relevance, appropriateness, fidelity or adherence, acceptability and feasibility. Various combinations of these criteria were used to assess a large number of response activities. Within a given epidemic as well as across epidemics, individual evaluations utilized a wide array of differing assessment criteria and assessed response activities. This variability combined with a lack of an overarching evaluation framework makes it difficult to compare evaluations to the same response or generalize their conclusions. This finding is consistent with a previous study on the use of public health evaluation frameworks in emergencies [1] and underscores a need for an approach and corresponding toolset that standardizes the evaluation of epidemics in these settings. We have previously proposed an overarching framework for such a unifying approach [1].

The term ‘impact’ was frequently found in the assessed evaluations, but very few of the assessed evaluations could be classified as impact evaluations, reflecting the relatively high technical and resource barriers required to conduct a robust impact evaluation. Furthermore, there were marked differences in the number of evaluations by disease pathogen. Whereas one would expect well-characterized diseases with frequent epidemics to have the most evaluations, the opposite was largely found. Approximately two thirds of the Ebola epidemics recorded had response evaluations compared to 8% of

cholera epidemics and 5% of Lassa fever epidemics. This is despite the annual attributable deaths due to cholera being 120,000 [163] and Lassa fever 5000 [164]. This finding is in line with previous research suggesting that more severe epidemics or epidemics that threaten large numbers of people do not necessarily receive more timely response [162]. The overrepresentation of Ebola response evaluations is perhaps reflective of a number of factors such as the unprecedented scale and better resourcing of the response of the West African outbreak. Superficially, this overrepresentation could perhaps be due to the poor containment efforts at the outset of the epidemic leading to international spread and in turn generating higher international attention and scrutiny. However, the scale-up and securitization of the response and subsequent increased scrutiny may have also reflected the proximity of the epidemic to developed countries [165, 166].

Implications of this study

The gaps identified in this review are particularly pertinent to future evaluations of the COVID-19 pandemic which has reached most low-income and humanitarian settings [167]. Infectious disease epidemics have been known to exploit and exacerbate social inequalities within societies for some time [168, 169]. This review highlights the current global inequality in the response to these epidemics as gauged by the number of epidemics in low-income settings and the paucity of evaluation reports. This nonexistence or lack of publication of these critical evaluations prevents improvements to future public health response. The lack of uniformity of

available evaluations limits comparison of the findings across responses and across time, precluding tracking of whether epidemic responses do in fact improve over time, globally or at regional level. The quality limitations of some of the evaluations hinder the strength of inference and applicability of their findings. There is a need to overcome this limitation in order to enable future research to be conducted on the findings of response evaluations. More specifically, future reviews of epidemic response should attempt to synthesize quantitative effects of response interventions and may benefit from SWiM guidelines where appropriate [170].

Limitations

Our study relied overwhelmingly on publicly available evaluations. It is possible that the disparity between the number of epidemics, their responses and their subsequent evaluations could be overstated as evaluation findings might simply be kept internal and not shared more widely. However, the effect is largely the same as internal evaluations are only of benefit to the commissioning organization and cannot be used more widely. Additionally, we assumed that all epidemics were responded to and therefore should have been evaluated. However, we did not know the true proportion of epidemics that were responded to and therefore could potentially overestimate the gap between evaluations and epidemics. On the other hand, the use of a 4-month decision rule to combine multiple reports of epidemics within the same country could have resulted in an underestimate of the total number of epidemics and thus an overestimate of evaluation coverage. We did not look at records that were not written in English or French and could potentially have missed some evaluations.

Conclusion

The relative paucity of evaluated epidemics, the disproportionate number of evaluations focusing on a limited number of epidemics together with constrained resource availability in low-income settings suggests the need for a governance arrangement or systematic mechanism that would trigger the conduct of evaluations, no matter what. The need for strengthening global governance mechanisms related to infectious disease epidemics and related challenges have been discussed [171, 172]. We suggest that arrangements should cover the criteria that should trigger an evaluation, the timing of evaluation, the composition and affiliation of the evaluation team, funding, minimum evaluation standards (e.g. a common scope and framework) and publication steps.

Approximately 2 billion people live in conflict-affected or fragile states and are at risk of increased morbidity and mortality due to epidemics every year. Robust epidemic response evaluations seek to improve response

through critically assessing the performance of response interventions in a given context. However, evaluations of epidemic response are not a stand-alone activity but rather must be integrated into a cycle of preparedness and recovery in order to reach their full utility [173]. The lessons learned from an evaluation should concretely support all responders to better prepare for similar epidemic and to support health system recovery.

Supplementary information

Supplementary information accompanies this paper at <https://doi.org/10.1186/s12916-020-01767-8>.

Additional file 1. List of Epidemics.

Additional file 2. Evaluation Extraction Table.

Additional file 3. Search Strategy & Evaluation Quality Checklist.

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Authors' contributions

This study was designed by AW and FC. The data collection and cleaning was undertaken by AW, JM and AG. The analysis was undertaken by AW. All authors contributed to writing of the first draft. All authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analysed during this study are included in this published article and its supplementary information files.

Ethics approval and consent to participate

As this study relied on secondary data, no ethical approval was required.

Consent for publication

Not applicable

Competing interests

We declare no competing interests.

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4.3 Research Paper 3: Evaluating COVID-19 decision-making in a humanitarian setting: the case study of Somalia

This case study evaluates policy and operational decisions of health actors within the COVID-19 response in Somalia. The case study used an a priori decision-making framework to describe the process of decision making with a focus on use of information and transparency by health actors. It summarizes the approaches utilized by various actors and the challenges encountered. It concludes with an assessment of the decision-framework and proposes a number of recommendations on improving decision-making in the Somali context and in epidemic response in general.

This paper is supplemented in annex 10.3 by interview guides, search strategy and study information sheets.



RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

SECTION A – Student Details

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First Name(s)	Abdihamid		
Surname/Family Name	Warsame		
Thesis Title	Developing an approach to evaluating epidemic decision-making in low resource and humanitarian settings		
Primary Supervisor	Professor Francesco Checchi		

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

SECTION B – Paper already published

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<p>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)</p>	<p>I was responsible for the study design, data collection and analysis and manuscript writing.</p>
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SECTION E

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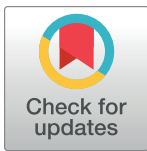
RESEARCH ARTICLE

Evaluating COVID-19 decision-making in a humanitarian setting: The case study of Somalia

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Abstract

The global COVID-19 pandemic is unprecedented in its scope and impact. While a great deal of research has been directed towards the response in high-income countries, relatively little is known about the way in which decision-makers in low-income and crisis-affected countries have contended with the epidemic. Through use of an a priori decision framework, we aimed to evaluate the process of policy and operational decision-making in relation to the COVID-19 response in Somalia, a chronically fragile country, focusing particularly on the use of information and the role of transparency. We undertook a desk review, observed a number of key decision-making fora and conducted a series of key informant and focus group discussions with a range of decision-makers including state authority, civil society, humanitarian and development actors. We found that nearly all actors struggled to make sense of the scale of the epidemic and form an appropriate response. Decisions made during the early months had a large impact on the course of the epidemic response. Decision-makers relied heavily on international norms and were constrained by a number of factors within the political environment including resource limitations, political contestation and low population adherence to response measures. Important aspects of the response suffered from a transparency deficit and would have benefitted from more inclusive decision-making. Development of decision support tools appropriate for crisis-affected settings that explicitly deal with individual and environmental decision factors could lead to more effective and timely epidemic response.

Introduction

While epidemics of infectious disease continue to pose a considerable threat to populations in low-income and crisis settings, evaluations of these epidemic responses are limited and heterogeneous [1]. Populations in need of humanitarian assistance or living in low income settings

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continue to grow [2] and the ongoing COVID-19 pandemic has further exacerbated the harmful impacts of these crises [3].

Somalia is a fragile state with a particularly weak health system [4]. With a population of just over 15 million, the nation has faced a protracted crisis due to ongoing insecurity, recurrent droughts and natural disasters, and frequent epidemics. The COVID-19 epidemic has strained the health system in Somalia and left wide ranging economic [5], social and political [6] impacts. As of November 15 2021, the country had reported 22,837 confirmed cases and 1313 deaths [7] while recent research points to a significantly greater excess death toll [8]. While calls are beginning to surface around the world for inquiries and evaluations [9–11] around all facets of COVID-19 response, none so far has been conducted in Somalia or, to our knowledge, other low-income or crisis settings. Among the few previous studies of epidemic decision-making in low income countries, most have been conducted in high-countries [12] or after the conclusion of an epidemic [13].

Decision-making in the context of an ongoing epidemic is particularly challenging [14,15]. Previous research has highlighted the important role that prioritization of political and economic considerations play how this can lead to delayed or ineffective response [16–18]. However, these findings can be strengthened by further study to confirm their applicability to a wider array of contexts. In particular, in order to better understand and ultimately improve epidemic decision-making, it would be useful to identify a generic model for in low-income or crisis-affected contexts, taking into account the actors, process and the contextual factors.

Aim and objectives

The overall aim of the study was to evaluate the process of policy and operational decision-making in relation to the COVID-19 response in Somalia.

The specific objectives were to: (i) Describe who made the decisions, and how technical, security and political considerations as well as individual preferences influenced decision-making within this setting; (ii) Explore how these decisions affected the timeliness and performance of the response; (iii) Propose a conceptual model to describe policy and operational decision-making in epidemics in low-income and crisis-affected settings.

Methods

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Federal Ministry of Health and Social Services of Somalia (Ref: MOH&HS/DGO/0994/Aug/2020) and the ethics review committee of the London School of Hygiene & Tropical Medicine (Ref: 22778 /RR/21778). Informed written consent was taken from all key informants and focus group participants.

Study design

This study built on work conducted for the London School of Hygiene and Tropical Medicine's COVID-19 help desk in April–November 2020 during which we advised humanitarian and government actors in Somalia and participated in a number of high-level meetings where the response was discussed. We then undertook a qualitative study from November 2020 to March 2021 utilizing a combination of direct observation, remote and in person interviews, and focus group discussion, supplemented by a desk review of response documentation. Participants were purposively sampled to reflect a broad range of experiences and views of different levels of the epidemic response in Somalia (Table 1).

Data collection

Individual key informant and focus group discussions interviews. 31 key informant semi-structured interviews and one focus group discussion with 3 donors were conducted in English or Somali by the first author in both Somalia and Kenya. Data collection was capped when tracking of key themes identified during data collection suggested saturation had been reached. Written informed consent was acquired prior to any interviews. Interviews were recorded for transcription and analysis purposes. Each interview took approximately 30–60 minutes and respondents were given the option of complete or partial anonymity in which they agreed for their role or organization to be published. About half of respondents either chose to stay anonymous or requested that some portion of the interview be off the record in order to preserve important working relations. Non-English interviews were recorded, and transcribed in Somali. They were then translated into English with samples excerpts back-translated by the second author to ensure accuracy of translation.

Document review and observations. A review of response documents such as surveillance records, meeting minutes, operational plans and organograms was conducted to provide context, identify key decision points and potential key informants as well as to construct a response timeline. Documents were identified through grey literature search ([S1 Search Strategy](#)) as well as solicited from key informants. Additionally, news sources in English and Somali were reviewed to gain an understanding of the social, economic and political context in which the epidemic response is occurring and provided some topics for interviews.

Direct observation

Additionally, we observed decision-making within, eight national response meetings between April–November 2020. These included meetings of the humanitarian health cluster mechanism, the national coordination meetings of government and civil society and technical meetings to advise the chief medical officer ([Table 1](#)). Additional key coordination mechanisms including the UN Taskforce and Somalia Donor Group were identified but we were unable to attend meetings.

Table 1. Data collection by method and type of participant or setting.

Primary Data collection	Type of participant or setting	Number
Key informant interviews	Civil Society Members	3
	Donor staff	2
	Federal Government staff	6
	International Committee of the Red Cross (ICRC)/ International Federation of Red Cross and Red Crescent (IFRC)	2
	Independent Experts	3
	Nongovernmental Organization staff	5
	Regional Government staff	2
	United Nations staff	8
Focus Group Discussion	Donor staff	3
Meeting Observation	Health Cluster Coordination meeting	2
	Chief Medical Officer Advisory meeting	4
	Risk Communication and Community Engagement meeting	1
	National COVID-19 coordination meeting	1

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Decision-making framework

We previously reviewed existing policy and operational frameworks for responses to public health emergencies [19] and methods used in epidemic evaluations in low-income and crisis-affected countries [1], culminating in a new proposed Adaptive Epidemic Response Framework (AERF) [19]. We approached this study by combining the AERF with the Cynefan Framework for decision-making [20] into an a priori decision-making framework (DMF) for epidemic response, whose suitability for describing decision-making in epidemics we used this study to evaluate (Fig 1).

The framework posits that epidemic decision-makers first make sense of the scenario (through gathering and assessing incoming information), then analyse (integrate and categorize new and previous information according to available disease control decision-making strategies) and finally make a decision. However, each of these steps are filtered through and constrained by several internal and external factors [21] with both constraining factors and new opportunities for sense-making influencing analysis iteratively until a decision is finally taken.

Data analysis

Interview and focus group data were analysed using a deductive thematic approach structured by the DMF components and using Nvivo software. This approach helped explore how closely the reality of decision-making in the COVID-19 response in Somalia aligns with the DMF as well how the DMF could be adapted to reflect this reality. The analysis considered a number of potentially influential contextual factors which may have impacted on the COVID-19 response. These included the political relationships among and between state authorities, international actors (UN, INGO or donors), local actors and grassroots initiatives in the context of concurrent and recent crises (drought, food insecurity, economic crises, cholera outbreaks) and the impending 2020 contested election.

Results

Context, timeline and key actors

The first COVID-19 case was confirmed in Somalia on March 15, 2020 (Fig 2) in the midst of increased climactic shocks, chronic insecurity [22] and a once in a generation locust

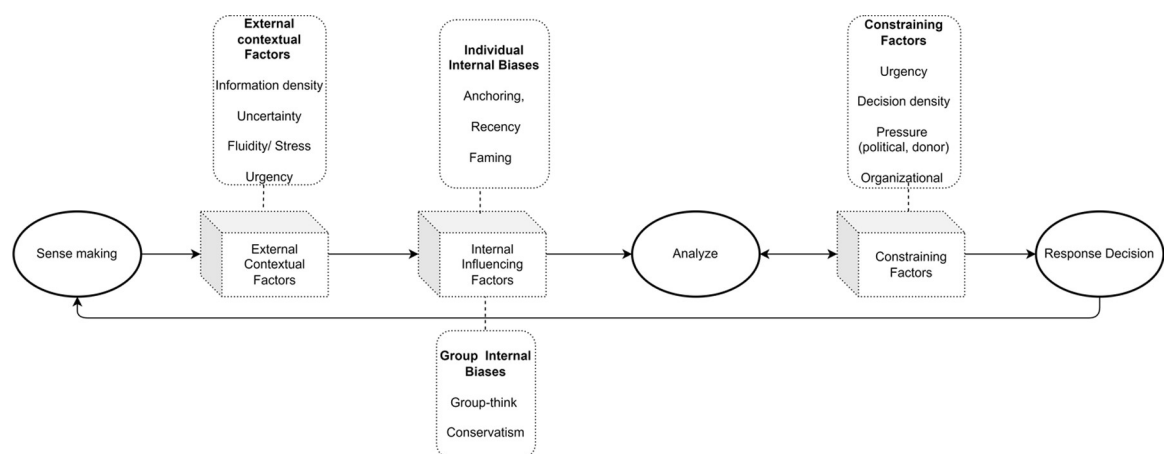


Fig 1. Draft decision-making framework for epidemic response.

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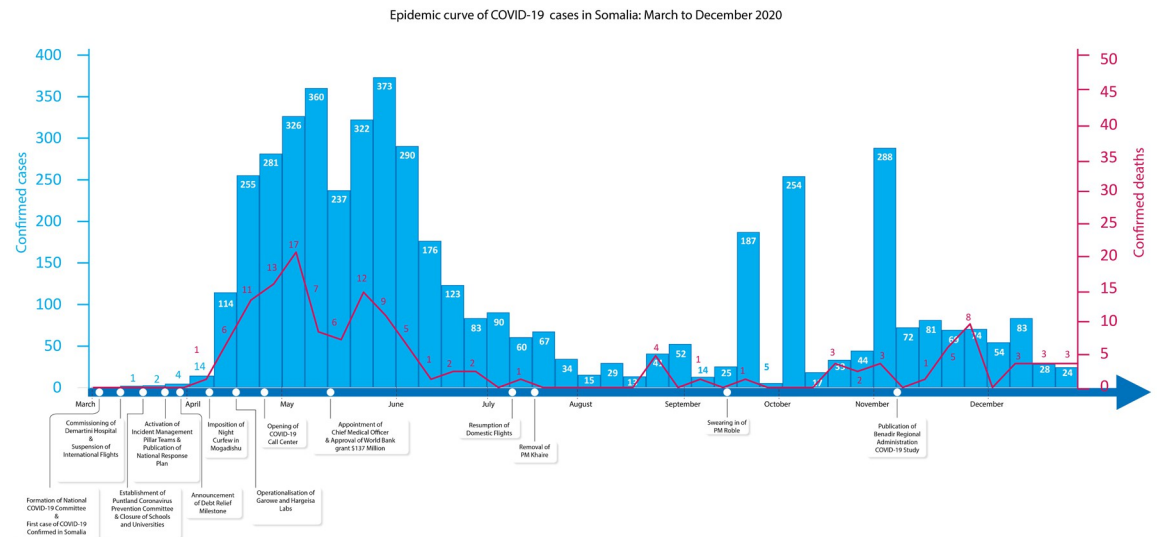


Fig 2. Timeline of key events and corresponding official weekly epidemic curve Mar–Dec 2020. Case data from Ministry of Health Federal Republic of Somalia and WHO Somalia.

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infestation [23]. Against this backdrop, the epidemic response coordination in Somalia was undertaken through existing as well as newly formed mechanisms.

As Somalia had a long history of public health emergencies, a large number of humanitarian and health actors were already in place supporting the public health system. These included seven specialized UN agencies, a multitude of local and international NGOs, federal and regional ministries of health, and several bilateral and multilateral donors.

Among the existing coordination mechanisms, clusters (groupings of humanitarian organizations working within the same thematic area) as well as the Humanitarian Donor Group (comprised of representatives of donor agencies) remained active and continued their role. The health cluster is an open forum for coordinating among all national and international organizations implementing health programming within Somalia while the Humanitarian Donor Group is a closed forum limited to bilateral donors.

UN agencies under the overall leadership of the WHO and pillar specific leadership of various UN agencies also activated a new incident management pillar system of coordination, previously utilized in other outbreaks [24] with the ministry of Health operating a similar incident management structure [25].

The epidemic occurred at a critical time when the leadership of the country was keen to be seen as having turned a corner towards political stability and economic development. The federal government had cleared debt arrears to the International Development Association (IDA) and was being considered for debt relief by the International Monetary Fund (IMF) under the heavily indebted countries mechanism [26]. If successful, this process was set to relieve the country of substantial debt, opening the door for substantial sums of development funding and signalling the international community's confidence in the governance and direction of the nation [27]. In this context, the Prime Minister's office was keen on centralizing high-profile projects under its direct management to increase legitimacy and protect against mismanagement. The epidemic provided an opportunity to realize both objectives.

In response to international reports of the pandemic, the Federal Government prepared a national contingency [28] plan and formed a national COVID-19 committee in the first week of March modelled on the COBRA emergency coordination mechanism in the UK. The

structure of this committee was due in part to the influence of British-Somali diaspora in key advisory positions. This committee, largely seen by a majority of informants to be inclusive and effective, was comprised of several ministries including the Ministry of Health, and Ministry for Relief and Disasters, civil society, representatives of the business community and infectious disease specialists [28]. Similar committees were set up at the regional level.

Respondents mentioned that at the outset of the crisis, the national COVID-19 committee chaired by the Prime Minister took decisive action through a number of key measures including closure of airspace and education facilities, the designation of treatment facilities and the formation of a national COVID-19 call centre. However, there were some oversights for example, interstate vehicle travel continued largely unabated. Overall, these actions cemented the leadership of the committee in the early months of the epidemic with international actors perceived by some informants as playing a delayed supporting role.

The Prime Minister was generally praised by a number of informants for being responsive and playing a direct and active role in many aspects of the response. The leadership role played by WHO was likewise praised by informants in setting up and guiding the response through its leadership in the UN task force as well as its support to government and implementing agencies.

Wide scale testing was a significant challenge with the limited number of tests being sent to neighbouring Kenya for analysis [29]. In April 2020 as testing capacity was expanded and an increasing number of cases were confirmed, the national committee attempted to impose a lockdown and curfew in the capital Mogadishu in an attempt to contain the epidemic [30]. However, these attempts by the government at imposing restrictions and securitizing the response met with considerable population pushback [31]. During this time, the Prime Minister appointed for the first time a chief medical officer to provide technical advice to the committee. Shortly after, a corruption scandal came to light in the Federal Ministry of Health in which several senior civil servants were implicated in embezzling COVID-19 funds [32]. The scandal threatened to derail the much anticipated external debt cancellation by the IMF and World Bank and led the Prime Minister to take an even more direct role in the COVID-19 response for example by bringing oversight of COVID-19 funds under his office. In July domestic flights were resumed in response to a decline in cases and heavy lobbying by business groups. By this time, there was a general perception that the worst-case scenario had not materialized and that a gradual reopening as observed in high-income countries at this time was warranted. National policymaker's attention then turned towards political contestation ahead of the national elections culminating in the removal of the Prime Minister on the 25th of July. Activities of the national committee and involvement of the PM's office lost momentum in the run-up to national elections on 25 July in which PM Khairi was removed from office. Management of the high-profile, COVID-19 call centre, for example, was handed over to the Ministry of Health. A new Prime Minister was not sworn in until the 23rd of September creating a vacuum in the national COVID-19 response coordination in which no major response initiatives were launched. During the last quarter of 2020, some locally driven research began to be published on the impact of COVID-19. Despite this increase in research evidence, COVID-19 continued to fall off the policy agenda as electoral politics grew increasingly acrimonious. In February 2021, a second, more aggressive wave of infections began to emerge possibly due to the introduction of new variants.

Sense making: Understanding the epidemic and its impact

Respondents struggled to come to grips with the epidemic due to a number of external contextual factors as well as internal drivers of individual and group decision-makers.

Previous emergencies were largely contained within the country and did not constrain the ability of international partners to source external support. However due to the global nature of the pandemic, resources for COVID-19 were not as readily available in Somalia.

“This was the first incidence of an outbreak or this kind of situation that the global situation affected the in-country situation.”—UN Official 2.

Respondents noted that the uncertainty around how to respond at a global level shaped sense-making within Somalia across several dimensions, particularly in terms of peoples’ anticipation of the scale of the epidemic.

“We struggled for quite some time with a better assessment of how deep is this epidemic actually going in Somalia.”—Donor Official 1.

There was also uncertainty on how to formulate an appropriate response in this rapidly changing information landscape.

“It seemed like there was a bit of a crisis in terms of [identifying] how to respond to something like this that was evolving. The information out there kept changing”—NGO Official 3. *“One of the difficult things early on was this flood of [new] guidance materials and international guidance.”*—UN Official 2.

Uncertainty was further compounded by a sense of unpreparedness which respondents attributed to a lack of appropriate pandemic planning, response structures and sufficient resourcing to deal with this crisis which was predicted to lead to a high death toll [33].

The unprecedented nature of this epidemic generated panic both in the general population and in responders. The Somali public exhibited ambivalence [34] with a large proportion of the population considering COVID-19 as non-existent or irrelevant to Somalia whilst others feared becoming infected [35,36]. This resulted in a situation in which people were simultaneously not practising preventative measures but also not using routine health services for fear of infection.

“The service utilization from the community was not that much at the beginning of the outbreak because people were afraid. People were not coming to health facilities and people were staying at home.”—UN Official 5

Response organizations not only felt unequal to the magnitude of the task but staff members felt particularly vulnerable as they felt they did not have adequate information, training or equipment to deliver services while protecting themselves. There was also widespread fear among responders about how the epidemic could impact the ability of the already fragile health system to protect the public.

“One of the things that I must acknowledge, that there was a lot of panic. There was a lot of panic amongst various agencies amongst various individuals. We knew that this is a fragile state, we knew the health system is not maybe ready.”—UN Official 3

Given the widespread panic at the outset, responders noted feeling overwhelmed by the urgency to respond.

“There was urgency in the sense that I had to get everything done before another wave came along, or before things escalated. It was almost like there was something that’s going to happen and you don’t know what’s going to happen, but you just got to act before it happens. That’s what it felt like, at least.” -Independent Health Expert 2

Respondents cited three factors that helped them find their footing in making sense of and responding to the epidemic: relying on their organizational mandate, taking guidance from international norms and falling back on their individual experiences of epidemics in Somalia and abroad. Several respondents mentioned their organizational mandate as being their primary driver to respond to the COVID-19 epidemic. However, other organizations cited the lack of capacity in the Somali context as driving their decision to respond while under normal circumstances epidemics may not have been within their mandate. As described by a representative from the Red Cross,

“Even though our mandate is of war and conflict and so forth, it became evident, especially in Somalia and in many other contexts and other delegations, that there wasn’t really a response from other organizations or they didn’t have the capacity to become as responsive as we could be.” -Red Cross Official 1

The longstanding aid relationship between Somalia and several high-income countries played a significant role in framing the response to COVID-19. This relationship reinforced expectations that, as had been the case with previous emergencies, best practise and support in responding to COVID-19 would come to Somalia from abroad. This reflex-like adoption of these best practises is a potential example of group-think bias as some respondents believed local alternatives did not exist. There was consensus, particularly among respondents in government on the necessity of such an approach as they believed local data and expertise were not sufficient to the task.

I can say most of the times, what was happening outside the world was influencing some of the decisions the committee and the government had to make because this was a new disease, it was a new virus. We had to learn from other countries where the virus appeared before us. -Government Official 3.

Lastly, because of the novelty of this epidemic, many respondents relied heavily on their own personal experiences to understand the situation.

“We were always dealing with outbreaks: outbreaks of meningitis, measles, outbreaks of cholera, they were all there.”—Government Official 5.

However, drawing uncritically on such experience may lead to recency bias as respondents overestimate the relevance of recent experience to COVID-19 and therefore utilize inappropriate response measures. For example, the existence of response tools such as vaccinations and well-established treatment protocols for previous epidemics might potentially incline responders to underestimate the challenge of COVID-19 despite the absence of such tools [37].

Analysis: Exploring options

Constraining factors. Respondents mentioned the already difficult humanitarian access landscape of Somalia being further compounded by COVID-19. They mentioned difficulties for responders to access locations outside of the major urban centres both in terms of receiving

information as well as providing necessary response measures. Several areas were labelled ‘silent districts’ because there was a near total COVID-19 information blackout. Respondents also stated that the repatriation of key international response staff impeded their response. As one humanitarian worker supporting a remote response from Nairobi reflected:

“I think our partners, as well as ourselves, were not able to go as often to the field, to Mogadishu and to the field outside Mogadishu, as already in normal times it’s very difficult for security reasons and logistic reasons. Now with the COVID pandemic, in addition, it was even more difficult to actually get around and to move around, and to be in contact with the beneficiaries”. -Donor Official 2.

Respondents also mentioned lack of transparency around information particularly around the official epidemiological figures. This was mainly in relation to instances of discordance between regional and federal statistics as well as periods of information blackout. Additionally, some particularly impactful decisions such as national lockdowns were said to be undertaken in a non-transparent way.

“The Ministry of Health just randomly shut down their information giving, and then the call centre was just shut down for no reason. I guess there’s almost cliff-hangers, so many cliff-hangers that are so unnecessary”-Government Official 2.

Such unaccountable actions were seen by some respondents as undermining the rhetoric of strengthening state legitimacy that had initially guided the response at the onset of the pandemic.

Financial constraints were a critical constraining factors in designing an appropriate response. Donors, in particular, felt the humanitarian funding arena was more uncertain compared to previous emergencies and they had little leeway to make new allocations. This was both because of the long-standing problem of donor fatigue due to the chronic nature of crises in Somalia as well as the globalized nature of the COVID-19 emergency where Somalia programmes had to compete with programmes not only in low-income countries but high-income ones as well.

Furthermore, they mentioned how the population’s coping mechanisms had been overstretched from previous emergencies as well as government’s inability to soften economic burden of lockdowns as underlying opposition or non-adherence to curfews and lockdowns. Implementing agencies as well as government respondents mentioned their overwhelming reliance on international partners. This was especially troubling given that less than 2% of the federal budget was allocated for health services [38]. Respondents felt their latitude to act was severely curtailed as a result of this resource limitation.

“Because every single country in the world was impacted including donor countries. It wasn’t a case of, ‘This was all happening in low-income countries and somehow OECD countries were doing fine.’ The response was required in the UK as much as it was in Mogadishu, . . . This whole question of could we apply for additional resources. It came at a time when the economy of everyone was being impacted. Money was actually getting tighter. We actually had to reduce our budget”. -Donor Official 3.

Respondents were ambivalent about whether and how the political environment in which the epidemic occurred constrained response options. Early on in the epidemic, many respondents felt that the pandemic had the effect of fostering a cohesive response and minimising

political jockeying among political leaders in Somalia. As elections loomed and political actors were drawn into a lengthy period of post-election contestation, however, national political tensions tended to heighten tensions over resources, diluting focus and resources away from the response.

Discord was not solely limited to political contestation but was also recognized as key constraint in coordinated decision-making amongst responders. Primary amongst them was disagreement between government health authorities and health partners. These were mainly to do with government actors asserting their authority over health partners on issues such as the channelling of external funds directly through health authorities, controlling information channels or changing programme activity areas. In one instance an NGO informant related the discord with the government arising from the prioritization of political considerations.

“[the government] focus too much on equality, but they don’t look very much on the equity [based on need]. They should instead let us put more resources where the pandemic is so prevalent, where it is high.”—NGO Official 5.

However other respondents rationalized this approach as necessary to the stability of the state.

*“The government trying to accommodate as many people as the government can, comes down to the aspect of the state building trajectory in Somalia—”*Civil Society Expert 2.

There was also discord within government between federal and state authorities and among different ministries largely over resources or areas of responsibilities. Some respondents disagreed with the structuring of the response and felt that existing institutions were side-lined. The pandemic further exacerbated the existing ambiguity in mandate between the Ministry of Health and Ministry of Humanitarian Affairs and Disaster Management with introduction of new and independent response bodies such as the National COVID-19 call centre.

“Why we are out of the blue creating new institutions when we already have two institutions whose job it is to tackle the pandemic?”—Civil Society Informant 1

Respondents characterised successful decision-making as being one in which disagreement in decision-making were addressed collectively at the correct level rather than implemented unilaterally. Examples given of successful collective decision making relied on two main approaches: consensus building at the lower levels and compromise through negotiations at the higher levels. At the lower or technical decision-making level, respondents mentioned that issues were thoroughly debated and consensus was sought so as to present a unified position to more senior decision-makers.

Some respondents however mentioned that decision-makers in more senior forums sometimes debated issues for which they were not technically proficient. In one meeting we observed, the national committee debated revising the lockdown strategy in response to widespread public resistance. Some non-health members of the committee lobbied for shifting all focus towards equipping and running treatment facilities as they perceived outreach activities such as prevention messaging to be ineffective. Health members of the committee supported prioritising resources towards robust community-based social-distancing and shielding measures, as well as case detection and surveillance, rather than more expensive curative approaches. Perceiving their influence to be diluted by the opinions of non-health committee members, health members responded by calling upon external technical expertise to present

on the potential impacts of various response approaches through mathematical modelling. The models presented several potentially catastrophic scenarios if different response modalities were adopted including one in which only case management was undertaken. The presentation of these scenarios was acknowledged by senior committee members as lending credence to the health members' position to continue utilizing a multipronged approach rather than focusing on a single response activity. The committee dismissed the suggestion of relying solely on case management as too risky and consensus reached on the necessity of a multipronged approach including community outreach.

On the other hand, compromise was often used for tackling the more sensitive issues. A pertinent example is the disagreement between government and religious authorities over mosque closures. This issue arose early in the response when the role of mosques as important avenues of transmission, was first debated in the national committee. The issue was raised by the Minister of Religious Affairs in the context of safeguarding the accessibility of mosques and was debated by other committee members. The chief medical officer and other health officials presented evidence that persuaded the committee of the risk that mosques posed.

“Even the Grand Mosques in Mekkah and Madinah are closed because it is recognized risk, so we must do the same.” Government Official 5.

Once consensus was reached on this point, the debate then proceeded to the best mitigation strategy; whether it was enforcing social distancing and limiting attendance or whether a complete closure was warranted. The committee was split on this issue, with some calling for the latter while the members of the religious community argued that this was premature given that markets and schools and other public venues remained open. A compromise was reached in which the religious community successfully argued that mosques were an essential service and should only be closed as a last resort and only when a full lockdown of other venues was in place. This compromise was illustrative of the influence wielded by religious constituents, the degree to which the government was keen not to alienate them as well as the government's limited capacity to unilaterally enforce closure in the face of opposition. In the end, while schools were successfully closed [35], a brief attempt at a general curfew was ineffective [31] and the closure of mosques was never implemented.

While examples such as these demonstrate the deliberative nature of some high level meetings, this was not the norm in many decision-making fora. Meetings observed tended to be structured around information sharing rather than deliberation with the chair wielding large influence on the degree to which deliberations were permitted.

Decision-making criteria. Respondents disclosed several criteria that guided their COVID-19 response decision-making including equity, accountability, windows of opportunity, as well as state-building aims.

Respondents mentioned that the epidemic brought to the forefront the pre-existing neglect of health systems in the country. Respondents also stated that the pandemic had unequal impact on different socioeconomic segments of the population with those at the lowest socioeconomic level bearing the greatest burden.

“Basically, what we realized along the way was that COVID was a very privileged disease”.
-Government Official 2.

This reality eventually became clear to many responders, who addressed it by utilizing an equity-based approach to allocating resources and efforts to combat the pandemic.

“I think in terms of location by region, we started from the [geographic] area which is affected most”—NGO Official 2.

Some respondents revealed the role that wider economic factors had in their decision-making for example with regards to imposing travel restrictions.

“There is pressure from other sectors especially trade, commerce and they’re saying that closure of the airport cannot continue”—Independent health expert 1

Respondents identified a general deficit in accountability in the response. They cited in particular a lack of transparency in the allocation of and utilization of response resources. This was cited as a problem at all levels including within organizations, between government bodies as well as with regards to allocation from global to national levels within individual agencies.

“A lot of money to be distributed but absolute opacity as to [how]. . . And we kept asking right, “How much is Somali getting? How much has come to Somalia? What are you buying with that money?” Donor Official 3

Much of the discussion around accountability centred on the importance of financial accountability to donors as well as the lack of consideration given to accountability to affected populations. Some actors felt that the lack of transparency in an already complex political environment was a critical factor in poor decision-making, suggesting that a decision support tool that could explicitly address decision criteria might be helpful in future epidemics.

In weighing the options presented by various decisions, respondents often considered whether a decision presented a new opportunity to further an existing aim. Respondents stated that the epidemic focused attention on the health arena and presented new opportunities to raise funds to strengthen Somalia’s chronically weak health system.

“One of the advice that we gave was we have to use COVID as an entry point to build a resilient health system for not only COVID but also for future pandemics and epidemics.”—Independent Health Expert 1.

Some respondents mentioned that some actors were more interested in highlighting their response activities rather than on their impact.

“From the way it seemed like, it seemed as if it was a point-scoring opportunity to say, “Look, we are doing this great work. Look at us. Look at us.”—Independent health expert 3.

Many respondents stated that the epidemic presented an opportunity to underscore legitimacy and credibility on the part of some decision-makers. In particular, this was seen as a key motivation for government authorities.

“The Office of the Prime Minister coming in and taking charge of the response efforts was sending a picture to the Somali public and to the Somali people that the government is sparing no efforts to respond.”—Civil Society Expert 2.

Many respondents also considered state building as a crucial criterion in undertaking a response with all respondents stating their activities were done with the explicit goal of strengthening government capacity. To many respondents, contributing to state building has

meant taking care not to undermine the authority of state actors while ensuring humanitarian support is delivered in a neutral manner.

Processes. Respondents generally agreed about the criticality of decision-making being inclusive, however there were challenges in striking the right balance of inclusivity. In particular, decisions around flight restrictions and lockdown measures were said to be done without broad consultation and participation appears to have been limited to some federal cabinet members.

“We were informed probably a day and a half or a day I would say if my memory serves me right, that there would be on lockdown and to make the necessary arrangements”—UN Official 6.

Other respondents indicated short-cutting typical inclusive approaches in favour of speeding up the decision-making process. Some respondents, primarily donors, mentioned simplifying their decision-making process by giving more leeway to implementing partners to conduct activities without the typical numerous rounds of consultation.

“We didn’t have the time to go through the wholly inclusive approach, as we would for the HRP, but we did engage with the ministry, with the lead agencies, and several of the larger more active partners to see what they were thinking about some of these things” UN Official 2

In navigating the complexities of the response, many actors discussed their reliance on expert advice. Most respondents mentioned utilizing formal channels to seek expert advice internally or particularly from the World Health Organization (WHO). Some respondents suggested that some of the expert advice provided, particularly around a plethora of mathematical models and projections was overwhelming and not well understood.

I remember in those early days, there was a lot of time spent analysing these things. Maybe [we were] not equipped really to use them effectively.—Donor Official 4

Respondents mentioned struggling to determine where COVID-19 stood in relation to threats from competing emergencies. Some respondents affirmed utilizing a no-regrets approach in prioritizing COVID-19 which in practical terms manifested in COVID-19 trumping all other health priorities in the country.

Of course when COVID began not only in Somalia but everywhere, the focus was on how to contain this virus and how to treat people. It is true that there was a shift taken from all other areas and all efforts and resources directed to COVID, attention was diverted away from areas like maternal and child vaccination services in Somalia, TB, malaria and HIV- UN Official 3

A number of respondents however indicated utilizing a more pragmatic and cautious approach through attempting to maintain a minimum of essential services throughout the epidemic. Additionally, some respondents stated favouring a preventative strategy because they did not have the capacity to conduct large scale case management.

“I think we try to do the minimum basics which are protect essential services, equip health workers, do infection prevention within the basics and recognize that maybe some of these secondary impacts get more significant and then watch and see what happened. Yes, we definitely avoided the swing of the whole program.”—Donor Official 4

Respondents described activating existing organizational mechanisms as part of the analysis process.

“Whenever a crisis situation happens, we normally activate our Country Emergency Teams, led by the country emergency coordinator. They do the quick assessments and that kind of stuff, and that information is immediately disseminated to the regional and HQ level, for the information, with all the analysis”—NGO Official 4

Respondents mentioned being guided by these mechanisms and protocols to quickly analyse the severity of the situation, the decisions to be taken and whether local capacity is sufficient to deal with the crisis or whether external supported is warranted. A limited number of respondents stated that their organisation’s use of contingency plans and funds in the acute phase of the epidemic allowed them to make efficient and timely decisions.

Response: Arriving at decisions

After making sense of the situation and conducting their analyses, respondents described arriving at a number of decisions to adopt overall approaches as well as to undertake specific activities.

Responders outlined a number of limitations that they felt impacted on the timeliness and performance of response measures in Somalia. These included lack of capacity, resource limitations, physical access to populations, political considerations, as well as difficulties engaging with the public.

Lack of capacity of state authorities to implement COVID-19 measures was the most commonly cited limitation by responders. This included capacity to roll out wide-scale testing and influence and enforce certain population measures such as the wearing of face masks, the closure of mosques and curfews.

Respondents emphasized the importance of flexibility and adaptability in harnessing the high-level attention directed at COVID-19 to respond effectively without undermining existing humanitarian response. In particular, they mentioned adapting ongoing programmes to ensure continuity of lifesaving activities.

“We did not overwhelmingly put the COVID there as enemy number one of Somalia. That is not the case. We pleaded, and I think many of the other donors pleaded for continuation of the normal programs as much as possible, with here and there an adaptation and here and there additional funding for the COVID, but the most essential thing was to keep going with the other programs.”—Donor Official 1

Despite a majority of donor funding being earmarked for specific humanitarian or development projects, donor flexibility in shifting to COVID-19 response was also highlighted by respondents. Respondents mentioned utilizing crisis modifier mechanisms (legal clauses permitting program adjustments) to redirect resources. However, despite these mechanisms, this process was not as fast as required nor was it fit for pandemic response.

Respondents also mentioned putting in place organizational business continuity measures. Measures included adopting remote working arrangements, designating replacements for incapacitated staff members, shielding vulnerable staff, as well as producing and implementing business continuity plans.

Importantly, respondents stated locally contextualizing and adapting global response measures to circumstances within Somalia. Some respondents mentioned three stages of

localization: adapting guidance from headquarters to regional contexts, from regional to Somalia context and within Somalia, adapting from state to state.

Respondents also described adapting and refining COVID specific response measures to improve effectiveness, for example in the targeting of relevant age groups. Further instances of adaptation included modifying community surveillance systems to include COVID-19, modifying programme delivery to maintain social distance, using locally available resources to produce masks and PPE as well as test for COVID-19 using GeneXpert machines already available in the country for tuberculosis control.

In previous localized epidemics, respondents stated utilizing a bottom-up approach towards the decision-making and response.

“If I recall the 2016, 2017 cholera outbreak, the decision rather came from this level, the country level, up the ladder to ask for support. Because it was localized cholera in Somaliland and Puntland”—Red Cross Official 1.

In contrast, some respondents suggested that early in the epidemic, response priorities and activities were largely set at a global headquarter or regional level but as time progressed, the local counterparts took over this role.

Discussion

From the perspective of decision makers, the catastrophic scenario of the epidemic seemed not to have materialized in Somalia. However, this may be less to do with response efforts and more to do with population characteristics (e.g. age, outdoor social mixing) [39] and/or inadequate surveillance. Anecdotal reports as well as recent studies suggest that the impact in terms of mortality was indeed much higher than reported [40,41]. As such it is even more crucial to reflect on the decisions that impacted on this outcome. The largely acritical adoption of response measures developed abroad in the early period of the epidemic may be characterised as emerging from conformity bias during the ‘sense-making’ phase of decision-making. This type of bias in which decision makers in Somalia emphasized conforming to international response norms has been observed in other humanitarian crises [21]. This conformity occurring despite Somalia’s ample experience with outbreaks and well-established humanitarian mechanisms illustrates the exceptional nature of the COVID-19 pandemic. Excessive effort and resources were directed at case management relative to Non-Pharmaceutical Interventions such as risk communication & community engagement [28]. No serious consideration of alternatives to lockdown and blanket population restrictions such as shielding of vulnerable people [42] took place at the outset due to a number of factors. These include the perception that it would be complicated to communicate such alternatives and would likely result in low adherence. The centralized approach adopted by the federal government was also an important characteristic of the response though it was not unique to Somalia and seems to have been the preferred method by many governments [43]. However, in the case of Somalia, the overcentralization of the response risked eroding the already tenuous capacity of the various line ministries to conduct their work.

Discord among various actors often constrained the ‘analysis’ phase of decision-making for the COVID-19 response in Somalia. The epidemic occurring in a heated election year and political manoeuvring and contestation was an important feature of response dynamics [44]. Such politicized decision-making environments have been known to lead to polarisation [45] and may hinder response cooperation. The occurrence of election clashes despite pandemic restrictions presents an example of such polarisation [46].

In terms of outcomes, decisions early in the response may have contributed to the direct and indirect impact of the epidemic disproportionately being felt by the poorest segments of society [47]. Authorities attempted to offset this impact by instituting price controls on food, tax reductions alongside the maintenance and expansion of cash programmes by some actors [48]. The fall in utilization of vaccination and maternal health services illustrates that decision-makers may have been unsuccessful in balancing these key priorities against COVID-19 response [49]. The decision to loosen restrictions at the end of the first wave including permitting diaspora arrivals from high-burden countries may also have contributed to resurgence of the virus and accelerated introduction of new variants [50].

New pandemic waves are likely due to low vaccination coverage and the emergence of new variants that may partially evade immunity. As a result, there is an urgent need to improve the decision-making process in light of this threat. Currently, the decision-making around COVAX has been limited to a few agencies with few individuals involved in the planning. Inclusive and open decision-making can contribute to strengthening public trust and legitimacy [51] and is key to addressing the limited uptake of the vaccines in Somalia [52]. The decision to administer vaccines within health facilities ignores considerable vaccine hesitancy among the population and sets aside the substantial experience of health actors in delivering community-based vaccine drives. Mobile and outreach approaches should be utilized as has been recommended in crisis-affected settings [53].

Appropriateness of decision-making framework

The DMF was largely found to be valuable in conceptualizing the decision-making arena in the Somali COVID-19 response. This study allowed for additional dimensions to be added to the framework including further refinement of the analysis element into processes, criteria and constraints (Fig 3). Additionally, the results indicated a need to make a clear distinction between response decisions and their outcomes.

Recommendations

This study revealed the outsized influence that the decision-making process had on the shape of the COVID-19 response in Somalia. It is therefore important in an epidemic context to strengthen the process by which decision makers arrive at their response decisions. This process includes embedding best deliberative practice in order to account for individual and group preferences or biases. Such best practice includes increasing transparency around the

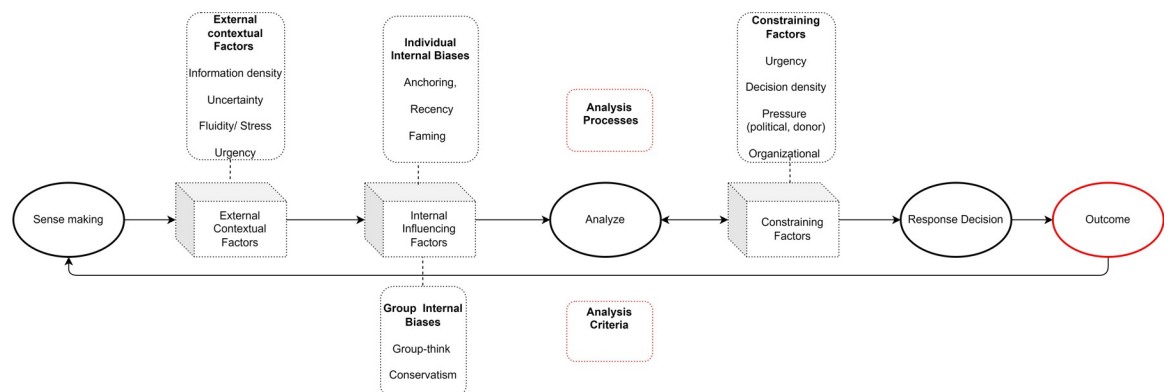


Fig 3. Updated decision-making framework for epidemic response.

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evidence utilized and the decision-making processes implemented as well as clarifying roles and responsibilities. Furthermore, it is critically important to devolve decision-making to allow for robust technical discussion and consensus building. One way this can be done is to ensure a more diverse range of stakeholders as well as to allow for divergent opinions to be thoroughly debated. Strengthened decision-making processes should allow for participation by skill and experience rather than by rank. Decision makers should also be more explicit about uncertainties and motivations in order to more openly and effectively address them. Lastly decision-makers would benefit from decision support tools which incorporate these recommendations and would allow for more effective and timely epidemic response.

Conclusion

The challenges and opportunities of the covid-19 response in Somalia typifies what other low-income and crisis-affected countries may potentially be facing. Such settings not only must deal with the epidemic directly and its indirect impacts but must also contend with a host of urgent competing emergencies. As such decision-makers are under heavier strain than those in better resourced and stable environments and require adequate support. COVID-19 is unlikely to be the last pandemic faced by decision-makers in such settings and therefore evaluations such as this are especially critical to strengthening future preparedness and improving response.

Supporting information

S1 Search Strategy. Search Strategy underlying the grey literature search. Table A grey literature English search terms. Table B grey literature Somali search terms. (DOCX)

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4.4 Research Paper 4: Auditing the quality of decision-making within an epidemic response

This study aims to determine the feasibility and utility of a decision-making audit tool to assess the quality of decision-making in epidemic settings. The audit tool is piloted by two operational agencies responding to the COVID-19 epidemic in Somalia. The audit highlights key areas of decision-making for improvement. It concludes that it is feasible to audit decision-making in the midst of an epidemic response and recommends further use of this tool.

This paper is supplemented in annex 10.4 by the audit tool, audit Standard Operating Procedures (SOP), interview guides, consent forms and decision scorecards for both operational agencies.



RESEARCH PAPER COVER SHEET

Please note that a cover sheet must be completed for each research paper included within a thesis.

SECTION A – Student Details

Student ID Number	296802	Title	Mr
First Name(s)	Abdihamid		
Surname/Family Name	Warsame		
Thesis Title	Developing an approach to evaluating epidemic decision-making in low resource and humanitarian settings		
Primary Supervisor	Professor Francesco Checchi		

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?			
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Please list the paper's authors in the intended authorship order:	Abdihamid Warsame Abdulkadir Ore Abdullah Azad Farhan Hassan Karl Blanchet

	Jennifer Palmer Francesco Checchi
Stage of publication	Undergoing revision

SECTION D – Multi-authored work

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 was responsible for the study design, data collection and analysis and manuscript writing.
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SECTION E

Student Signature	
Date	17/09/22

Supervisor Signature	
Date	20/09/2022

Auditing the quality of epidemic decision-making in Somalia: a pilot evaluation

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Abstract

Objective

To assess decision making quality through piloting an audit tool among decision makers responding to the COVID-19 epidemic in Somalia.

Design and Setting

We utilized a mixed methods programme evaluation design comprising quantitative and qualitative methods. Decision-makers in Somalia piloted the audit tool generating a scorecard for decision-making in epidemic response. They also participated in key informant interviews discussing their experience with the audit process and results.

Participants

A total of 18 decision-makers from two humanitarian agencies responding to COVID-19 in Somalia were recruited to pilot the audit tool.

Outcome measures and analysis

We used thematic analysis to assess the feasibility and perceived utility of the audit tool by intended users (decision-makers). We also calculated Fleiss' Kappa to assess interrater agreement in the audit scorecard.

Results

The audit highlighted areas of improvement in decision-making amongst both organisations including in the dimensions of accountability and transparency. Despite the audit occurring in a highly complex operating environment, decision-makers found the process to be feasible and of high utility. The flexibility of the audit approach allowed for organisations to adapt the audit to their needs. As a result, organisation reported a high level of acceptance of the findings

Conclusion

The pilot evaluation illustrates that it is possible to systematically assess decision-making quality in an ongoing epidemic within a humanitarian setting. Improving decision-making quality can contribute to better response outcomes including more efficient allocation of resources, greater coordination, and saved lives

Strengths and limitations of this study

- The criteria for decision-making quality are listed and defined
- This study utilizes mixed methods to both audit quality of decisions as well as shed light on the utility and feasibility of the tool
- This study is limited to auditing organisational decision-making and does not attempt to audit individual decision-makers
- Only decisions related to a single epidemic within one setting were audited
- The audit process was organisationally led in order to determine the feasibility of the audit.

Introduction

Evaluating decision-making has been recognized as essential to improving health outcomes in a number of contexts[1]. In humanitarian and crisis contexts good decisions at program, sector and response level are especially critical to saving lives and improving response[2]. Despite recent calls for concerted evaluation of decision-making in these settings[3,4], the literature is still sparse. In crisis-affected settings experiencing epidemics, evaluations to date have primarily focused on establishing the extent to which epidemic response outcomes (for example reduced transmission, improved case management) have been attained. Less attention has been given to evaluate the processes underlying these outcomes (for example how response activities were decided and implemented) [5]. Process evaluations have largely been conducted in high-income

countries or after high-profile epidemics to retrospectively determine which decisions led to response failures[6–8].

The need to improve decisions in epidemic settings is especially relevant considering the ongoing COVID-19 pandemic, in which decision-makers contend with a plethora of competing emergencies[9]. Decision support tools have been developed for a variety of settings and purposes but are particularly ubiquitous in corporate business management[10] and in the pharmaceutical and health technology sector[11] for example in the development and licensing of medicinal products, equipment and diagnostics. They are less frequent in humanitarian contexts where they focus primarily on supporting decision-makers in optimizing selected response interventions through for example specifying target populations or modalities of delivery[12,13]. To our knowledge there does not exist an evaluation tool that examines the quality of decision processes within epidemic settings. In a previous study in Somalia, we described factors relevant to COVID-19 decision-making processes; results suggested a need for such a tool.[9] We thus developed a decision-making audit tool to support epidemic responders in assessing and improving the quality of organisational decision processes. Here, we report on a pilot application of this tool amongst two epidemic response organisations in Somalia, a country grappling with the ongoing COVID-19 pandemic and ongoing humanitarian crises [14].

Aim and Objectives

The overall aim was to evaluate the utility and feasibility of a decision support tool for epidemic responders in humanitarian settings.

The specific objectives were to: (i) document the implementation of the tool among select epidemic responders in Somalia; (ii) generate epidemic decision-making scores using the decision support tool; and (iii) explore the feasibility and utility of the tool through key informant interviews of epidemic responders involved in the audit. We refer to objectives 1 and 2 as comprising the audit while objective 3 is referred to as the evaluation.

Methods

Study Design

This study used a mixed methods programme/response evaluation design. It comprised quantitative and qualitative data collection to both assess the decision-making in epidemic response as well as the feasibility and perceived utility of the tool by intended users (decision-makers). We then revised the tool based on this data. The final structure of the decision-making evaluation tool was determined from input collected during the pilot evaluation.

Patient or public involvement

Neither patients or the public were involved in the design of this study.

Description of the tool

We developed an evaluation tool, protocol and Standard Operating Procedure (SOP) (Supplementary Files 3-6) founded on previous reviews [15] and extensive fieldwork in an epidemic setting[9]. This foundational work resulted in findings of very low coverage of epidemic evaluations globally, limited focus on decision processes, lack of standardized evaluation methods as well as an absence of a comprehensive evaluation framework suitable for epidemic response. As a result, we developed an Adaptive Epidemic Response (AER) evaluation framework[16] and drawing from an assessment of the COVID-19 response in Somalia[9], we derived a decision-making framework. The tools and SOPs are based on this decision-making framework. The tool is comprised of three sections and is summarized below (Figure 1).

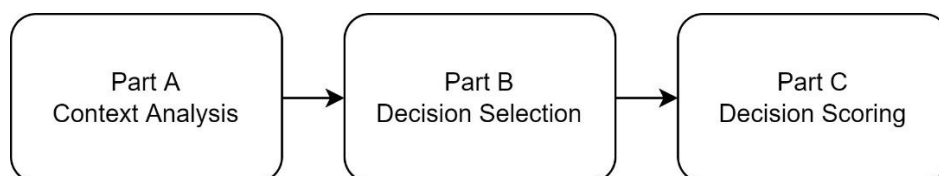


Figure 3 Structure of the audit tool

The first section (Part A) of the tool is the context analysis. which requires information on the historical, geographic and health context in which the epidemic is occurring.

The second section (Part B) entails identification of critical decisions in the response to the specific epidemic. These critical decisions are identified and selected with reference to five Critical Decision Characteristics that differentiate critical decisions from minor or low impact decisions[2] (Table 1).

Table 2. Characteristics of 'critical' decisions

Characteristic	Definition
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Consequential	Decision shapes the response to a significant degree
Not reversible	Decision is difficult to overturn or reverse, at least in the short term
Strategic	Decision involves substantial shift in terms of action taken, resources committed or precedent set
Uncertain	'Decision is made in context of substantial uncertainty with complex array of options
Reputationally risky	Decision entails a high level of organisational reputational risk

In the third section of the tool (Part C), users assess each of the selected decisions against the criteria for 'quality' decision-making. Although there is no agreed definition of a good quality decision[17], we have derived a number of defining criteria from previous published research on health prioritization[18], organizational decision-making[17,19,20] as well as decision-making in emergencies[21]. The 11 criteria are grouped into 4 dimensions: transparency, contestability, accountability, and rigour (Table 2).

Table 3. Criteria for assessing decision quality

Dimension	Criteria	Description
Transparency	Inclusivity	The extent to which the process was inclusive, reflected in heterogeneity in rank and roles amongst decision makers involved.
	Use of explicit decision-making criteria	The extent to which the goals and objectives of the decision were clearly pre-specified. The absence of post-decision rationalization.
	Following clear process or method	The extent to which a priority setting process was in place, reflected in demonstrated use of priority setting frameworks, decision trees or other mechanism.
	Use of mechanism to publicise rationale	The extent to which clear documentation on the decision exists as well as the method used to communicate decisions.
Contestability	Opportunity for revision	The extent to which there existed scope to revise and overturn a decision including the debating of alternatives and description of how consensus was reached.
	Was the decision devolved?	The degree to which participants in closest proximity to the epidemic (e.g. subnational level) or local technical experts participate in the decision, including consideration of rank.
Accountability	Engagement with affected communities	The degree to which affected communities were involved in the response decision-making including at a minimum whether they were informed of the response activities and what effect this notification had on the communities.
Rigour	Explicit outcome	The extent to which intended outcomes of the decision were clearly articulated, including through setting of targets.

Feasible outcome	The extent to which feasibility was considered in decision-making including debating of alternatives.
Strengthens healthcare system	The extent to which the decision was in-line with wider strategy including the strengthening of the health system
Evidence based	The extent to which the decision was based on strong public health rationale and robust scientific information.

Users are required to rate on a Likert scale (a type of linear rating scale commonly used to measure respondents' opinions or attitudes), the strength of evidence supporting the fulfilment of each criterion. They are also expected to provide reference to documentary or observational evidence to support their rating. Users' individual scores are then aggregated, and a summary score is generated.

Data Collection

Audit

We invited three organisations actively engaged in the COVID-19 response in Somalia to pilot the audit tool. After separate presentations in which the protocol and study objectives were explained by the first author, we partnered with two organisations (WHO Somalia and CARE Somalia) in September 2021. Both organisations then nominated audit focal persons tasked with recruiting relevant colleagues (a 'decision-making committee'), gathering the necessary documentation, and completing part A of the tool. Focal persons were instructed to recruit colleagues who had an active role in decision-making within the response as well as to compile key documents which informed or documented decisions. The location and modality of the audit (combination of face to face and remote sessions) and timeline were jointly determined by the audit focal persons and the first author. Study information and consent forms were shared, and written consent was obtained from all participants in the pilot.

The decision-making audit and feasibility evaluation took place in Garowe, Somalia from November 8-22nd 2021 with CARE Somalia and in Mogadishu from November 22- December 8 with WHO Somalia. The audit was led by each organisation's focal persons with the facilitation of the first author. Each audit was comprised of 3 group sessions with the decision-making

committee interspersed with individual sessions (Figure 2). The first group session introduced the audit approach, tool, timeline and expected outputs. Participants were then asked to review Part A (context analysis) of the tool and incorporate any changes before the next group session. In the second group session, participants were introduced to Part B (selection of critical decisions) and were tasked with individually generating their perceived list of critical decisions. In the third group session, participants were asked to each present and advocate for their selection of critical decisions to the wider group. The group was then tasked with forming a consensus on at least 3 of the decisions to carry forward to the last stage. After consensus was reached, participants were asked to complete Part C of the tool for each decision in which they assessed the availability and strength of evidence supporting the fulfilment of various quality decision-making criteria. Audit focal persons and the LSHTM researcher then aggregated the scores and created a draft scorecard.

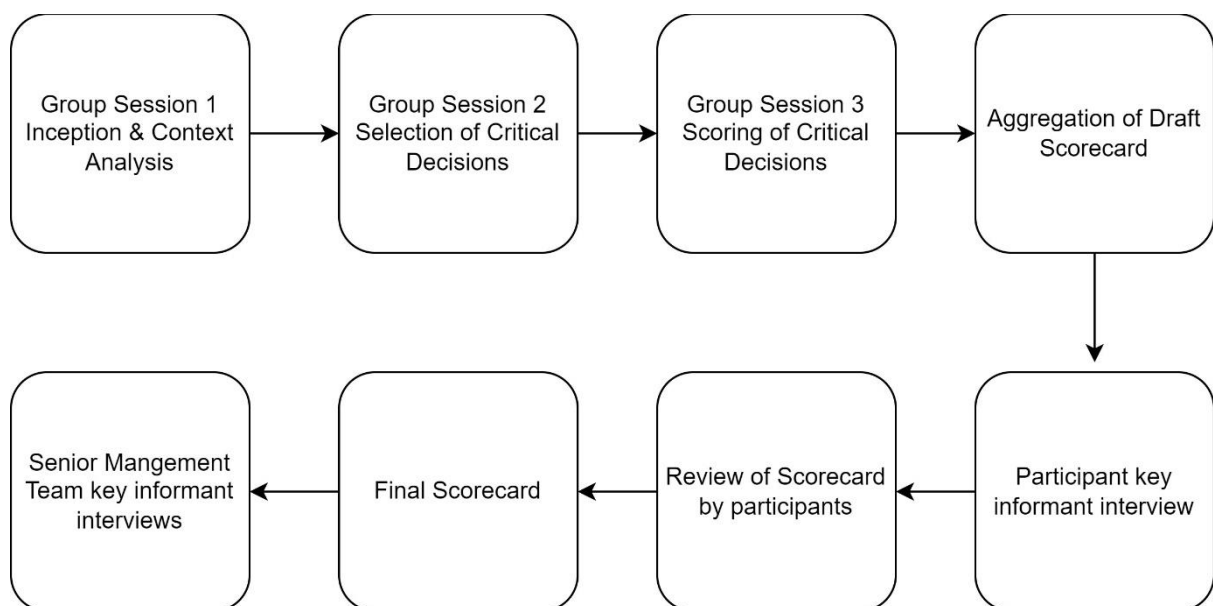


Figure 4 Data collection timeline of evaluation

Evaluation

All audit participants were then invited to take part in a key informant interview to expound on their selected decisions and explore their views on the evaluation process and tools. After the key informant interviews, the draft scorecard was shared with all participants to provide individual written feedback on the results. The final scorecard was then developed by the audit focal persons and first author and shared with the senior management of the respective organisation.

Finally, key informant interviews were conducted by the first author with senior managers who were not involved in the other aspects of the audit and evaluation to solicit their views on the results and their understanding of the process. The tool and related documents were then updated based on pilot findings.

A total of 18 key informant semi-structured interviews were conducted in English or Somali by the first author either face-to-face or via Zoom (Table 3). The first author is a fluent Somali speaker who has substantial experience in health evaluations and epidemic response in the Somali context. The topic guide covered participants' views on the feasibility of the audit process including time and human resources required, the utility of the audit tool in understanding and improving decision making as well as recommendations for future iterations.

Table 4 Data collection by method and type of participant or setting

Primary Data collection	Type of Participants	Number of Participants
Key informant interviews	WHO audit team	7
	WHO Staff- Other	2
	WHO Senior management	2
	CARE Somalia audit team	5
	CARE Somalia senior management	2
	Group Sessions	WHO audit Team
	CARE audit Team	6

Interviews were recorded for transcription and analysis purposes. Each interview took approximately 30-45 minutes and participants were given the option of complete or partial anonymity in which they considered whether they would like their name or only their role to be published. A total of 13 participants took part in the group sessions and notes were taken by the first author. All participants in the CARE audit were national staff members while the majority of WHO participants were international (85%).

Data Analysis

Generation of audit tool scoring

The scorecard for the audit was produced by calculating for each of the 11 criteria assessed, the average of the individual participants scores. Average scores were also presented according to the

four dimensions listed in table 2.

Evaluation of the audit implementation

In order to evaluate the implementation of the audit tool as it relates to the feasibility and utility, interview transcripts and group session notes were analysed using a thematic approach[22] using Nvivo software. Emerging themes were grouped into two categories: those relating to identified critical COVID-19 decisions and those relating to the implementation of the audit. Lastly the validity of the tool was evaluated. The interrater agreement of each organisation's scoring was calculated using Fleiss' Kappa.

In the following results section, we focus on the implementation of the audit while details of specific decisions can be found within the decision-making scorecards in the supplemental material (Supplementary File 5, Supplementary File 6).

Results

Implementation of the decision-making audit

Participants in both organisations opted for a mixture of face-to-face and remote (video conference) data collection citing the busy schedule and geographic dispersion of the participants. Although preparatory material including documentation was shared prior to the arrival of the LSHTM focal person, some participants were not immediately aware of the purpose of the audit. The delayed setup of shared folders containing key audit documentation proved difficult for participants' engagement with the audit and subsequent evaluation. Furthermore, the period in which this audit took place coincided with multiple projects including end-of-year evaluations, annual planning and multiple pre-scheduled activities, hindering the timely recruitment of participants. Many participants were not able to be physically present in the location of the audit due to competing engagements but were nevertheless present through remote means.

Decision Selection

CARE participants had difficulty identifying critical decisions with individual participants submitting on average only 1 critical decision for consideration. However, consensus was reached fairly quickly once the proposed decisions were deliberated by the wider group. In contrast, WHO audit participants put forward 15 decisions for consideration. Consensus took

longer to achieve as participants vigorously advocated for their proposed individual decisions. Eventually the group reached consensus on 4 decisions to proceed to the next stage (Table 4). In both groups, moderate reference was made to the Critical Decision Characteristics (Table 1) with participants arguing for decisions in their particular area of work. Participants in WHO were particularly inclined to view decisions in terms of their alignment with the Incident Management Support Team (IMST) Pillars[23]. Additionally, there was an effort by some participants to reach consensus by collapsing together multiple decisions into a single decision in order to capture all opinions. In both WHO and CARE evaluations, participants focused on positive decisions (i.e. a decision to take an action) and may have overlooked negative decisions (i.e. decisions not to take action).

Table 5. List of selected critical decisions by organisation

CARE Somalia	WHO Somalia
Closure of offices and restriction of staff movement	Scale up of case management through improving access to therapeutic oxygen
Modification of Nutrition programme guidelines to be COVID-19 sensitive including changing patient assessment, facility management and outreach procedures	Establishment of 3 key PCR labs in Mogadishu, Garowe and Hargeisa to strengthen diagnostic and surveillance capacity
Scale up of COVID-19 response activities such as community outreach, contact tracing, provisioning of IPC supplies in Sool and Sanaag Regions	Implementation of the Incident Management Support Team to coordinate COVID-19 response
	Establishment of rapid response teams to scale up surveillance capacity within high priority districts

Decision Scoring

Participants in the CARE audit on average scored their decision-making quality lower than those of WHO. Both organisations scored lowest in accountability to target populations. The scoring of WHO participants on the decision to focus on case management through oxygen scale up demonstrates the low scoring of accountability relative to the other dimensions of quality decision-making (Figure 3). Full details can be found in the supplementary materials (Supplementary File 5, Supplementary File 6).

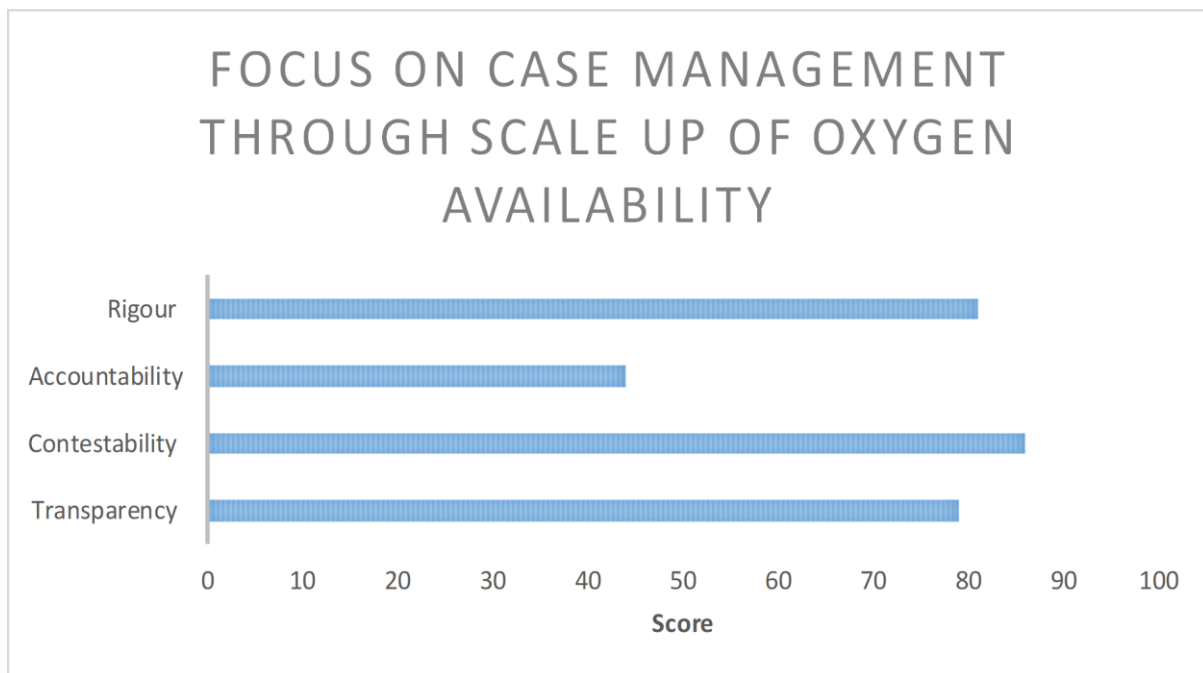


Figure 5 Extract of decision scorecards where accountability was rated low

Participants in CARE scored their decisions lower in contestability compared to WHO. Both organisations rated themselves highly in transparency, particularly in the inclusivity criteria. However, the key stakeholder mentioned under these criteria differed, with CARE highlighting the need to improve inclusive decision-making within the organisation (national staff vs country office senior management) while WHO referred to inclusivity with government authorities. Lastly, CARE participants rated their decision-making as less rigorous than WHO's, citing their unfamiliarity with the evidence underlying the decisions. By contrast, WHO participants cited use of the latest scientific findings and alignment with health systems strengthening frameworks.

Interrater agreement

There was very low interrater agreement amongst participants in both WHO (Kappa = -0.000948, P= 0.977) and CARE (Kappa = 0.0684, P= 0.172) audit groups with a slightly higher interrater agreement amongst CARE participants, indicating high heterogeneity of scores.

Perceptions of the audit tool

Utility

Participants described clearly seeing the purpose and value of the audit. For example, one participant from WHO said, "*We learned that decisions are not just simply taken as decisions, but you have to have a clear decision-making process, a methodology, or criteria, or something, but*

not necessarily that we just come and say, "Oh, let's do this and that". Participants articulated the ongoing need for such an exercise, arguing: *"If there's no understanding of how a decision happened, there's no way to improve on it"* (WHO Participant 5). Critically, they understood that this exercise was meant as an internal audit: *"It was really for us to be able to critically evaluate ourselves as an organisation"* (CARE Participant 3). Some participants also saw the potential utility in a wider range of contexts, beyond epidemics: *"I think [the audit tool] can apply to any decision in humanitarian emergency response"* (WHO Participant 2).

Participants mentioned learning new things about the decision process including recognizing neglected characteristics of good decision-making:

"When I was trying to fill in some of the scores, I realized that these are very important [aspects] that were neglected before. For example, devolving certain decisions, it is very important. Not just like you sit up at national level, you decide for anyone and you decide for people at all levels, I think if we devolve certain functions it is good". WHO Participant 1

They also were able to identify areas for improvement. *"I think for accountability most of the evidence was very minimal. It just got me thinking of ways in which we can involve the communities in decision-making."* (WHO Participant 4).

Participants also highlighted that the audit was useful in allowing them to be more reflective. *"It helped me look at things objectively. If I was not part of the Incident Management Support Team (IMST) would I have advocated for this decision or not?"* (WHO Participant 4). They highlighted the relevance of the decision-making critical characteristics as useful in their work and recognised these as reflective of best-practice: *"I think the tool helped a lot to give me a reflection as to what should be done. I think I learned a lot going through the questions."* (WHO Participant 1).

Participants mentioned the gradual understanding they accrued throughout the audit process as strengthening their engagement with the audit. *"I think some of it was clear, but some of it was also not very clear. I think I understood the methodology with time, of course, when you explained and when we were having the group discussions. That is why in the last forms, I revised and added a few components and sent back to you. I think as usual when people read something, it might not be clear in the first place, but when you explain it, it becomes clear".*

(WHO Participant 4).

Participants also noted the benefit of the group format in deriving new insights and creating a useful forum for reflection to review decisions that otherwise didn't exist in their typical organisational practices:

"We all had our own ideas, but when we met as a group, there were a few other things that came out that probably I didn't think about as an individual, which were very valid". WHO Participant 4

"I also liked that we were able to meet as a group and look at these things because to be very honest, I don't feel like we have that as a group, as an IMST team to review the decisions that we made or look at what we could have done differently, or whether we felt this decision was important or not. This was a very unique exercise and I'm glad that we got an opportunity to do this." WHO Participant 7

Participants expressed their commitment to use the lessons learned in future decision making:

"I will inform my colleagues, 'Please, let us have certain criteria to use, let us make our methodology clear, and let us document everything,' because at some point down the road, we should know our decision-making process. This has helped a lot and will change a lot in the future." WHO Participant 5

However, participants mentioned that there was a certain element of subjectivity which was difficult to overcome:

"It might be very difficult to understand exactly the reality on the ground, because it depends on the person. Not only the person but also, the involvement of the person in the response activity, and also the understanding of the context. If you are someone who is quite new to Somalia, and maybe who doesn't have detailed involvement, you might give a different ranking than a person who's spent more time in Somalia and directly engaged in response activity". WHO Participant 2

Feasibility

In terms of the audits' feasibility, participants expressed that they were easily able to comprehend the process. *"[The tool] was very understandable and also, it was very user friendly."* (CARE Participant 1). However, a few participants noted some areas for improvement: *"I'm looking at this tool being used for an outbreak. If that is to happen, as I said, we need to really condense some aspects, and lump some of these criteria together to cut on time."* (CARE Participant 3).

In terms of time, participants expressed that the duration of the audit was acceptable but that the

time of year chosen for the implementation could have been improved. *“In terms of length of the time, this is fine. This amount of time we need to give. The issue is the timing of the programming, because in some of the months, we are very busy, like last quarter of the year we are very busy.”* (CARE Participant 5).

As a result, some participants expressed their confidence that they could implement this audit independently at a more opportune time. However, others expressed their preference for this work to be led by an independent evaluator.

As the independent outsider, everybody can open up to you, and this is the best advantage I can see. I also saw something similar in my previous organization, that again, it is the power dynamic or the personality thing that not everybody speaks openly, or the culture doesn't allow it but when somebody from outside comes, everybody opens up. At the end, you come up with some really good findings and recommendations” WHO Participant 1

In their engagement with the audit tool, participants faced a challenge in coming to a consensus on the limited number of decisions to score. *“Considering the response that we are doing in the country, it might be a bit challenging to come up with one or two out of so many critical decisions.”* (WHO Participant 2).

Additionally, there were challenges in accessing documentation relevant to the audit. *“Maybe the big challenge is getting the evidence, documentation, preparing the documentation, extracting the email, finding the document, it might be time-consuming.”* WHO Participant 3. Where documents did exist, some participants stated that not all staff may have access. Lastly, some participants highlighted language or conceptual understanding barriers as challenges in the audit. *“At some point, I felt like we were not looking at the decisions, but we were looking at pillars.”* (WHO Participant 4).

Selection of decision-making committee

Participants noted that the composition of the decision-making committee had the potential to affect the audit outcome because of a lack of detailed knowledge on how decisions were made.

“If somebody is not involved in a certain pillar, they would struggle to look for evidence or they might not be able to direct somebody to a particular document.” (WHO Participant 2)

They mentioned that all who were part of the audit had some role to play in COVID-19 decision making but conversely not all who had decision-making roles participated in the audit.

Some participants highlighted the potential of overlooking critical decisions when the primary responsible staff member was not present in the audit.

“Later I thought about COVID-19 vaccine, and I wondered if we could have included the focal person and whether they would have felt that the introduction of the COVID-19 vaccine into the country was a critical decision. I thought about it, and I thought maybe nobody mentioned it, or nobody talked much about it during the discussion because the focal point was not there. WHO Participant 4

Participant Recommendations

Participants made several recommendations to improve the utility and feasibility of the audit for future iterations. These included broadening the scope of participants by more clearly outlining who should participate.

Participants also suggested incorporating the emergency response cycle into the evaluation tool.

“There are emergency response cycle phases such as preparedness, implementation, monitoring, and evaluation [...] There are critical decisions at each phase which need to be evaluated.” (WHO Participant 2)

They also made several suggestions to improve the implementation including ensuring more face-to-face rather than virtual interactions amongst participants and undertaking a joint review of documentation to improve participant familiarity with the available documents.

Views of senior management

Senior management largely agreed with the findings of their respective scorecards. They did, however, provide further detail and rationale for some aspects of the selected decisions. For example, senior managers in both organisations cited mitigating factors in explaining lower-than-expected scoring in some dimensions. Referring to closure of offices and restriction of staff movements, one CARE senior manager explained:

“When the first case of COVID-19 was reported in Somalia in March, I think it was around 16, 17. There was a bit of panic in that it was not business as usual. When it comes to between life and death, certain positions have to be taken. As a result of that, yes, the senior management team made a decision to ensure that because we are accountable to everyone and every staff, and every staff exposed to any risk as a result of negligence of the organization, then the organization

takes responsibility.” CARE Senior Manager 1

A WHO senior manager explained the circumstances behind a decision to increase testing capacity:

“Obviously there’s scope for improvement, but sometimes when we are in a pressured situations and we see that the PCR based labs are overwhelmed and at the peripheral level there is no access or testing facilities are not there, and the GeneXpert machines are also not functioning, then sometimes we make decisions and implement swiftly, and then [later] we provide other evidence and information of the value and effectiveness of those strategies”. WHO Senior Manager 1

They did however agree on gaps highlighted through the scorecard stating: *“I would say that [decision-making] can become more inclusive. I think that we are just talking internally amongst ourselves and we are not engaging sufficiently with our government counterparts. I think that that’s a fundamental mistake that we are doing, and we continuously do so, because of maybe convenience, because of maybe comfort.” (WHO Senior Manager 2).*

Discussion

This pilot evaluation of a tool to audit decisions taken during epidemic response demonstrates that the tool can be successfully deployed even in the midst of an ongoing response and even in circumstances where responders are dealing with unusually high workload. The audit also elicited very positive user feedback with participants expressing a willingness to implement it in future epidemic responses. Importantly, participants viewed the audit as reflecting good decision-making practice indicating high levels of acceptability.

As populations affected by epidemics continue to grow[24], there is an urgent need to improve epidemic response particularly through improved decision-making. Much of the focus has been on improving decision outcomes and less attention has been paid to decision-making processes[25]. However, strengthening decision processes can improve decision-making quality[26] and, accordingly, outcomes[27] including more efficient allocation of resources, improved accountability and greater coordination.

The literature on decision-making in emergencies has been underpinned by an analytically oriented[28] conceptualization of decision making in which the ‘correct’ decision is sought[29,30]. This is in contrast to the process conceptualization in which the decision is pursued correctly.

Towards this end, decision support approaches have been developed to optimize the decision-making process to achieve efficient[2] and timely decisions[31] but have largely not considered the aspect of quality. The evaluation of this tool within the COVID-19 response in Somalia contributes towards filling this gap.

The audit sheds light on shortcomings in the quality of decision processes within piloting organisations and provided participants opportunity for reflection and key areas for improvement. The tool was found to be highly adaptable as it allowed organizations to evaluate decisions that were considered significant by their staff. Nevertheless, while the audit instructed organisation to select participants that were largely reflective of staff making or implementing response decisions, some participants expressed reservations about the final composition of the evaluation panel. The scoring of some decision dimensions was however largely reflective of the panel's experiences and characteristics. For example, amongst CARE participants, the lower scoring on the contestability of some decisions might be due to their roles as national staff who may not have had sufficient opportunity to contest decisions. The rollout of the tool allowed for gradual understanding to develop and for participants to question their basic assumptions. For example, participants were able to acknowledge elements that were absent from their decision-making process. They were also surprised by the paucity of documentary evidence within their organisations and were able to contrast this with their initial self-assessed high scoring. The lower-than-expected agreement amongst raters could possibly due to lack of consensus on what various levels of evidence represented. While limited documentation does not necessarily equate with poor decision processes, it does make subsequent evaluations more challenging. Furthermore, the audit tool was found to be highly flexible as users highlighted its potential utility in assessing the quality of decision-making in broader humanitarian response by generating a quantitative measure of decision quality that can allow for tracking over time. In addition to the retrospective assessment of decisions, the tool can also be used in real time to improve decision-processes.

Limitations

Although this pilot was undertaken within two organisations, it assessed decision-making related to a single epidemic within one country. While this pilot study was led by the first author who was

external to both organisations, future iterations led entirely by internal staff members may be more vulnerable to censorship if results reveal low decision quality. However this is a challenge that is present in global health arena in general[32] and a number of resources have been published to strengthen independence of evaluations[33–35]. Additionally, much of the scoring relied on the subjective assessment of the individual rater and may thus have been reflected in the lower-than-expected interrater correlation. Furthermore, this pilot focused on face validity (the extent to which a tool appears to measure a concept) rather than on content validity which requires further exploration and methods. Additionally, we did not use quantitative methods such as factor analysis to reduce the number of items within the critical decision criteria as there were too few items. Instead, we relied exclusively on direct feedback from the participant interviews. Definitions for the decision-making criteria were not exhaustive and could have been further expanded. For example with regards to community engagement criteria we provided a minimum definition rather than broader definition[36]. Finally, the methods described in this study assessed only organisational decision-making rather than individual and as such cannot be used to assess the decision-making of individual epidemic responders.

Recommendations

The audit can be further piloted in a wider range of crisis settings and amongst different response actors to ascertain its feasibility and utility in diverse settings. Additionally, the audit should be conducted internally by response actors in order to compare how the audit is implemented when it is entirely independent of an external facilitator. Furthermore, the audit should be conducted periodically in order to determine whether there has been a quantitative change in the decision quality scoring. Lastly, the audit tool could also be integrated within the WHO recommended intra-action reviews[37] as well as after action reviews[38] for health emergencies.

Conclusion

Strengthening decision-making processes is key to realizing the objectives of epidemic response. This pilot evaluation contributes towards this goal by the testing what, to our knowledge, may be the first tool designed specifically to assess quality of decision-making processes in epidemic response. The tool has proven feasible and acceptable in assessing decision-making quality in an ongoing response and has potential applicability in assessing decision-making in broader

humanitarian response.

Declarations

Contributorship statement

This study was designed by AW with input from FC. The data collection was undertaken by AW, AO, FH and AA. The analysis was undertaken by AW with input from KB, FC, and JP. The first draft was written by AW. All authors have contributed significantly to the final draft.

Competing interests

We declare no competing interests.

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Data sharing statement

No additional data available

Ethics approval and consent to participate

Ethical approval for this study was obtained from the National Institute of Health Research of the Federal Republic of Somalia (Ref: NIHS0102208) and the ethics review committee of the London School of Hygiene & Tropical Medicine (Ref: 26369). Informed written consent was taken from all key informants.

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PART THREE

5. General Discussion

Epidemics continue to pose a substantial risk to the health and wellbeing of millions. They do so in non-equitable way, having a greater impact on populations that live in low-income and humanitarian settings. Epidemics in such settings often exacerbate the effects of poverty, displacement and poor health systems on the population's health. Furthermore, the response to epidemics in these settings often suffer from under-resourcing and less scrutiny compared to higher income settings. The COVID-19 pandemic represents only the most prominent example of these phenomena. In particular, the early and sustained inequitable distribution of COVID-19 vaccines has led to many high-income countries achieving vaccination coverage above 80% whilst many low-income countries particularly in sub-Saharan Africa struggle to reach 20% coverage.⁶⁵ The pandemic has highlighted the inadequacies of existing response systems and the inability of response actors to mount an appropriate and adequate response. In many high-income countries, governments introduced wide scale social safety net programmes to alleviate the impacts of lockdowns, while similar programmes in low-income countries were either not feasible or of limited scale.⁶⁶ The pandemic also revealed the inequity in the distribution of curative services such as access to intensive care units and oxygen therapy both within high-income settings and between high-income and low-income settings.⁶⁷ This gap extends to fundamental information on the true impact of the pandemic, with high-income countries able to produce detailed statistics on cases and deaths attributable to COVID-19 whilst similarly robust statistics or at least estimates have been unavailable for most low-income countries.⁶⁸ Efforts are underway to initiate a global pandemic treaty to address some of these inequities, but experience has shown that existing international agreements have suffered from insufficient governance and inconsistent adherence.^{69,70}

The study of decision-making has been most intense within the corporate business sector where there is growing evidence on the relationship between improved decision-making and stronger performance.⁷¹ The recognition of the central importance of decision-making has also reached the world of humanitarian response, in which a growing conversation has emerged on how decision-

making is undertaken in these contexts.³⁷ This thesis contributes to the study of decision-making by extending it into the domain of epidemic response within low-income and humanitarian settings, where the burden of epidemics is often disproportionately high. It addresses a call for studies on higher level decision making; cognitive biases; variations in situational awareness; group decision making and political interference in epidemic response.⁷² The real-time mixed method approach developed in this thesis combines two common data approaches often used in epidemic response monitoring and evaluation. Firstly, it uses quantitative indicators such as those used in the Joint External Evaluations or Epidemic Preparedness Index. The Joint External Evaluations are evaluations intended to support the implementation of the International Health Regulations (IHR) through in-depth assessment of country capacity to prevent, detect, and rapidly respond to public health threats.⁷³ The capacities are evaluated through use of scaled indicators ranging from '1-no capacity' to '5-sustained capacity' with documented evidence required to substantiate each indicator score. The Epidemic Preparedness Index measure countries broad capacity to prepare and respond to epidemics in 5 areas including economic resources, public health communications, infrastructure, public health systems and institutional capacity. Secondly, this thesis draws on qualitative methods to document lessons learned commonly used in after action reviews. After action reviews are a type of evaluation done after the completion of a project to document project events and processes as well as review success and challenges. It is only through critical evaluations that one can begin to learn important lessons and address common or context-specific limitations of current response efforts.

5.1 Synthesis of thesis findings

Papers one and two provide necessary background information on the state of epidemic response evaluation globally. They highlight broad shortcomings in epidemic evaluation such as the lack of appropriate frameworks, lack of uniformity in evaluation practice, delays in publication and variability in quality. Papers three and four focused on one particular gap, decision-making, within

the context of a single humanitarian setting. In paper 3, I describe how epidemic response decisions were made by Somali actors dealing with the COVID-19 pandemic: this exploration seemed necessary so as to first understand the decision-making process before proposing any solutions for improvement. Through document review, direct observation, individual key informant and group interviews, I tested the validity of a decision-making framework to capture the factors influencing and processes followed by actors in Somalia. The shortcomings highlighted in this study, together with the revised decision-making framework, directly contributed to the construction of a decision audit tool. In paper 3, I drew on input from a wide range of actors whilst in paper 4, I recruited primarily operational actors to pilot the audit tool. The methods used across paper 3 and 4 were complementary in that the largely qualitative methods used in paper 3 contributed to the development of the decision audit tool which produced a quantitative scorecard. The usage of qualitative analysis and participatory approaches within paper 4 also produced informative data that supported the generation and interpretation of the quantitative scorecard.

5.2 Summary of findings

The overall aim of this PhD thesis was to contribute to improving epidemic response in humanitarian and low-income settings by developing an approach to evaluate decision-making. I intended to realize this aim through answering four primary research questions:

Research Question 1

What public health evaluation frameworks are available to evaluate epidemic response and what is their suitability to evaluate response within humanitarian settings?

The first phase of understanding the state of epidemic response evaluations within low income and humanitarian settings was to identify an orienting evaluation framework. Such a framework was desirable to structure and guide the research project as a whole and should identify both the critical processes in a response and the various evaluation dimensions along which these can be assessed.

The framework should in turn be underpinned by a clear Theory of Change (ToC). Therefore, the

first step was to conduct a review of existing public health evaluation frameworks and to determine their suitability to evaluate epidemics in low income and humanitarian settings.

I undertook a scoping review of the public health evaluation literature in emergency settings in the MEDLINE, EMBASE, Global Health and Web of Science databases as well as a search of grey literature using Google and Google Scholar, with a timeframe of 2008 to 2019. The review focused on recent public health evaluation frameworks utilized in low- income countries defined using the 2018 World Bank criteria⁷⁴, and humanitarian settings within LMICs as reported in the United Nations Office for the Coordination of Humanitarian Affairs' (OCHA) annual Global Humanitarian Overview. I

developed an epidemic response ToC for the purpose of selecting, categorising and assessing identified public health evaluation frameworks. A total of 39 frameworks which had been primarily used in emergency settings in sub-Saharan Africa, the Middle East or Southeast Asia were identified and categorized according to type, methods and audience. After inclusion criteria were applied a total of 13 frameworks⁷⁵⁻⁸⁷ were brought forward for narrative synthesis. No single overarching framework was found that was suitable for epidemic evaluation. Each of the 13 frameworks had limitations which precluded them from being adopted. These limitations included overemphasis on applicability within specific contexts, insufficient attention to the iterative nature of emergency response, and focus on specific segments of an intervention lifespan. Despite these limitations, the identified evaluation frameworks did provide sufficient material from which to construct an overarching epidemic specific evaluation framework. Specifically, I proposed an Adaptive Epidemic Response Framework (Figure 3) that covers both the phases of an epidemic response (design, implementation, and performance) as well as the types of analyses that can be undertaken within these phases. This broad evaluation framework is intended to encompass all stages and components of epidemic response in general. It also serves as a basis to zero in on specific aspects of a response through development of detailed analysis tools.

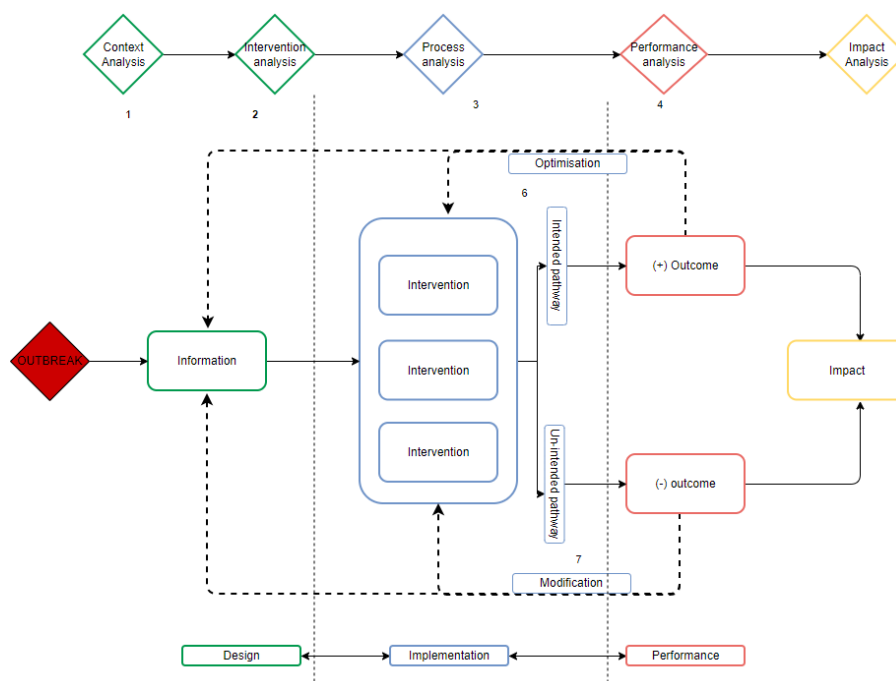


Figure 6 Adaptive Epidemic Response Framework. Extracted from Warsame et al. Towards Systematic Evaluation of epidemic response during humanitarian crises: a scoping review of existing public health evaluation frameworks. *BMJ Global Health*, 2020

Research Question 2

To what extent are epidemics in low and middle income and crisis settings evaluated and what are the strengths and gaps in evaluation practises in these settings?

In research paper 2, I undertook a systematic review of the literature using PRISMA criteria to determine how epidemic evaluations are practised in LMIC and crisis settings. This was undertaken in three stages: i) identifying individual epidemics that had occurred in low resource or humanitarian settings during the period 2010 to 2019; ii) identifying published epidemic evaluations during the same period, and matching these to the extent possible with epidemics identified in stage (1) so as to determine the extent to which epidemics occurring in low resource or humanitarian settings are evaluated; and iii) describing patterns in the typology and quality of evaluations identified. Drawing upon a number of databases of the peer reviewed literature as well as the grey literature, 429 epidemics were identified, reported in 40 countries across Sub-Saharan Africa, the Middle East and Central Asia. Only one in ten epidemics were found to have a corresponding

response evaluation and within these evaluations there was wide variability in quality, content and disease coverage. These findings have a number of implications for the state of epidemic response evaluation. Firstly, the low coverage of evaluations points to a deficit in accountability to affected populations. Populations who are intended to be the primary beneficiaries of epidemic response do not have a clear way of understanding how well the response was undertaken and as a result cannot hold responders to account. The average 2-year delay between the implementation of an evaluation and the publication of the evaluation report arguably worsens this accountability. While the limited coverage of evaluations could have been due to many evaluations being kept internal, to external actors the effect of this opaqueness and lack of knowledge sharing may be largely the same as if no evaluation had been done: internal evaluations provide no opportunity for the wider epidemic response community to learn and improve. In line with the findings of research paper 1, very few evaluations utilized an explicit evaluation framework. Furthermore, there was a relative paucity of process evaluations and evaluations that explicitly focused on decision-making.

The lack of uniformity of evaluations and the variability in quality limits the comparability of evaluation findings across time and responses and the inferences that can be drawn from them. The findings under this objective thus underscore the findings of the first research paper: namely there is a need to more consistently and systematically evaluate epidemic response through a standardized approach and toolset. This paper also adds to the call for improving the governance around epidemic response^{88,89}; specifically, the findings support the need to establish a mechanism and standards which govern criteria that should trigger an evaluation, the timing of evaluation, the composition and affiliation of the evaluation team, funding, minimum evaluation standards (e.g. a common scope and framework) and publication steps. Further discussion on this topic is provided in the recommendations of this thesis.

Research Question 3

How do epidemic responders tackling the COVID-19 epidemic in Somalia formulate and implement response decisions?

The relatively limited number of evaluations which focused on decision-making was a pivotal finding as decision-making may be among the most upstream and potentially impactful aspects of an epidemic response. As a result, I undertook in research paper 3 a mixed methods evaluation of COVID-19 decision-making amongst responders in Somalia and used it to refine a decision-making framework that captures the different factors and processes involved in decision-making. A total of 31 informants across diverse organisations spanning from government policymakers to operational managers within NGOs were interviewed, along with observation of several key decision-making fora and review of response documentation. Across the board, decision-makers faced to varying degrees a number of key challenges in the different phases of decision-making. Beginning with the sense-making, responders struggled to understand the scope and scale of the unfolding epidemic. Despite having ample experiences with epidemics, the novelty of the COVID-19 epidemic and its global reach led many decision-makers to rely on international norms and standards that may not have been suitable for the context. This phenomenon was not unique to Somali responders and has been observed in a number of other humanitarian settings.⁹⁰

The epidemic was occurring in the midst of a particularly volatile political season^{91,92} and concurrently with other crises.^{93,94} Additionally, decision-makers were limited by existing constraints that were further amplified by the emergence of the epidemic, including limited resources⁹⁵, poor population access to health services and discord amongst health actors over resources and areas of responsibility. In the face of such challenges, decision-makers noted a sense of urgency to respond leading to reduced transparency. Under these circumstances, decision-makers were guided by internal influencing factors (Figure 4). These modalities do not necessarily serve the response well and have led to sub-optimal outcomes such as the inefficient usage of resources through

overreliance on case management⁹⁶, social measures that disproportionately impact the most vulnerable⁹⁷ and low adherence to preventative measures.⁹⁸

Findings allowed me to refine the decision-making framework (Figure 4) to more fully capture the factors at play within a complex, crisis-affected decision-making environment such as Somalia's.

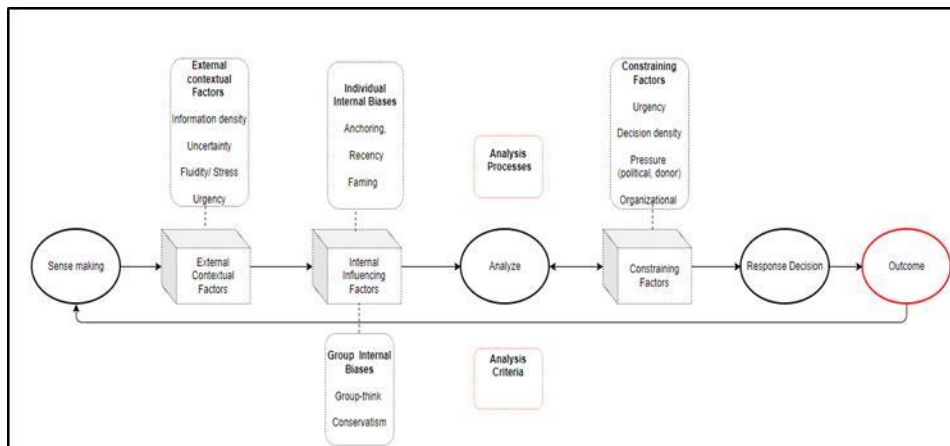


Figure 7 Decision-making framework. Extracted from Warsame et al, Evaluating COVID-19 decision-making in a humanitarian setting. PloS Global Health.2022

Elements of the decision-making framework (sense-making, analysis, decision) shared similarities to that of the OODA (Observe, Orient, Decide, Assess) loop in Figure 5, initially developed for high stakes decision-making and utilized in a wide array of fields.^{99,100} The similarities include the stages of sensemaking and analysis, known as observation and orientation in the OODA loop, preceding the decision point. Additionally, the iterative nature of decision making in which decision outcomes lead to further sensemaking and analysis is common to both OODA and decision-making frameworks.

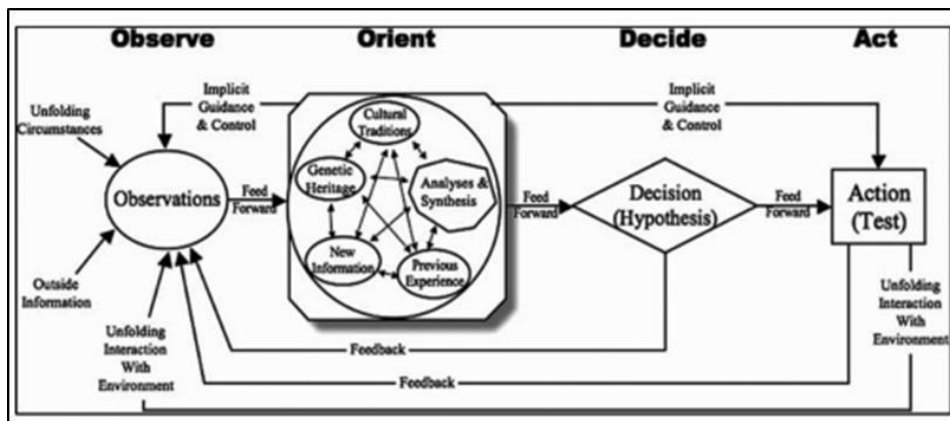


Figure 8 OODA Loop. Extracted from: Azuma R, Daily M, Furmanski C. A Review of Time Critical Decision-Making Models and Human Cognitive Processes. IEEE Aerospace Conference Proceedings 2006:9 pp. DOI:10.1109/AERO.2006.1656041

The results of paper 3 highlighted the need for improving the decision-making processes amongst all response entities through a methodical and reflective evaluation mechanism. Such a mechanism could be supported by a tool aligned with the decision-making framework which would allow responders to critically assess the quality of their decision-making processes in order to support better decision-making.

Research Question 4

What is the utility and feasibility of a decision-making quality audit tool within the organisational response of epidemic response agencies in Somalia?

In research paper 4, I undertook a pilot evaluation of a decision quality audit tool amongst two agencies responding to the COVID-19 epidemic within Somalia. The purpose of the pilot was to assess the utility of the tool as well as its feasibility in a low income or crisis epidemic context. The tool was developed based on the decision-making framework and the gaps in decision-making identified in the previous research papers. These gaps included findings of low accountability towards affected populations highlighted in research papers two and three, limited transparency and lack of clear decision processes identified in research paper 3.

The audit tool was predicated on a process-oriented decision-making conceptualization. The tool was found to be of high utility to epidemic responders within the organisation at both project and senior management level in assessing the quality of decision processes. Epidemic responders found the generated scorecard to be largely reflective of the way in which decisions were undertaken. The process of the evaluation and the implementation of the audit tool were found to be highly feasible despite the heavy burden and time limitations experienced by responders due to the contextual factors external to the pilot evaluation itself. The flexibility of the tool allowed for the audit to be tailored to decisions that were considered relevant and important to each organisation. The generation of a semi-quantitative score for decision quality allows for tracking progress over time and comparison across decisions. This quantitative approach is similarly used in the Joint External Evaluation Tool to track progress in national IHR core capacities.⁷³ The audit tool was also similar to the WHO recommended inter-action and after-action reviews.¹⁰¹ Aspects of the audit were also in line with evaluation standards proposed by the European Centre for Disease Prevention and Control (ECDC) and WHO, which for example call for the development of a timeline of events and focus on specific decision or 'pain points'.^{101,102} The organisationally led character of the audit allows for increased buy-in and ownership of the results. It also helps bring to light more authentic and detailed findings in comparison to an evaluation that might be externally driven or executed. On the other hand, the internally led nature of the audit is vulnerable to censorship of unfavourable results which is an ongoing challenge in global health research and evaluation.¹⁰³

6. Limitations of the thesis

Evaluating epidemic response entails a number of research and operational challenges which are particularly acute in humanitarian contexts. As part of this research, three primary limitations have been identified that run across this thesis.

a) Publication and measurement bias

Both the findings of papers one and two are vulnerable to reporting bias¹⁰⁴ due to a number of reasons. In undertaking the literature searches, I relied on primarily publicly available records which are unlikely to comprehensively encompass all relevant records. Additionally, limiting the search to the English and French languages further restricted the records that could be considered in both reviews. It is likely that reports of epidemic evaluations may have been produced in other languages. It is also likely that a significant number of records may not have been found due to them being disseminated only locally or kept internal within the evaluating organisation. Thus, the gap in epidemic evaluations may potentially have been overestimated. Nevertheless, the effect of limited or restricted dissemination ultimately prevents lessons learned from being applied more widely amongst different responders and in different contexts. The focus on contemporary records in both papers 1 and 2 may also have led to relevant albeit older documents being overlooked. Lastly, limitations placed on the search of the grey literature may also have minimised the number of relevant frameworks and evaluations acquired.

Additionally, although I drew upon multiple databases to gather reports on epidemics, they are unlikely to have covered all known epidemics, particularly given that the geographical scope was settings expected to feature relatively weak surveillance. Therefore, the proportion of unreported epidemics is unknown. Furthermore, I assumed that all reported epidemics had an epidemic response and should, as a result, have been evaluated. However, I did not know the true proportion of epidemics that were responded to and therefore could potentially have overestimated the evaluation coverage gap.

In paper 4, the decision-making audit tool relied on strong record keeping and documentation related to response decisions. Participants struggled to find the necessary documentation to base their quality scoring on, which may have led to lower decision scoring. While the paucity of documentation may not necessarily have meant that decision quality was low, it does make

evaluations more difficult as participants must rely on potentially conflicting recollections of events. The lack of evaluation documentation was found to be common across a large number of COVID-19 evaluations in various settings⁴⁹. The audit tool can be further refined to offset limited documentation with methods to better capture decision-makers' recollections of events.

In paper 4, I was unable to undertake a more conventional intensive tool development and validation process due to limitations in resources and time. This would have required several stages of expert consultations in which each item in the tool was ranked and tested with the goal of ensuring the content validity.¹⁰⁵ As a result, the decision audit tool was developed to the stage of face validity but can be further strengthened to achieve content validity. Additionally, I did not produce an overall quality score as there was insufficient evidence on how much weight each of the decision-making dimensions should be given. Furthermore, because the focus was on decision processes, it was not possible to understand the relative influence of different dimensions of decision quality on the decision outcomes. Lastly to allow for rapid implementation, definitions of certain technical constructs were kept minimal. For example, while there are comprehensive definitions of what constitutes community engagement¹⁰⁶, a simplified definition was used in this thesis to allow for tool users to quickly gauge whether this domain of public health action was indeed part of their epidemic response and thus to be considered when implementing the tool.

b) Limitations in scope

Much of the focus of this thesis has been on epidemic response within Somalia. Somalia does typify many aspects of what epidemic responders in humanitarian settings may face including concurrent emergencies^{93,107}, insecurity, resource limitations⁹⁵ and complex political landscapes.⁹¹ However no two settings are exactly the same and the applicability to other geographies of the findings and tools developed need to be confirmed.

While paper 2 did consider a wide array of epidemics, paper 3 and 4 focused entirely on the response to COVID-19. The COVID-19 epidemic has arguably been atypical due to its unprecedented scale, impact and the subsequent attention and dedicated response both at global and national levels. Thus, there is a need to ensure that the frameworks and tools developed in this thesis during the course of COVID-19 response be assessed for their relevance in evaluating more routine epidemics such as epidemics of cholera and measles. This would address the inequality in evaluations first mentioned in paper 2 in which a disproportionate number of evaluations were undertaken for relatively few large-scale epidemics whilst more common and possibly more impactful epidemics were largely overlooked. This gap reflects a deficit in the accountability to affected populations, a key principle in humanitarian response.¹⁰⁸

Additionally, there was limited engagement with community perspectives in this thesis. Although in paper 3, representatives of civil society did contribute to the findings as key informants, no direct engagement was done to gather the perspectives of epidemic affected communities. Communities can provide important information necessary to shaping the epidemic response and eventually to evaluate performance of responders^{109,110} and are thus a key stakeholder that has been overlooked. Conducting fieldwork in Somalia during the COVID-19 pandemic and against a backdrop of insecurity and political instability pre-empted in part such potentially enriching contact with the affected population.

c) Response bias and reflexivity considerations

The evaluation activities in Papers 3 and 4 were largely possible due to the strong existing network which I drew upon to gain access to both informants, datasets and pilot organisations. Due to my ethnic identity as a Somali, my fluency in the language and my prior public health experience in Somalia as well as my role as an external academic actor, I was able to successfully construct a network as both an insider and outsider. My identity as an experienced, Somali public health expert

may have lent me legitimacy in the eyes of some informants and allowed me a measure of insider access. My role as a trusted and experienced outsider was key to eliciting critical insight into the overall COVID-19 response in research paper 3. Access to data and networks may have been more challenging had I been less successful in balancing these two identities and raises questions as to how the audit approach would be perceived if undertaken by researchers with more limited networks or a more unambiguous identity.

Furthermore, my role as an external facilitator in research paper 4 allowed me to act relatively independently when navigating some censorship issues inherent in internal evaluations. While external evaluation often (but not necessarily) enables greater independence, external evaluators often are limited by an inadequate understanding of the operating context.¹¹¹ In this study, I was able to combine my external position with my robust knowledge of Somalia to identify and navigate around attempts at censorship. The perception that I possessed a strong understanding of the political dynamics and sensitivities relevant to the COVID-19 response and the impartiality attributed to my external position likely prevented overt attempts at censorship. However, it remains unknown if an external facilitator without the same understanding of the context or an audit conducted entirely internally would suffer from some degree of censorship. There is a need to develop or adapt criteria for ensuring the independence of evaluations within epidemic settings.

7. Conclusion and Recommendations

This thesis was undertaken in partnership with a number of operational agencies and involved a diverse array of epidemic response stakeholders. Each of the papers has provided specific recommendations that aim to support operational agencies to improve their epidemic response within humanitarian contexts. There are however several broad recommendations that can be predicated on the findings and limitations of the thesis as a whole:

Global Recommendations

1. Put epidemic evaluation front and centre of the global agenda of epidemic preparedness and response

One of the primary findings of this thesis was the relative paucity, inequity and diversity of epidemic response evaluations globally. Even prior to COVID-19 the number of large-scale initiatives related to epidemic preparedness and response had proliferated and included global initiatives such as the Global Preparedness monitoring Board (GPMB)⁸⁸ and the Global Outbreak and Response Network (GOARN)¹¹² amongst others. However, with the advent of COVID-19, epidemics have risen to the top of the global conversation in health security as a result of unprecedented urgency to both end the pandemic and prevent similar ones. One of the largest projects is that of the Global Pandemic Treaty¹¹³, led by the WHO, which seeks to develop a global consensus and legally binding mechanism governing how nations should prepare and respond to epidemics and pandemics. Much of the discussion has been aimed at national capacities to prepare and respond, with growing calls for ensuring the independence of evaluations in any pandemic treaty. However more focus is needed on promoting, standardizing and publishing epidemic evaluations that are also applicable to the work of the large number of non-governmental response actors (e.g. non-governmental organisations, United Nations agencies, the Red Cross, donors, etc.) that ultimately support or directly provide a bulk of technical advice and services during epidemic response.

2. Standardize epidemic response evaluations through creation of a global observatory body

Once epidemic evaluations are included in the ongoing policy agenda on health security, a body similar to the global preparedness monitoring board composed of representatives of epidemic responders from low-income and humanitarian sectors should be formed. The body could have several functions including: (i) developing and advocating for the implementation of global standards for epidemic evaluations similar to those developed for public health information services in humanitarian responses¹¹⁴, (ii) monitoring the 'state of epidemic evaluations' globally to ensure that evidence generated is applied in subsequent responses and (iii) establishing and maintaining a global

repository of epidemic response evaluations. The establishment of the observatory would require sufficient resourcing, including human and financial in order to ensure the long-term viability and global scope of such a body. This body will need to be inclusive of the broad range of expertise required for epidemic response and should include stakeholders from both operational and academic agencies to ensure that standards are developed based on the best available evidence and are feasibly operationalized in across many contexts.

3. Establish a global repository of epidemic response evaluations

Calls have already emerged to increase the public availability of some types of evaluations such as action reviews¹⁰¹ through the creation of global repositories. To date however, there has been a proliferation of repositories sharing some information, including evaluations. However, these have either been disease specific such as for COVID-19^{52,53}, limited to single agencies^{115–117}, or couched within broader humanitarian evaluations.¹¹⁸ Thus, there is a lack of a consolidated global repository for epidemic evaluation. The task of the repository should not be solely to ensure evaluations are undertaken and then recorded as a tick box exercise. Lessons from corporate business institutions have shown that the practice of simply undertaking evaluations is insufficient and did not prove beneficial. In fact, merely going through the motions of evaluations without concerted efforts to apply lessons resulted in staff ‘rediscovering gaps’ already noted in previous evaluations¹¹⁹. This has also been evidenced in numerous epidemic responses.^{120–123} However, there is also evidence that where a concerted effort is undertaken to actively apply the lessons from previous epidemics, success can be found such as in South Korea’s response to COVID-19 benefiting from its experience from MERS¹²⁴ or Nigeria’s Lassa fever response benefiting from experience with Ebola.¹²⁵ Such a repository should be open access and allow for the deposit of abstracts similar to academic databases in order to allow for ease of indexing, search and review.

Somalia-specific Recommendations

1. Adopt an inequality-sensitive response

In Somalia, I have observed how the COVID-19 epidemic, the response measures, and the population's reaction to these measures shed stark light on existing social inequalities. While the link to epidemics and worsening social inequality has been well established¹²⁶, in Somalia I observed how some epidemic response measures in particular, may have worsened these existing inequalities. I documented in paper 3 how the burden of a widescale lockdown was felt most acutely by those in the lowest income brackets. With a Gini index of 36.8¹²⁷, there exists a significant gap in income equality amongst the population in Somalia. Epidemic responders at both operational and policy level should strive to respond in ways which do not exacerbate these inequalities. One of the ways this can be done is to strengthen the inclusivity of decision-making by ensuring the presence within the decision-making process of marginalised groups or those affected the most by response measures. In humanitarian crises, mortality and morbidity tends to be clustered within marginalized or vulnerable groups.¹²⁸ It is therefore imperative that response decisions are formulated jointly and such that affected populations are viewed as decision partners and not merely passive recipients of response efforts.¹²⁹ More inclusive decision-making bodies can address inequality by proposing actions that reduce harms on marginalized or vulnerable groups and can also acknowledge other relevant issues that might otherwise have been overlooked.

2. Develop contextually relevant response measures

Health actors in Somalia have a significant history of responding to humanitarian emergencies as well as to numerous epidemics.¹³⁰ Many of the more than 150 humanitarian health organisations active across the country have a long operating history and have responded to epidemics in numerous parts of Somalia.¹³¹ In paper 3, I noted that because of the novel nature of the COVID-19 epidemic as well as its emergence in donor countries prior to its arrival in Somalia, health actors tended to favour adopting measures taken in those countries without sufficient reflection on their appropriateness in the Somali context. In West Africa, locally developed and driven response contributed significantly to turning back Ebola.¹³² By developing contextually relevant measures,

health actors can not only deal with the direct threats of epidemics but also build trust in health actors and public institutions.¹³³ In paper 3, political contestations and disagreements amongst actors were identified as challenges in the epidemic response. Health actors should consider how epidemic response measures can be undertaken in a way that is conflict sensitive and contributes to state building. This can be done through supporting devolved decision-making in line with the federalized system¹³⁴, as well as ensuring response efforts contribute to the implementation of the development humanitarian peace nexus approach¹³⁵ which calls for greater alignment between actors in the humanitarian, development and peace sectors at strategic, programmatic and institutional levels. This can in turn lead to more cohesive response and foster stronger cross-sectoral coordination. Ensuring the contextual relevance of epidemic response measures will also require investment in prospective operational research to understand what works in Somalia in addition to drawing on previously documented evaluations.

3. Consolidate Health Information Systems

The global paucity of epidemic evaluations identified in paper 2 is also observable in Somalia with only two response evaluations out of 13 epidemics reported in 9 years. Efforts to remedy this gap in Somalia can serve as an entry point for addressing shortcomings in the wider health information environment in Somalia where, as in other fragile environments, health service provision can appear chaotic.¹³⁶ While delivering health services to the Somali population, the substantial number of providers in Somalia generate an immense amount of primary data. This information is in various formats including health service records, assessments, program updates and evaluation of both routine and emergency response including of epidemics.¹³⁷ Despite billions having been spent on health services, relatively little health information exists in the public domain in a format which allows for ease of analysis.¹³⁸ In paper 4, I documented a low awareness of the availability of necessary response documentation amongst even staff of response agencies. The contrast between the vast amount of health information being generated by health actors and its availability and

utility to decision-makers should be addressed by actors in Somalia. There is a pressing need to establish systems to improve the availability and quality of health information in general and health or epidemic evaluations in particular. This information is critical to establishing an understanding of population needs and service gaps and is necessary to supporting quality decision-making. A concerted effort is required to consolidate and improve the availability of these data. This effort should be done under the leadership of Somali health authorities who are the legitimate custodians of Somalia's health information and who have already taken some steps to address this shortcoming such as through the development of strategic plans.¹³⁹

8. Agenda for future research

The work presented in this thesis warrants follow-on research to further strengthen the evidence base for improved epidemic response evaluation. Specific research questions would include:

- 1) What is the feasibility and utility of the audit tool in other epidemic contexts?
- 2) Are changes in quality of decision-making quantitatively correlated with improved outcomes of epidemic response in various contexts?
- 3) How are the results of evaluations utilized by operational agencies? To what extent are identified gaps from the audit tool implemented?
- 4) How do evaluators in operational agencies navigate independence and censorship?

Strong partnership is required amongst operational epidemic responders, health authorities, global health bodies and academic institutions to improve epidemic response through strengthening the availability, utilization, and coherence of response evaluations. This thesis has contributed towards this aim by providing evidence on the state of epidemic response within a humanitarian setting, highlighting gaps and developing a tool to evaluate response decisions. This was possible through the strong collaboration amongst the LSHTM, Federal Ministry of Health Somalia and operational partners such as WHO and CARE. Although small in scale, this collaboration across institutions and

stakeholders, if replicated, systematized, and scaled up can potentially make a greater contribution towards improving epidemic response evaluation. The collaboration could serve as a model for how to conduct epidemic evaluations in challenging humanitarian settings and allows for evaluation findings to be incorporated into future epidemic response. Epidemics are unlikely to recede as a global threat in the near future. Ongoing investment in refining evaluation processes will improve the timeliness and quality of epidemic response and can improve outcomes.

9. References

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10. Annexes

10.1 Supplementary Material for paper 1

Extraction Table and Search Strategy

Supplementary Material

ANNEX

Extraction Table

No.	Year	Title	Type of paper	Detail	Framework utilized or proposed	Dimensions of the framework	Type of data collection (primary or secondary)	Type of indicators of focus	Type of data collection (Quant vs Qual)	Humanitarian Setting	Humanitarian Population	Epidemic type	Epidemic Setting

Search Strategy

Medline

1. Public Health/
2. health/ or global health/ or population health/ or public health/
3. Nutrition Surveys/ or Nutrition Assessment/
4. Sanitation/ or Hygiene/
5. exp Program Evaluation/
6. Nutrition Assessment/ or Needs Assessment/ or Health Impact Assessment/
7. apprais*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
8. framework*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
9. conceptual framework*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10. Program* evaluation*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
11. Program Evaluation/
12. evaluation framework*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
13. (evaluation* adj3 method*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
14. (evaluation adj3 model*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
15. (service* adj2 evaluation*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
16. humanitarian.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
17. emergenc*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol

- supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
18. Emergencies/
 19. Disaster Planning/
 20. disaster*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
 21. crisis*.mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
 22. 1 or 2 or 3 or 4 or 5 or 6
 23. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15
 24. 16 or 17 or 18 or 19 or 20 or 21
 25. 22 and 23 and 24

Embase

1. public health/
2. health/ or global health/
3. nutrition/ or nutritional assessment/ or nutritional health/
4. environmental sanitation/
5. exp program evaluation/ or exp evaluation study/ or exp health program/ or exp program appropriateness/ or exp program effectiveness/ or exp program efficacy/ or exp program feasibility/ or exp program impact/ or exp program sustainability/
6. conceptual framework/
7. conceptual framework*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
8. Program* evaluation*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
9. evaluation framework*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
10. (evaluation adj3 model*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
11. (evaluation* adj3 method).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
12. (service* adj2 evaluation*).mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
13. humanitarian.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
14. emergenc*.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]

15. disaster/ or mass disaster/ or natural disaster/ or relief work/
 16. cris*s.mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword, floating subheading word, candidate term word]
 17. 1 or 2 or 3 or 4
 18. 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12
 19. 13 or 14 or 15 or 16
 20. 17 and 18 and 19
- Global Health
1. exp public health/
 2. public health.mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 3. health/ or community health/ or public health/
 4. nutrition/ or nutrition programmes/
 5. sanitation/ or disease prevention/
 6. hygiene/ or sanitation/
 7. evaluation/ or program evaluation/
 8. needs assessment/ or assessment/ or health impact assessment/ or nutritional assessment/
 9. project appraisal/
 10. Conceptual framework*.mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 11. Program* evaluation*.mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 12. evaluation framework*.mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 13. (evaluation* adj3 method).mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 14. (evaluation adj3 model*).mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 15. (service* adj2 evaluation*).mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 16. humanitarian.mp. [mp=abstract, title, original title, broad terms, heading words, identifiers, cabicodes]
 17. emergenc*.mp. or emergencies/
 18. disasters/ or disaster*.mp. or natural disasters/
 19. cris*s.mp. or crises/
 20. 1 or 2 or 3 or 4 or 5 or 6
 21. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15
 22. 16 or 17 or 18 or 19
- LMIC expert search
1. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (economy or economies)).ti,ab.
 2. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab.
 3. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab.
 4. (low adj3 middle adj3 countr*).ti,ab.
 5. (lmic or lmics or third world or lami countr*).ti,ab.
 6. transitional countr*.ti,ab.

7. global south.ti,ab.
8. Developing Countries/
9. "africa south of the sahara"/ or africa, central/ or africa, eastern/ or africa, southern/ or africa, western/
10. ("africa south of the sahara" or sub-saharan africa or central africa or eastern africa or southern africa or western africa).ti,ab.
11. "Democratic People's Republic of Korea"/
12. (north korea or (democratic people* republic adj2 korea)).ti,ab.
13. Cambodia/
14. cambodia.ti,ab.
15. Indonesia/
16. indonesia.ti,ab.
17. Micronesia/
18. Kiribati.ti,ab.
19. Laos/
20. (laos or (lao adj1 democratic republic)).ti,ab.
21. (marshall island* or caroline island* or ellice island* or gilbert island* or johnston island* or mariana island* or micronesia or pacific island*).ti,ab.
22. Mongolia/
23. mongolia.ti,ab.
24. Myanmar/
25. (myanmar or burma).ti,ab.
26. Papua New Guinea/
27. Papua New Guinea.ti,ab.
28. Philippines/
29. Philippines.ti,ab.
30. Timor-Leste/
31. Timor-Leste.ti,ab.
32. Vanuatu/
33. Vanuatu.ti,ab.
34. Vietnam/
35. (Viet Nam or Vietnam).ti,ab.
36. American Samoa/
37. american samoa.ti,ab.
38. exp China/
39. china.ti,ab.
40. Fiji/
41. fiji.ti,ab.
42. Malaysia/
43. malaysia.ti,ab.
44. marshall islands.ti,ab.
45. nauru.ti,ab.
46. samoa/
47. "independent state of samoa"/
48. ("independent state of samoa" or (samoa not american samoa) or western samoa or navigator islands or samoan islands).ti,ab.
49. Thailand/
50. Thailand.ti,ab.
51. Tonga/
52. tonga.ti,ab.
53. Tuvalu.ti,ab.

54. Armenia/
55. Armenia.ti,ab.
56. "Georgia (Republic)"/
57. Kosovo/
58. Kosovo.ti,ab.
59. Kyrgyzstan/
60. (kyrgyzstan or kyrgyz republic or kirghizia or kirghiz).ti,ab.
61. Moldova/
62. Moldova.ti,ab.
63. Tajikistan/
64. tajikistan.ti,ab.
65. Ukraine/
66. Ukraine.ti,ab.
67. Uzbekistan/
68. Uzbekistan.ti,ab.
69. Albania/
70. Albania.ti,ab.
71. Azerbaijan/
72. Azerbaijan.ti,ab.
73. "Republic of Belarus"/
74. (belarus or byelarus or belorussia).ti,ab.
75. Bosnia-Herzegovina/
76. (bosnia or herzegovina).ti,ab.
77. Bulgaria/
78. Bulgaria.ti,ab.
79. Kazakhstan/
80. (Kazakhstan or kazakh).ti,ab.
81. "Macedonia (Republic)"/
82. Macedonia.ti,ab.
83. Montenegro/
84. Montenegro.ti,ab.
85. Romania/
86. Romania.ti,ab.
87. exp Russia/
88. USSR/
89. (Russia or Russian Federation or USSR or Union of Soviet Socialist Republics or Soviet Union).mp.

90. Serbia/
91. serbia.ti,ab.
92. Turkey/
93. turkey.ti,ab. not animal/
94. Turkmenistan/
95. Turkmenistan.ti,ab.
96. Yugoslavia/
97. yugoslavia.ti,ab.
98. Haiti/
99. Haiti.ti,ab.
100. Bolivia/
101. Bolivia.ti,ab.
102. El Salvador/
103. El Salvador.ti,ab.

104. Guatemala/
105. Guatemala.ti,ab.
106. Honduras/
107. Honduras.ti,ab.
108. Nicaragua/
109. Nicaragua.ti,ab.
110. Belize/
111. Belize.ti,ab.
112. Brazil/
113. Brazil.ti,ab.
114. Colombia/
115. Colombia.ti,ab.
116. Costa Rica/
117. Costa Rica.ti,ab.
118. Cuba/
119. Cuba.ti,ab.
120. Dominica/
121. Dominica.ti,ab.
122. Dominican Republic/
123. Dominican Republic.ti,ab.
124. Ecuador/
125. Ecuador.ti,ab.
126. Grenada/
127. Grenada.ti,ab.
128. Guyana/
129. Guyana.mp.
130. Jamaica/
131. Jamaica.ti,ab.
132. Mexico/
133. Mexico.ti,ab.
134. Paraguay/
135. Paraguay.mp.
136. Peru/
137. Peru.ti,ab.
138. Saint Lucia/
139. (St Lucia or Saint Lucia).ti,ab.
140. "Saint Vincent and the Grenadines"/
141. Grenadines.ti,ab.
142. Suriname/
143. Suriname.ti,ab.
144. Venezuela/
145. Venezuela.ti,ab.
146. Djibouti/
147. (Djibouti or French Somaliland).ti,ab.
148. Egypt/
149. Egypt.ti,ab.
150. Jordan/
151. Jordan.ti,ab.
152. Morocco/
153. Morocco.ti,ab.
154. Syria/

155. (Syria or Syrian Arab Republic).ti,ab.
156. Tunisia/
157. tunisia.mp.
158. Gaza.ti,ab.
159. Yemen/
160. Yemen.ti,ab.
161. Algeria/
162. Algeria.ti,ab.
163. Iran/
164. Iran.ti,ab.
165. Iraq/
166. Iraq.ti,ab.
167. Jordan/
168. Jordan.ti,ab.
169. Lebanon/
170. Lebanon.ti,ab.
171. Libya/
172. Libya.ti,ab.
173. Afghanistan/
174. Afghanistan.ti,ab.
175. Nepal/
176. Nepal.ti,ab.
177. Bangladesh/
178. Bangladesh.ti,ab.
179. Bhutan/
180. Bhutan.ti,ab.
181. exp India/
182. India.ti,ab.
183. Pakistan/
184. Pakistan.ti,ab.
185. Sri Lanka/
186. Sri Lanka.ti,ab.
187. Indian Ocean Islands/
188. Maldives.ti,ab.
189. Benin/
190. (Benin or Dahomey).ti,ab.
191. Burkina Faso/
192. (Burkina Faso or Burkina Fasso or Upper Volta).ti,ab.
193. Burundi/
194. Burundi.ti,ab.
195. Central African Republic/
196. (Central African Republic or Ubangi-Shari).ti,ab.
197. Chad/
198. Chad.ti,ab.
199. Comoros/
200. (Comoros or Comoro Islands or Mayotte or Iles Comores).ti,ab.
201. "Democratic Republic of the Congo"/
202. ((democratic republic adj2 congo) or belgian congo or zaire).ti,ab.
203. Eritrea/
204. Eritrea.ti,ab.
205. Ethiopia/

206. Ethiopia.ti,ab.
207. Gambia/
208. Gambia.ti,ab.
209. Guinea/
210. (Guinea not (New Guinea or Guinea Pig* or Guinea Fowl)).ti,ab.
211. Guinea-Bissau/
212. (Guinea-Bissau or Portuguese Guinea).ti,ab.
213. Liberia/
214. Liberia.ti,ab.
215. Madagascar/
216. (Madagascar or Malagasy Republic).ti,ab.
217. Malawi/
218. (Malawi or Nyasaland).ti,ab.
219. Mali/
220. Mali.ti,ab.
221. Mozambique/
222. (Mozambique or Mocambique or Portuguese East Africa).ti,ab.
223. Niger/
224. (Niger not (Aspergillus or Peptococcus or Schizothorax or Cruciferae or Gobius or Lasius or Agelastes or Melanosuchus or radish or Parastromateus or Orius or Apergillus or Parastromateus or Stomoxys)).ti,ab.
225. Rwanda/
226. (Rwanda or Ruanda).ti,ab.
227. Senegal/
228. senegal.ti,ab.
229. Sierra Leone/
230. Sierra Leone.mp.
231. Somalia/
232. Somalia.ti,ab.
233. South Sudan/
234. south sudan.ti,ab.
235. Tanzania/
236. (Tanzania or Tanganyika or Zanzibar).ti,ab.
237. Togo/
238. (Togo or Togolese Republic).ti,ab.
239. Uganda/
240. Uganda.ti,ab.
241. Zimbabwe/
242. (Zimbabwe or Rhodesia).ti,ab.
243. Angola/
244. angola.ti,ab.
245. Cameroon/
246. Cameroon.ti,ab.
247. Cape Verde/
248. (Cape Verde or Cabo Verde).ti,ab.
249. Congo/
250. (congo not ((democratic republic adj3 congo) or congo red or crimean-congo)).ti,ab.
251. Cote d'Ivoire/
252. (Cote d'Ivoire or Ivory Coast).ti,ab.
253. Ghana/
254. (Ghana or Gold Coast).ti,ab.

255. Kenya/
 256. kenya.mp.
 257. Lesotho/
 258. (Lesotho or Basutoland).ti,ab.
 259. Mauritania/
 260. Mauritania.ti,ab.
 261. Nigeria/
 262. Nigeria.ti,ab.
 263. Atlantic Islands/
 264. (sao tome adj2 principe).ti,ab.
 265. Sudan/
 266. (Sudan not south sudan).ti,ab.
 267. Swaziland/
 268. Swaziland.ti,ab.
 269. Zambia/
 270. (Zambia or Northern Rhodesia).ti,ab.
 271. Botswana/
 272. (Botswana or Bechuanaland or Kalahari).ti,ab.
 273. Equatorial Guinea/
 274. (Equatorial Guinea or Spanish Guinea).ti,ab.
 275. Gabon/
 276. (Gabon or Gabonese Republic).ti,ab.
 277. Mauritius/
 278. (Mauritius or Agalega Islands).ti,ab.
 279. Namibia/
 280. Namibia.ti,ab.
 281. South Africa/
 282. South Africa.ti,ab.
 283. or/1-282 [ALL COUNTRIES DESIGNATED AT LMIC]

Web of Science Search Terms

1) TS=(public health OR health OR nutrition OR Water sanitation OR hygiene)
 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
 2,138,300
 2) TS=(Conceptual framework* OR Program* evaluation* OR evaluation framework* OR
 evaluation* NEAR/3 method* OR evaluation NEAR/3 model* OR service* NEAR/2 evaluation*)
 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
 398,173
 3) TS=(Humanitarian OR emergenc* OR disaster* OR Cris*s)
 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
 720,724
 4) WC=(Public, Environmental & Occupational Health)
 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
 912,527
 5) #4 AND #3 AND #2 AND #1
 Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=All years
 676

Grey Literature Search terms
 GOOGLE

(public health OR health OR nutrition OR Water sanitation OR hygiene) AND (((Conceptual framework* OR Program* evaluation* OR evaluation framework* OR evaluation* AROUND(3) method* OR evaluation AROUND(3) model* OR service* AROUND(2) evaluation*)))) AND (humanitarian OR emergenc* OR cris*s) Related: www.who.int

10.2 Supplementary Material for paper 2

List of epidemics

year	month	Disease	Humanitarian	Category	Location	Source
2011	11	Brucellosis	Y	Low income	Afghanistan	GIM
2017	12	Cholera	Y	Low income	Afghanistan	GIM
2018	6	Cholera	Y	Low income	Afghanistan	GIM
2019	4	Cholera	Y	Low income	Afghanistan	GIM
2019	10	Dengue	Y	Low income	Afghanistan	GIM
2012	2	Measles	Y	Low income	Afghanistan	RW
2014	10	Polio	Y	Low income	Afghanistan	GIM
2012	10	Cholera	N	Low income	Benin	RW
2013	8	Cholera	N	Low income	Benin	RW
2016	1	Cholera	N	Low income	Benin	DONS
2018	12	Cholera	N	Low income	Benin	GIM
2010	9	Cholera	N	Low income	Benin	PROMED
2016	n.a	Cholera	N	Low income	Benin	UNICEF cholera platform
2014	11	Lassa Fever	N	Low income	Benin	GIM
2017	2	Lassa Fever	N	Low income	Benin	DONS
2012	3	Meningococcal disease	N	Low income	Benin	DONS
2013	6	Meningococcal disease	N	Low income	Benin	DONS
2012	8	Cholera	Y	Low income	Burkina Faso	RW
2016	8	Cholera	Y	Low income	Burkina Faso	DONS
2016	11	Cholera	Y	Low income	Burkina Faso	GIM
2017	9	Cholera	Y	Low income	Burkina Faso	DONS
2017	2	Lassa Fever	Y	Low income	Burkina Faso	DONS
2012	3	Meningococcal disease	Y	Low income	Burkina Faso	DONS
2013	6	Meningococcal disease	Y	Low income	Burkina Faso	DONS
2011	8	Cholera	Y	Low income	Burundi	RW
2012	10	Cholera	Y	Low income	Burundi	RW
2015	5	Cholera	Y	Low income	Burundi	GIM
2016	7	Cholera	Y	Low income	Burundi	RW
2017	1	Cholera	Y	Low income	Burundi	GIM
2017	8	Cholera	Y	Low income	Burundi	GIM
2018	12	Cholera	Y	Low income	Burundi	GIM
2019	5	Cholera	Y	Low income	Burundi	RW
2011	8	Cholera	Y	Low income	Burundi	PROMED
2018	n.a	Cholera	Y	Low income	Burundi	UNICEF cholera platform
2015	2	Malaria	Y	Low income	Burundi	GIM
2017	3	malaria	Y	Low income	Burundi	RW
2019	8	Malaria	Y	Low income	Burundi	GIM
2011	10	Cholera	Y	Low income	Central African Republic	RW

2015	12	Cholera	Y	Low income	Central African Republic	RW
2016	9	Cholera	Y	Low income	Central African Republic	DONS
2019	5	Cholera	Y	Low income	Central African Republic	GIM
2016	n.a	Cholera	Y	Low income	Central African Republic	UNICEF cholera platform
2013	7	Malaria	Y	Low income	Central African Republic	GIM
2013	1	Measles	Y	Low income	Central African Republic	RW
2010	7	Cholera	Y	Low income	Chad	DONS
2011	3	Cholera	Y	Low income	Chad	RW
2016	9	Cholera	Y	Low income	Chad	DONS
2017	9	Cholera	Y	Low income	Chad	GIM
2018	9	Cholera	Y	Low income	Chad	GIM
2011	9	Cholera	Y	Low income	Chad	PROMED
2017	n.a	Cholera	Y	Low income	Chad	UNICEF cholera platform
2018	1	Measles	Y	Low income	Chad	RW
2011	3	Measles	Y	Low income	Chad	RW
2011	3	Meningitis	Y	Low income	Chad	RW
2012	5	Meningitis	Y	Low income	Chad	RW
2010	4	Meningococcal disease	Y	Low income	Chad	DONS
2011	3	Meningococcal disease	Y	Low income	Chad	DONS
2012	3	Meningococcal disease	Y	Low income	Chad	DONS
2011	6	Polio	Y	Low income	Chad	DONS
2013	2	Yellow fever	Y	Low income	Chad	DONS
2011	3	Cholera	Y	Low income	DRC	PROMED
2011	4	Cholera	Y	Low income	DRC	PROMED
2011	6	Cholera	Y	Low income	DRC	PROMED
2011	7	Cholera	Y	Low income	DRC	DONS
2012	7	Cholera	Y	Low income	DRC	DONS
2013	1	Cholera	Y	Low income	DRC	RW
2015	9	Cholera	Y	Low income	DRC	GIM
2015	12	Cholera	Y	Low income	DRC	DONS
2016	9	Cholera	Y	Low income	DRC	GIM
2017	5	Cholera	Y	Low income	DRC	DONS
2017	6	Cholera	Y	Low income	DRC	GIM
2018	4	Cholera	Y	Low income	DRC	DONS
2018	5	Cholera	Y	Low income	DRC	GIM
2016	n.a	Cholera	Y	Low income	DRC	UNICEF cholera platform
2018	n.a	Cholera	Y	Low income	DRC	UNICEF cholera platform
2019	n.a	Cholera	Y	Low income	DRC	UNICEF cholera platform
2012	8	Dengue	Y	Low income	DRC	GIM
2012	8	Ebola	Y	Low income	DRC	GIM

2013	5	Ebola	Y	Low income	DRC	GIM
2014	7	Ebola	Y	Low income	DRC	GIM
2018	8	Ebola	Y	Low income	DRC	PROMED
2019	7	Ebola	Y	Low income	DRC	GIM
2012	5	Malaria	Y	Low income	DRC	GIM
2013	2	Malaria	Y	Low income	DRC	PROMED
2011	7	Measles	Y	Low income	DRC	DONS
2013	1	Measles	Y	Low income	DRC	RW
2011	3	Measles	Y	Low income	DRC	PROMED
2012	3	Measles	Y	Low income	DRC	PROMED
2013	7	Measles	Y	Low income	DRC	PROMED
2015	7	Measles	Y	Low income	DRC	PROMED
2010	6	Polio	Y	Low income	DRC	DONS
2010	6	Yellow fever	Y	Low income	DRC	DONS
2012	12	Yellow fever	Y	Low income	DRC	DONS
2013	6	Yellow fever	Y	Low income	DRC	DONS
2014	4	Yellow fever	Y	Low income	DRC	DONS
2016	4	Yellow Fever	Y	Low income	DRC	PROMED
2016	9	Cholera	N	Low income	Eritrea	GIM
2011	7	Measles	Y	Low income	Ethiopia	PROMED
2013	5	Yellow fever	Y	Low income	Ethiopia	DONS
2013	10	Polio	Y	Low income	Ethiopia	DONS
2013	11	Cholera	Y	Low income	Ethiopia	GIM
2015	7	Cholera	Y	Low income	Ethiopia	DONS
2016	5	Cholera	Y	Low income	Ethiopia	RW
2017	3	Cholera	Y	Low income	Ethiopia	GIM
2019	6	Cholera	Y	Low income	Ethiopia	GIM
2019	8	Chikungunya	Y	Low income	Ethiopia	GIM
2018	1	Rift Valley Fever	N	Low income	Gambia	DONS
2010	1	Yellow fever	N	Low income	Guinea	DONS
2012	3	Cholera	N	Low income	Guinea	PROMED
2013	3	Meningitis	N	Low income	Guinea	PROMED
2013	5	Cholera	N	Low income	Guinea	PROMED
2013	6	Meningococcal disease	N	Low income	Guinea	DONS
2014	1	Polio	N	Low income	Guinea	DONS
2014	2	Measles	N	Low income	Guinea	RW
2014	3	Ebola	N	Low income	Guinea	DONS
2014	5	Anthrax	N	Low income	Guinea	GIM
2014	9	Malaria	N	Low income	Guinea	GIM
2015	5	Cholera	N	Low income	Guinea	GIM
2017	2	Measles	N	Low income	Guinea	RW
2018	2	Cholera	N	Low income	Guinea	GIM
2019	2	Cholera	N	Low income	Guinea	GIM
2011	6	Anthrax	N	Low income	Guinea-Bissau	GIM
2018	1	Cholera	Y	Low income	Haiti	RW
2010	10	Cholera	Y	Low income	Haiti	DONS

2012	5	Cholera	Y	Low income	Haiti	GIM
2013	1	Cholera	Y	Low income	Haiti	PROMED
2014	5	Chikungunya	Y	Low income	Haiti	GIM
2014	8	Anthrax	Y	Low income	Haiti	GIM
2015	4	Cholera	Y	Low income	Haiti	PROMED
2015	10	Cholera	Y	Low income	Haiti	GIM
2016	7	Cholera	Y	Low income	Haiti	GIM
2016	9	Cholera	Y	Low income	Haiti	PROMED
2018	6	Cholera	Y	Low income	Haiti	GIM
2018	11	Diphtheria	Y	Low income	Haiti	PROMED
2019	9	Dengue	Y	Low income	Haiti	GIM
2015	9	Cholera	Y	Middle Income	Iraq	DONS
2018	6	Cholera	Y	Middle Income	Iraq	GIM
2015	10	Cholera	Y	Middle Income	Iraq	PROMED
2014	3	Polio	Y	Middle Income	Iraq	DONS
2015	3	Cholera	N	Low income	Liberia	GIM
2016	5	Cholera	N	Low income	Liberia	DONS
2017	5	Cholera	N	Low income	Liberia	DONS
2018	2	Cholera	N	Low income	Liberia	DONS
2019	1	Cholera	N	Low income	Liberia	GIM
2016	n.a	Cholera	N	Low income	Liberia	UNICEF cholera platform
2017	n.a	Cholera	N	Low income	Liberia	UNICEF cholera platform
2014	3	Ebola	N	Low income	Liberia	DONS
2013	9	Lassa Fever	N	Low income	Liberia	GIM
2017	2	Lassa Fever	N	Low income	Liberia	GIM
2019	9	Lassa Fever	N	Low income	Liberia	GIM
2019	3	Cholera	Y	Middle Income	Libya	GIM
2011	4	Chikungunya	Y	Low income	Madagascar	GIM
2015	2	Cholera	Y	Low income	Madagascar	GIM
2015	7	Cholera	Y	Low income	Madagascar	DONS
2017	9	Cholera	Y	Low income	Madagascar	DONS
2018	9	Cholera	Y	Low income	Madagascar	GIM
2019	3	Cholera	Y	Low income	Madagascar	GIM
2018	10	Measles	Y	Low income	Madagascar	DONS
2011	4	Plague	Y	Low income	Madagascar	GIM
2013	12	Plague	Y	Low income	Madagascar	GIM
2014	11	Plague	Y	Low income	Madagascar	GIM
2016	12	Plague	Y	Low income	Madagascar	GIM
2014	11	Plague	Y	Low income	Madagascar	PROMED
2017	9	Plague	Y	Low income	Madagascar	PROMED
2014	11	Polio	Y	Low income	Madagascar	DONS
2015	2	Cholera	N	Low income	Malawi	RW
2015	12	Cholera	N	Low income	Malawi	RW
2016	4	Cholera	N	Low income	Malawi	GIM
2017	3	Cholera	N	Low income	Malawi	GIM

2018	12	Cholera	N	Low income	Malawi	GIM
2012	5	Malaria	N	Low income	Malawi	GIM
2010	5	Measles	N	Low income	Malawi	PROMED
2011	7	Cholera	Y	Low income	Mali	PROMED
2012	7	Cholera	Y	Low income	Mali	PROMED
2017	7	Cholera	Y	Low income	Mali	GIM
2014	10	Ebola	Y	Low income	Mali	DONS
2010	1	Cholera	Y	Low income	Mozambique	PROMED
2011	1	Cholera	Y	Low income	Mozambique	PROMED
2012	3	Cholera	Y	Low income	Mozambique	GIM
2014	3	Cholera	Y	Low income	Mozambique	GIM
2014	4	Dengue	Y	Low income	Mozambique	GIM
2015	1	Cholera	Y	Low income	Mozambique	GIM
2015	10	Cholera	Y	Low income	Mozambique	PROMED
2017	2	Cholera	Y	Low income	Mozambique	PROMED
2017	10	Cholera	Y	Low income	Mozambique	DONS
2019	1	Cholera	Y	Low income	Mozambique	DONS
2019	6	Malaria	Y	Low income	Mozambique	GIM
2014	1	Cholera	Y	Middle Income	Myanmar	GIM
2015	6	Cholera	Y	Middle Income	Myanmar	GIM
2015	12	Cholera	Y	Middle Income	Myanmar	DONS
2016	7	Cholera	Y	Middle Income	Myanmar	GIM
2017	5	Cholera	Y	Middle Income	Myanmar	GIM
2018	5	Cholera	Y	Middle Income	Myanmar	GIM
2012	10	Dengue	Y	Middle Income	Myanmar	GIM
2014	8	Dengue	Y	Middle Income	Myanmar	GIM
2016	12	Dengue	Y	Middle Income	Myanmar	GIM
2019	6	Dengue	Y	Middle Income	Myanmar	GIM
2014	8	Ebola	Y	Middle Income	Myanmar	GIM
2019	6	Polio	Y	Middle Income	Myanmar	DONS
2014	5	Cholera	Y	Low income	Nepal	GIM
2015	7	Cholera	Y	Low income	Nepal	GIM
2016	7	Cholera	Y	Low income	Nepal	GIM
2017	5	Cholera	Y	Low income	Nepal	GIM
2018	6	Cholera	Y	Low income	Nepal	GIM
2019	5	Cholera	Y	Low income	Nepal	GIM
2017	n.a	Cholera	Y	Low income	Nepal	PubMed
2010	9	Dengue	Y	Low income	Nepal	GIM
2011	8	Dengue	Y	Low income	Nepal	GIM
2012	6	Dengue	Y	Low income	Nepal	GIM
2013	6	Dengue	Y	Low income	Nepal	GIM
2014	8	Dengue	Y	Low income	Nepal	GIM
2016	12	Dengue	Y	Low income	Nepal	GIM
2019	6	Dengue	Y	Low income	Nepal	GIM
2010	9	Japanese Encephalitis	Y	Low income	Nepal	GIM

2011	8	Japanese Encephalitis	Y	Low income	Nepal	GIM
2012	7	Japanese Encephalitis	Y	Low income	Nepal	GIM
2014	8	Japanese Encephalitis	Y	Low income	Nepal	GIM
2010	7	Cholera	Y	Low income	Niger	DONS
2011	6	Cholera	Y	Low income	Niger	PROMED
2012	5	Meningitis	Y	Low income	Niger	RW
2012	7	Cholera	Y	Low income	Niger	PROMED
2013	2	Polio	Y	Low income	Niger	DONS
2014	9	Cholera	Y	Low income	Niger	RW
2015	3	Cholera	Y	Low income	Niger	GIM
2015	4	Meningitis	Y	Low income	Niger	PROMED
2016	2	Cholera	Y	Low income	Niger	RW
2016	9	Cholera	Y	Low income	Niger	GIM
2016	9	Rift Valley Fever	Y	Low income	Niger	PROMED
2017	3	Cholera	Y	Low income	Niger	RW
2017	5	Hepatitis E	Y	Low income	Niger	PROMED
2018	7	Cholera	Y	Low income	Niger	GIM
2019	4	Cholera	Y	Low income	Niger	DONS
2015	n.a	Cholera	Y	Low income	Niger	UNICEF cholera platform
2016	n.a	Cholera	Y	Low income	Niger	UNICEF cholera platform
2019	n.a	Cholera	Y	Low income	Niger	UNICEF cholera platform
2010	1	Cholera	Y	Middle Income	Nigeria	DONS
2010	2	Cholera	Y	Middle Income	Nigeria	PROMED
2011	2	Lassa Fever	Y	Middle Income	Nigeria	PROMED
2011	7	Measles	Y	Middle Income	Nigeria	DONS
2012	1	Lassa Fever	Y	Middle Income	Nigeria	GIM
2012	5	Malaria	Y	Middle Income	Nigeria	GIM
2012	5	Polio	Y	Middle Income	Nigeria	GIM
2012	7	Measles	Y	Middle Income	Nigeria	PROMED
2013	1	Lassa Fever	Y	Middle Income	Nigeria	PROMED
2013	6	Meningococcal disease	Y	Middle Income	Nigeria	DONS
2013	9	Lassa Fever	Y	Middle Income	Nigeria	GIM
2013	10	Cholera	Y	Middle Income	Nigeria	GIM
2013	10	Polio	Y	Middle Income	Nigeria	GIM
2014	4	Dengue	Y	Middle Income	Nigeria	GIM
2014	6	Polio	Y	Middle Income	Nigeria	GIM
2014	7	Ebola	Y	Middle Income	Nigeria	GIM
2015	3	Cholera	Y	Middle Income	Nigeria	DONS
2016	1	Cholera	Y	Middle Income	Nigeria	DONS
2016	10	Cholera	Y	Middle Income	Nigeria	DONS
2016	12	Lassa Fever	Y	Middle Income	Nigeria	GIM
2016	12	Meningitis	Y	Middle Income	Nigeria	RW
2017	3	Cholera	Y	Middle Income	Nigeria	DONS

2017	6	Cholera	Y	Middle Income	Nigeria	DONS
2018	1	Lassa Fever	Y	Middle Income	Nigeria	PROMED
2018	1	Polio	Y	Middle Income	Nigeria	PROMED
2018	3	Cholera	Y	Middle Income	Nigeria	DONS
2018	9	Cholera	Y	Middle Income	Nigeria	DONS
2018	12	Lassa Fever	Y	Middle Income	Nigeria	PROMED
2019	6	Lassa Fever	Y	Middle Income	Nigeria	GIM
2019	6	Polio	Y	Middle Income	Nigeria	GIM
2019	7	Yellow fever	Y	Middle Income	Nigeria	DONS
2019	10	Dengue	Y	Middle Income	Nigeria	GIM
2015	n.a	Cholera	Y	Middle Income	Nigeria	UNICEF cholera platform
2016	n.a	Cholera	Y	Middle Income	Nigeria	UNICEF cholera platform
2019	n.a	Cholera	Y	Middle Income	Nigeria	UNICEF cholera platform
2016	10	Cholera	N	Low income	North Korea	GIM
2012	2	Anthrax	Y	Middle Income	Pakistan	GIM
2012	9	Anthrax	Y	Middle Income	Pakistan	GIM
2014	3	Anthrax	Y	Middle Income	Pakistan	GIM
2010	9	CCHF	Y	Middle Income	Pakistan	GIM
2011	9	CCHF	Y	Middle Income	Pakistan	GIM
2012	5	CCHF	Y	Middle Income	Pakistan	PROMED
2014	4	CCHF	Y	Middle Income	Pakistan	GIM
2019	7	CCHF	Y	Middle Income	Pakistan	GIM
2016	12	Chikungunya	Y	Middle Income	Pakistan	GIM
2010	10	Cholera	Y	Middle Income	Pakistan	DONS
2013	8	Cholera	Y	Middle Income	Pakistan	GIM
2014	7	Cholera	Y	Middle Income	Pakistan	GIM
2015	3	Cholera	Y	Middle Income	Pakistan	GIM
2016	11	Cholera	Y	Middle Income	Pakistan	DONS
2017	7	Cholera	Y	Middle Income	Pakistan	RW
2019	5	Cholera	Y	Middle Income	Pakistan	RW
2010	8	Dengue	Y	Middle Income	Pakistan	GIM
2016	12	Dengue	Y	Middle Income	Pakistan	GIM
2019	6	Dengue	Y	Middle Income	Pakistan	GIM
2011	8	Dengue	Y	Middle Income	Pakistan	PROMED
2012	10	Dengue	Y	Middle Income	Pakistan	PROMED
2014	11	Ebola	Y	Middle Income	Pakistan	GIM
2011	9	Japanese Encephalitis	Y	Middle Income	Pakistan	GIM
2019	7	Malaria	Y	Middle Income	Pakistan	GIM
2012	6	Measles	Y	Middle Income	Pakistan	PROMED
2012	11	Measles	Y	Middle Income	Pakistan	PROMED
2013	12	Meningitis	Y	Middle Income	Pakistan	GIM
2011	7	Polio	Y	Middle Income	Pakistan	DONS
2012	5	Polio	Y	Middle Income	Pakistan	GIM
2013	1	Polio	Y	Middle Income	Pakistan	RW

2013	10	Polio	Y	Middle Income	Pakistan	GIM
2016	12	Polio	Y	Middle Income	Pakistan	DONS
2019	6	Polio	Y	Middle Income	Pakistan	GIM
2015	3	Cholera	Y	Middle Income	Palestinian Territory	GIM
2018	6	Cholera	N	Low income	Rwanda	GIM
2014	8	Ebola	N	Low income	Rwanda	GIM
2012	2	Cholera	N	Low income	Sierra Leone	DONS
2015	2	Cholera	N	Low income	Sierra Leone	GIM
2016	7	Cholera	N	Low income	Sierra Leone	GIM
2018	6	Cholera	N	Low income	Sierra Leone	GIM
2019	n.a	Cholera	N	Low income	Sierra Leone	UNICEF cholera platform
2014	6	Ebola	N	Low income	Sierra Leone	PROMED
2010	9	Lassa Fever	N	Low income	Sierra Leone	GIM
2013	8	Lassa Fever	N	Low income	Sierra Leone	GIM
2019	11	Lassa Fever	N	Low income	Sierra Leone	GIM
2011	3	Yellow fever	N	Low income	Sierra Leone	DONS
2011	3	Cholera	Y	Low income	Somalia	PROMED
2011	4	Measles	Y	Low income	Somalia	PROMED
2011	9	Dengue	Y	Low income	Somalia	GIM
2012	5	Cholera	Y	Low income	Somalia	GIM
2013	5	Polio	Y	Low income	Somalia	DONS
2014	4	Cholera	Y	Low income	Somalia	GIM
2014	5	Measles	Y	Low income	Somalia	RW
2016	3	Cholera	Y	Low income	Somalia	UNICEF cholera platform
2016	12	Cholera	Y	Low income	Somalia	GIM
2017	12	Cholera	Y	Low income	Somalia	DONS
2018	9	Cholera	Y	Low income	Somalia	GIM
2019	5	Cholera	Y	Low income	Somalia	GIM
2018	n.a	Cholera	Y	Low income	Somalia	UNICEF cholera platform
2014	1	Cholera	Y	Low income	South Sudan	PubMed
2014	5	Cholera	Y	Low income	South Sudan	DONS
2015	3	Cholera	Y	Low income	South Sudan	RW
2016	5	Cholera	Y	Low income	South Sudan	DONS
2017	5	Cholera	Y	Low income	South Sudan	PubMed
2018	12	Cholera	Y	Low income	South Sudan	RW
2019	9	Cholera	Y	Low income	South Sudan	GIM
2014	5	Cholera	Y	Low income	South Sudan	PROMED
2012	11	Hepatitis E	Y	Low income	South Sudan	PROMED
2011	10	Leishmaniasis	Y	Low income	South Sudan	PROMED
2012	9	Leishmaniasis	Y	Low income	South Sudan	PROMED
2013	9	Measles	Y	Low income	South Sudan	RW
2013	6	Meningococcal disease	Y	Low income	South Sudan	DONS
2014	11	Polio	Y	Low income	South Sudan	DONS
2014	4	Leishmaniasis	Y	Low income	South Sudan	RW

2011	3	Anthrax	Y	Middle Income	Sudan	GIM
2019	7	Chikungunya	Y	Middle Income	Sudan	GIM
2015	3	Cholera	Y	Middle Income	Sudan	RW
2015	11	Cholera	Y	Middle Income	Sudan	GIM
2016	8	Cholera	Y	Middle Income	Sudan	RW
2018	1	Cholera	Y	Middle Income	Sudan	GIM
2018	5	Cholera	Y	Middle Income	Sudan	DONS
2014	6	Dengue	Y	Middle Income	Sudan	GIM
2019	11	Dengue	Y	Middle Income	Sudan	GIM
2019	9	Malaria	Y	Middle Income	Sudan	GIM
2012	4	Meningococcal disease	Y	Middle Income	Sudan	DONS
2013	9	Polio	Y	Middle Income	Sudan	GIM
2013	10	Rift Valley Fever	Y	Middle Income	Sudan	GIM
2019	10	Rift Valley Fever	Y	Middle Income	Sudan	GIM
2010	8	Typhoid	Y	Middle Income	Sudan	GIM
2012	10	Yellow Fever	Y	Middle Income	Sudan	PROMED
2013	10	Yellow fever	Y	Middle Income	Sudan	DONS
2015	8	Cholera	Y	Low income	Syrian Arab Republic	GIM
2016	8	Cholera	Y	Low income	Syrian Arab Republic	GIM
2017	6	Cholera	Y	Low income	Syrian Arab Republic	GIM
2013	10	Polio	Y	Low income	Syrian Arab Republic	RW
2012	7	Anthrax	N	Low income	Tajikistan	GIM
2013	7	Anthrax	N	Low income	Tajikistan	GIM
2011	6	CCHF	N	Low income	Tajikistan	GIM
2017	4	Cholera	N	Low income	Tajikistan	RW
2011	8	Dengue	N	Low income	Tajikistan	GIM
2010	1	Polio	N	Low income	Tajikistan	DONS
2013	7	Anthrax	N	Low income	Tanzania	GIM
2015	5	Cholera	N	Low income	Tanzania	DONS
2018	12	Cholera	N	Low income	Tanzania	GIM
2015	10	Cholera	N	Low income	Tanzania	PROMED
2018	n.a	Cholera	N	Low income	Tanzania	UNICEF cholera platform
2014	2	Dengue	N	Low income	Tanzania	GIM
2019	6	Dengue	N	Low income	Tanzania	GIM
2012	8	Ebola	N	Low income	Tanzania	GIM
2011	6	Measles	N	Low income	Tanzania	PROMED
2013	10	Meningitis	N	Low income	Tanzania	GIM
2012	2	Anthrax	N	Low income	Togo	GIM
2013	8	Cholera	N	Low income	Togo	RW
2014	2	Anthrax	N	Low income	Togo	GIM
2016	2	Cholera	N	Low income	Togo	RW
2017	1	Meningococcal disease	N	Low income	Togo	DONS
2017	3	Cholera	N	Low income	Togo	DONS
2019	1	Cholera	N	Low income	Togo	GIM

2015	n.a	Cholera	N	Low income	Togo	UNICEF cholera platform
2016	n.a	Cholera	N	Low income	Togo	UNICEF cholera platform
2010	2	Cholera	N	Low income	Uganda	PROMED
2010	10	Anthrax	N	Low income	Uganda	GIM
2010	12	Plague	N	Low income	Uganda	GIM
2010	12	Yellow Fever	N	Low income	Uganda	PROMED
2011	5	Ebola	N	Low income	Uganda	DONS
2011	11	Anthrax	N	Low income	Uganda	GIM
2011	11	Cholera	N	Low income	Uganda	PROMED
2012	3	Measles	N	Low income	Uganda	PROMED
2012	7	Ebola	N	Low income	Uganda	PROMED
2012	7	Ebola	N	Low income	Uganda	DONS
2013	1	Cholera	N	Low income	Uganda	RW
2013	8	CCHF	N	Low income	Uganda	GIM
2013	8	Measles	N	Low income	Uganda	RW
2014	1	Cholera	N	Low income	Uganda	PubMed
2014	2	Meningitis	N	Low income	Uganda	GIM
2014	10	Marburg	N	Low income	Uganda	DONS
2015	3	Cholera	N	Low income	Uganda	DONS
2016	3	Cholera	N	Low income	Uganda	GIM
2017	6	Cholera	N	Low income	Uganda	GIM
2019	6	Ebola	N	Low income	Uganda	DONS
2019	8	CCHF	N	Low income	Uganda	GIM
2019	12	Rift Valley Fever	N	Low income	Uganda	GIM
2015	9	Cholera	Y	Middle Income	Ukraine	DONS
2018	10	Cholera	Y	Middle Income	Ukraine	GIM
2015	9	Polio	Y	Middle Income	Ukraine	PROMED
2018	8	Cholera	Y	Middle Income	Venezuela	GIM
2019	6	Dengue	Y	Middle Income	Venezuela	GIM
2018	11	Diphtheria	Y	Middle Income	Venezuela	PROMED
2019	8	Malaria	Y	Middle Income	Venezuela	GIM
2018	4	Measles	Y	Middle Income	Venezuela	PROMED
2015	6	Cholera	Y	Low income	Yemen	GIM
2016	10	Cholera	Y	Low income	Yemen	RW
2017	8	Cholera	Y	Low income	Yemen	DONS
2019	3	Cholera	Y	Low income	Yemen	GIM
2012	4	Dengue	Y	Low income	Yemen	GIM
2019	11	Dengue	Y	Low income	Yemen	GIM
2017	12	Diphtheria	Y	Low income	Yemen	PROMED
2012	3	Measles	Y	Low income	Yemen	PROMED

Extraction table of included studies

Study ID	Pathogen	Country	Humanitarian setting	Evaluation Type	Timing	Commissioned	Evaluation framework or criteria	Data collection	Indicator Type	Data	Quality Score
Malik 2014 ¹⁴⁰	Chikungunya	Yemen	No	Outcome	mid-outbreak	external	effectiveness	mixed	outcome	mixed	69.23
Makoutodé 2010 ¹⁴¹	Cholera	Benin	No	Process,	Post outbreak	Internal	Process	mixed	Process	mixed	42.31
Aka 2013 ¹⁴²	Cholera	Benin	Yes	Output	post-outbreak	internal	Quality, relevance and accountability, effectiveness and efficiency of management	mixed	output	qualitative	80.77
ACF 2011 ¹⁴³	Cholera	Chad	Yes	Process	Mid outbreak	internal	Effectiveness	Primary	Process, Impact	mixed	69.23
Grayel 2014 ¹⁴⁴	Cholera	DRC	Yes	Process	Mid outbreak	internal	Process	Primary	Process	mixed	61.54
Ciglenecki 2013 ¹⁴⁵	Cholera	Guinea	No	Feasibility	post-outbreak	internal	Feasibility, cost, timeliness, and acceptability	secondary	process, outcome	quantitative	73.08
Cavallaro 2011 ¹⁴⁶	Cholera	Guinea-Bissau	No	Outcome	mid-outbreak	external	effectiveness	primary	outcome	quantitative	88.46
Ciglenecki 2013 ¹⁴⁷	Cholera	Haiti	Yes	Outcome	mid-outbreak	internal	effectiveness	primary	outcome	quantitative	80.77

Routh 2017 ¹⁴⁸	Cholera	Haiti	Yes	Outcome	post-outbreak	internal	cost-effectiveness, efficiency	primary	process	quantitative	88.46
Severe 2016 ¹⁴⁹	Cholera	Haiti	Yes	Outcome	mid-outbreak	internal	vaccine effectiveness	mixed	process, outcome	mixed	88.46
Ivers 2015 ¹⁵⁰	Cholera	Haiti	Yes	Process	mid-outbreak	internal	vaccine effectiveness	mixed	process, outcome	mixed	96.15
Santa-Olalla 2013 ¹⁵¹	Cholera	Haiti	Yes	Output	mid-outbreak	internal	effectiveness	primary	output, outcome	quantitative	73.08
Tauxe 2011 ¹⁵²	Cholera	Haiti	Yes	Impact	mid-outbreak	internal	effectiveness	primary	impact	quantitative	76.92
Dhillon 2012 ¹⁵³	Cholera	Haiti	Yes	Process	post-outbreak	external	fidelity (quality of reporting)	secondary	output	quantitative	92.31
Teng 2014 ¹⁵⁴	Cholera	Haiti	Yes	Feasibility	mid-outbreak	internal	efficiency (timeliness),	mixed	process, outcome	quantitative	88.46
Grayel 2011 ¹⁵⁵	Cholera	Haiti	Yes	Process	Mid outbreak	internal	Effectiveness	Primary	Impact	mixed	61.54
Dobai 2016 ¹⁵⁶	Cholera	Haiti , Dominican Republic	Yes	Impact	post-outbreak	internal	relevance, impact, coverage, sustainability and connectedness of the interventions and assess the cooperation,	mixed	output, outcome	mixed	92.31

							coordination and effectiveness of the accountability process				
Tappero 2011 ¹⁵⁷	Cholera	Haiti, Dominican Republic	Yes	Output	mid-outbreak	internal	n/a	secondary	outputs, outcome	mixed	53.85
Khonje 2012 ¹⁵⁸	Cholera	Malawi	No	Outcome	post-outbreak	internal	effectiveness	mixed	outcome	mixed	53.85
Msyamboza 2016 ¹⁵⁹	Cholera	Malawi	No	Feasibility	mid-outbreak	internal	feasibility, acceptability	primary	process, outcome	quantitative	88.46
Oladale 2012 ¹⁶⁰	Cholera	Nigeria	Yes	Process	mid-outbreak	external	n/a	primary	process	mixed	69.23
Fogden 2015 ¹⁶¹	Cholera	Nigeria	Yes	Outcome	post-outbreak	internal	1) Relevance and appropriateness, 2) Efficiency, 3) Effectiveness, 4) Coverage, 5) Coherence, and 6) Sustainability and connectedness	mixed	output, outcome	mixed	96.15
Rees-Gildea 2013 ¹⁶²	Cholera	Sierra Leone	No	Impact	post-outbreak	internal	Quality, relevance and accountability, effectiveness and efficiency of management	mixed	outcome, impact	mixed	80.77
OXFAM 2012 ¹⁶³	Cholera	Sierra Leone	No	Impact	mid-outbreak	internal	Global Humanitarian Indicator Tool.	mixed	outcome, impact	mixed	73.08

Mcgowan 2018 ¹⁶⁴	Cholera	Somalia	Yes	Process	post-outbreak	internal	relevance, appropriateness, effectiveness, accountability, coordination, evaluation and learning, management and staffing, efficiency	mixed	process	mixed	92.31
Dyson 2018 ¹⁶⁵	Cholera	Somalia	Yes	Outcome	mid-outbreak	internal	appropriate in terms of: scale, scope, timeliness, and relevance; standards of quality technical programming; effectiveness, efficiency, connectedness and coherence	mixed	process, outcome	mixed	84.62
Azman 2016 ¹⁶⁶	Cholera	South Sudan	Yes	Process	mid-outbreak	internal	vaccine effectiveness	mixed	process, outcome	mixed	96.15
Gauthier 2014 ¹⁶⁷	Cholera	South Sudan	Yes	Outcome	mid-outbreak	internal	Efficiency, effectiveness, appropriateness	mixed	process, outcome, impact	mixed	92.31
Bwire 2016 ¹⁶⁸	Cholera	Uganda, Malawi	No	Output	post-outbreak	external	n/a	secondary	n/a	quantitative	46.15
Dureab 2019 ¹⁶⁹	Cholera	Yemen	Yes	Process	mid-outbreak	external	Timeliness	secondary	process	quantitative	69.23

Altmann 2017 ¹⁷⁰	Cholera	Yemen	Yes	Outcome	mid- outbreak	internal	effectiveness	primary	output, outcome	mixed	80.77
Federspiel 2018 ¹⁷¹	Cholera	Yemen	Yes	Process	post- outbreak	external	n/a	secondary	n/a	qualitative	53.85
Darcy 2018 ¹⁷²	Cholera	Yemen	Yes	Outcome	post- outbreak	internal	appropriateness., coordination, effectiveness, efficiency, coverage, connectedness	mixed	output, process. Outcome	mixed	96.15
Spiegel 2019 ¹⁷³	Cholera	Yemen	Yes	Process	post- outbreak	external	GTFCC 3 approaches	mixed	outcome, impact	mixed	80.77
Ashbaugh 2017 ¹⁷⁴	Ebola	DRC	No	Outcome	post- outbreak	external	effectiveness	secondary	output	quantitative	73.08
McGowan 2019 ¹⁷⁵	Ebola	DRC	Yes	Process	mid- outbreak	internal	Core Humanitarian Standard on Quality and Accountability	mixed	process	mixed	88.46
Hennessee 2018 ¹⁷⁶	Ebola	Guinea	No	Process	mid- outbreak	external	effectiveness	mixed	process	mixed	88.46
Diallo 2015 ¹⁷⁷	Ebola	Guinea	No	Outcome	mid- outbreak	external	effectiveness based on SBM-R performance standards for IPC	mixed	outcome	mixed	61.54

Fu 2015 ¹⁷⁸	Ebola	Guinea	No	Outcome	mid-outbreak	external	effectiveness	primary	outcome	qualitative	69.23
Standley 2019 ¹⁷⁹	Ebola	Guinea	No	Outcome	mid-outbreak	internal	timeliness, adherence (fidelity)	primary	output, process	mixed	69.23
Lee 2016 ¹⁸⁰	Ebola	Guinea	No	Output	mid-outbreak	external	effectiveness (sensitivity)	secondary	output	quantitative	80.77
Requesa 2017 ¹⁸¹	Ebola	Guinea	No	Process	mid-outbreak	external	fidelity	mixed	input, output. Process, outcome	mixed	88.46
Soeters 2018 ¹⁸²	Ebola	Guinea	No	Outcome	mid-outbreak	internal	effectiveness	primary	outcome	mixed	73.08
Kokki 2017 ¹⁸³	Ebola	Guinea	No	Outcome	post-outbreak	internal	preparation, appropriateness and implementation of ECDC plans, procedures, structures • relevance, appropriateness, efficiency and effectiveness of the field activities • impact of this deployment on ECDC work programme.	mixed	process, outcome	qualitative	88.46

Fitzpatrick 2017 ¹⁸⁴	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post-outbreak	internal	operational research domains	secondary	output, outcome	qualitative	57.69
Murray 2015 ¹⁸⁵	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	mid-outbreak	internal	Relevance and appropriateness, Efficiency, Effectiveness connectedness	mixed	process, outcome	qualitative	84.62
UNICEF 2017 ¹⁸⁶	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post-outbreak	internal	effectiveness, efficiency, internal coordination, external coordination and accountability	mixed	output	mixed	96.15
WHO 2015 ¹⁸⁷	Ebola	Guinea, Liberia, Sierra Leone	No	Process	mid-outbreak	external	timeliness, appropriateness, scale, effectiveness), including (i) coordination within the Organization and with Member States (ii) resource mobilization and (iii) communications;	mixed	n/a	mixed	73.08
Shepherd 2017 ¹⁸⁸	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post-outbreak	internal	relevance, coherence and appropriateness; coverage; coordination and	mixed	output	mixed	88.46

							connectedness; effectiveness;				
Sadaphal 2017 ¹⁸⁹	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post- outbrea k	internal	overall effectiveness, effectiveness of different programmatic components,	mixed	output, outcome	mixed	92.31
Sadaphal 2018 ¹⁹⁰	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post- outbrea k	internal	overall effectiveness, effectiveness of different programmatic components,	mixed	output, outcome	mixed	92.31
Sadaphal 2018 ¹⁹¹	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post- outbrea k	internal	overall effectiveness, effectiveness of different programmatic components,	mixed	output, outcome	mixed	92.31
HoC 2016 ¹⁹²	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post- outbrea k	external	timeliness, resource allocation	mixed	n/a	qualitative	65.38
Lupel 2017 ¹⁹³	Ebola	Guinea, Liberia, Sierra Leone	No	Outcome	post- outbrea k	internal	leadership and operational direction; scaling up the response; coordination; strategic communications and community engagement;	mixed	n/a	mixed	61.54

							raising the profile of the response.				
Bell 2016 ¹⁹⁴	Ebola	Guinea, Liberia, Sierra Leone, Mali, Nigeria	No	Output	post-outbreak	internal	n/a	secondary	output	mixed	34.62
Summers 2014 ¹⁹⁵	Ebola	Liberia	No	Process	mid-outbreak	internal	county specific response plans	primary	n/a	qualitative	57.69
Swanson 2018 ¹⁹⁶	Ebola	Liberia	No	Outcome	post-outbreak	external	effectiveness	secondary	output, outcome	quantitative	73.46
Lindblade 2015 ¹⁹⁷	Ebola	Liberia	No	Impact	mid-outbreak	internal	effectiveness	secondary	outcome, impact	quantitative	80.77
Cardile 2016 ¹⁹⁸	Ebola	Liberia	No	Outcome	post-outbreak	internal	effectiveness	primary	outcome	mixed	61.54
De wit 2016 ¹⁹⁹	Ebola	Liberia	No	Output	mid-outbreak	internal	fidelity	secondary	output	mixed	42.31
Wolfe 2017 ²⁰⁰	Ebola	Liberia	No	Outcome	mid-outbreak	internal	effectiveness	primary	output, outcome	mixed	88.46
Katawera 2019 ²⁰¹	Ebola	Liberia	No	Output	mid-outbreak	internal	efficiency, effectiveness	secondary	output, outcome	quantitative	73.08

Kouaidio 2015 ²⁰²	Ebola	Liberia	No	Outcome	mid-outbreak	internal	effectiveness	primary	output, outcome	quantitative	65.38
Sepers 2019 ²⁰³	Ebola	Liberia	No	Outcome	mid-outbreak	internal	effectiveness	mixed	output, outcome	mixed	88.46
Oji 2018 ²⁰⁴	Ebola	Liberia	No	Outcome	mid-outbreak	internal	effectiveness	primary	process, outcome	mixed	96.15
Nyenswah 2016 ²⁰⁵	Ebola	Liberia	No	Outcome	post-outbreak	internal	crisis leadership tasks framework	secondary	outcome	qualitative	84.62
Munodawafa 2018 ²⁰⁶	Ebola	Liberia	No	Outcome	post-outbreak	internal	effectiveness	mixed	outcome	mixed	88.46
Nevin 2016 ²⁰⁷	Ebola	Liberia	No	Process	post-outbreak	internal	effectiveness, timeliness	mixed	output	mixed	65.38
Abramowitz 2015 ²⁰⁸	Ebola	Liberia	No	Process, Outcome	mid-outbreak	internal	effectiveness	mixed	outcome	mixed	80.77
YMCA 2015 ²⁰⁹	Ebola	Liberia	No	Outcome	mid-outbreak	internal	Relevance, Equity, Impact & Effectiveness, Efficiency	mixed	n/a	qualitative	65.38
GC 2015 ²¹⁰	Ebola	Liberia	No	Output	post-outbreak	internal	n/a	mixed	output, outcome	mixed	55.38

Carafano 2015 ²¹¹	Ebola	Liberia	No	Outcome	post-outbreak	external	n/a	secondary	n/a	qualitative	30.77
Brown 2014 ²¹²	Ebola	Liberia, Sierra Leone	No	Outcome	mid-outbreak	internal	WHO guidelines	primary	output, outcome	quantitative	73.09
Hurtado 2018 ²¹³	Ebola	Liberia, Sierra Leone, Guinea	No	Output	post-outbreak	external	availability	secondary	output	quantitative	84.62
Elemuwa 2015 ²¹⁴	Ebola	Nigeria	Yes	Outcome	post-outbreak	internal	effectiveness	secondary	outcome	qualitative	53.85
Oleribe 2015 ²¹⁵	Ebola	Nigeria	Yes	Outcome	post-outbreak	external	effectiveness	secondary	outcome	qualitative	38.46
Asuzu 2015 ²¹⁶	Ebola	Nigeria	Yes	Outcome	post-outbreak	internal	effectiveness	secondary	processes, outcomes	mixed	46.15
Vaz 2016 ²¹⁷	Ebola	Nigeria	Yes	Outcome	post-outbreak	internal	effectiveness	secondary	output, outcome	mixed	50.00
Li 2016 ²¹⁸	Ebola	Sierra Leone	No	Process	mid-outbreak	internal	impact	mixed	output, outcome	quantitative	69.23
Ratnayake 2016 ²¹⁹	Ebola	Sierra Leone	No	Process	mid-outbreak	internal	CEBS SOP	primary	process	mixed	88.46

Youkee 2015 ²²⁰	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	primary	outcome	quantitative	92.31
Vogt 2015 ²²¹	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	primary	outcome	quantitative	88.46
Logue 2017 ²²²	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	primary	output, outcome	quantitative	61.54
Stone 2016 ²²³	Ebola	Sierra Leone	No	Process	mid-outbreak	internal	CEBS SOP	primary	process	mixed	88.46
Olu 2016 ²²⁴	Ebola	Sierra Leone	No	Outcome	post-outbreak	external	effectiveness	mixed	output, outcome	mixed	96.15
Senga 2017 ²²⁵	Ebola	Sierra Leone	No	Outcome	post-outbreak	internal	effectiveness	primary	output, outcome	quantitative	84.62
Oza 2017 ²²⁶	Ebola	Sierra Leone	No	Output	mid-outbreak	internal	reliability	primary	output	mixed	76.92
Jobanputra 2016 ²²⁷	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	mixed	outcome	mixed	80.77
Gleason 2015 ²²⁸	Ebola	Sierra Leone	No	Output	mid-outbreak	internal	timeliness	primary	process	quantitative	80.77
Jia 2015 ²²⁹	Ebola	Sierra Leone	No	Outcome	mid-outbreak	external	effectiveness, efficiency	secondary	output, outcome	quantitative	65.38

Ilesanmi 2016 ²³⁰	Ebola	Sierra Leone	No	Process	post-outbreak	external	CDC updated guidelines for evaluating public health surveillance systems - simplicity, stability, acceptability, flexibility, representativeness, sensitivity, positive predictive value and data quality	mixed	process, outcome	mixed	96.15
Garde 2016 ²³¹	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	primary	output, outcome	quantitative	76.92
Nielson 2015 ²³²	Ebola	Sierra Leone	No	Process	mid-outbreak	internal	fidelity	primary	process, outcome	mixed	96.15
Lochlainn 2018 ²³³	Ebola	Sierra Leone	No	Feasibility	mid-outbreak	internal	effectiveness	primary	output, outcome	mixed	84.62
Jones-Konneh 2018 ²³⁴	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	mixed	outcome	mixed	34.62
Hermans 2017 ²³⁵	Ebola	Sierra Leone	No	Outcome	post-outbreak	internal	effectiveness	secondary	output, outcome	quantitative	84.62
Cancedda 2016 ²³⁶	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	secondary	output, outcome	quantitative	46.15

Lokuge 2016 ²³⁷	Ebola	Sierra Leone	No	Output	mid-outbreak	internal	effectiveness	secondary	output, outcome	quantitative	88.46
Stehling-Ariza 2016 ²³⁸	Ebola	Sierra Leone	No	Impact	post-outbreak	external	impact	secondary	outcome	mixed	80.77
Miller 2015 ²³⁹	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness	primary	output, outcome	quantitative	53.85
Fearon 2017 ²⁴⁰	Ebola	Sierra Leone	No	Output	post-outbreak	internal	HIT evaluation methodology	mixed	output, process. Outcome	mixed	80.77
YMCA 2016 ²⁴¹	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	effectiveness and impact, relevance, equity, impact, efficiency	primary	output	mixed	65.38
Cascioli 2014 ²⁴²	Ebola	Sierra Leone	No	Outcome	mid-outbreak	internal	quality and effectiveness	mixed	n/a	mixed	53.85
Platt 2016 ²⁴³	Ebola	Sierra Leone	No	Outcome	post-outbreak	internal	OECD/DAC criteria	mixed	outcome	mixed	92.31
Bayntun 2016 ²⁴⁴	Ebola	Sierra Leone	No	Process	post-outbreak	internal	n/a	mixed	n/a	qualitative	61.54
TKG 2016 ²⁴⁵	Ebola	Sierra Leone	No	Outcome	post-outbreak	internal	efficiency, effectiveness, accountability, adherence to standards	mixed	output	mixed	92.31

Batilo Momoh 2016 ²⁴⁶	Ebola	Sierra Leone	No	Outcome	post-outbreak	internal	relevance, effectiveness, efficiency, sustainability, impact	mixed	output, outcome	mixed	88.46
Age Interntional 2015 ²⁴⁷	Ebola	Sierra Leone	No	Impact	mid-outbreak	internal	relevance, effectiveness, efficiency, impact, accessibility, partnership	mixed	output	mixed	96.15
Adams 2015 ²⁴⁸	Ebola	Sierra Leone, Liberia	No	Impact	mid-outbreak	internal	Effectiveness and impact, Adherence to global standards, Accountability to beneficiaries, Partnerships, Application and generation of learning	mixed	output	mixed	96.15
Borchert 2011 ²⁴⁹	Ebola	Uganda	No	Outcome	post-outbreak	internal	effectiveness	secondary	outcome	mixed	73.08
Mbonye 2014 ²⁵⁰	Ebola	Uganda	No	Outcome	post-outbreak	internal	effectiveness	secondary	outcome	mixed	53.85
Thormar 2013 ²⁵¹	Ebola	Uganda	No	Outcome	post-outbreak	internal	Relevance, efficiency	mixed	outcome	qualitative	69.23
Abubakar 2014 ²⁵²	Leishmaniosisis	South Sudan	Yes	Outcome	post-outbreak	internal	effectiveness	secondary	output, outcome	quantitative	57.69

Wallace 2014 ²⁵³	Measles	Ethiopia	No	Process	post-outbreak	external	cost-effectiveness, efficiency	mixed	process, output	mixed	92.31
Lowe 2019 ²⁵⁴	Measles	Madagascar	Yes	Process	post-outbreak	internal	relevance, appropriateness, technical quality, effectiveness, efficiency,	mixed	process	mixed	92.31
Ntshoe 2013 ²⁵⁵	Measles	South Sudan	No	Impact	post-outbreak	internal	impact	primary	output, impact	quantitative	80.77
Yamageo 2011 ²⁵⁶	Meningitis	Burkina Faso	No	Process	Post outbreak	Unknown	Process	mixed	Process	mixed	73.08
Heitzinger 2018 ⁸⁶	Plague	Madagascar	No	Process	post-outbreak	internal	fidelity (operational research domains)	mixed	outputs, outcome	mixed	65.38
Ndiaye 2016 ²⁵⁷	Polio	Chad	Yes	Outcome	post-outbreak	internal	effectiveness	mixed	output, outcome	quantitative	84.62
Tegegne 2018 ²⁵⁸	Polio	Ethiopia	No	Outcome	post-outbreak	internal	effectiveness	mixed	output, outcome	mixed	88.46
Gammino 2014 ²⁵⁹	Polio	Nigeria	Yes	Process	mid-outbreak	external	SIA guidelines	primary	process	mixed	92.31
Nkwogu 2018 ²⁶⁰	Polio	Nigeria	Yes	Outcome	mid-outbreak	internal	effectiveness	mixed	output, outcome	mixed	88.46

Adamu 2019 ²⁶¹	Polio	Nigeria	Yes	Outcome	mid-outbreak	internal	effectiveness	mixed	output, outcome	quantitative	65.38
Kamadjeu 2017 ²⁶²	Polio	Somalia	Yes	Outcome	post-outbreak	internal	effectiveness, efficiency	primary	n/a	qualitative	53.85
Kamadjeu 2014 ²⁶³	Polio	Somalia	Yes	Outcome	post-outbreak	internal	effectiveness	mixed	output, outcome	mixed	76.92
IFRC 2010 ²⁶⁴	Polio	Uganda, Sudan, Côte d'Ivoire and Burkina Faso.	No	Outcome	post-outbreak	internal	n/a	mixed	outcome	mixed	57.69
Khetsuriani 2017 ²⁶⁵	Polio	Ukraine	Yes	Outcome	post-outbreak	internal	effectiveness	mixed	process, output, outcome	mixed	80.77
Bennet 2018 ²⁶⁶	Typhoid	Malawi	No	Outcome	mid-outbreak	external	effectiveness	mixed	outcome	mixed	80.77
IFRC 2013 ²⁶⁷	Various	Uganda	No	Outcome	post-outbreak	internal	relevance, effectiveness, accountability	mixed	process	qualitative	65.38
de la Rosa Vazquez 2017 ²⁶⁸	Yellow fever	DRC	Yes	Outcome	post-outbreak	internal	relevance, appropriateness and coverage; connectedness and coherence (sustainability); effectiveness;	mixed	process, outcome	qualitative	84.62

							efficiency; impact; child focus; community engagement and accountability.				
Bagonza 2013 ²⁶⁹	Yellow Fever	Uganda	No	Process	post- outbrea k	internal	effectiveness	mixed	process	quantitativ e	84.62
Ajay 2013 ²⁷⁰	Lassa Fever	Nigeria	No	Outcome	Post- outbrea k	External	Effectiveness	Secondary	Outcome	mixed	65.38

Evaluation Quality Checklist

	Criterion	Sub-score (S)	Weight (W)
1	Scope		0.25
	Rationale of evaluation clearly stated		
	specifies the evaluation criteria against which the subject to be evaluated be assessed, including, for example, relevance, efficiency, effectiveness, impact and/or sustainability		
	includes a comprehensive and tailored evaluation framework including evaluation criteria, questions and required indicators		
	Gives clear and relevant description of the context of the intervention (policy, socioeconomic, political, institutional, international factors relevant to the implementation of the intervention).		
	The geographic context and boundaries are clearly mentioned		
2	Methodology		0.25
	Contains a clear and complete description of a relevant design and methodological approach that are suitable for the evaluation's purpose, objectives and scope		
	Existing information sources, such as monitoring systems and/or previous evaluations are identified. An appraisal of quality and reliability is provided.		
	The evaluation methodology includes multiple methods (triangulation); preferably with analysis of both quantitative and qualitative data and with a range of stakeholders covered by the data collection methods		
	The evaluation methodology explicitly and clearly states the limitations of the chosen evaluation methods.		
	describes the key stages of the evaluation process and the implementation timeline		
3	Findings		0.25
	Reported findings address the evaluation criteria (such as efficiency, effectiveness, sustainability, impact and relevance) and questions defined in the evaluation scope.		
	Findings are objectively reported based on the evidence.		
4	Recommendations		0.25
	Recommendations are relevant to the object and purposes of the evaluation, are supported by evidence and conclusions, and were developed with the involvement of relevant stakeholders.		
<p>Summary Quality Score = (S₁ x W₁) + (S₂ x W₂) + (S₃ x W₃) + (S₄ x W₄)</p>			

Scoring: 1- Criteria fully demonstrated, **0.5** -Criteria partially demonstrated, **0** – no evidence of criteria demonstrated

Epidemic Search Strategy

The following sources were reviewed in order to compile a list of reported epidemics: World Health Organization Disease Outbreak News (WHO DON), WHO weekly epidemiological monitor (WEM), WHO EMRO Weekly Epidemiological Record (WER), UNICEF Cholera platform, Reliefweb, PROMED and Global Incidence Map.

In line with WHO guidance on communicable disease control in emergencies one suspected case of the following was considered to be an epidemic requiring a response: acute haemorrhagic fevers (Ebola, Lassa fever, Rift valley fever, Crimea-Congo haemorrhagic fever), anthrax, cholera, measles, typhus, plague and polio. For the remainder of the pathogens, we defined an epidemic as an unusual increase in incidence.

WHO DON reports were stored as narratives requiring each report to be opened and the metadata on location (country), year, month, pathogen extracted.

Reliefweb was searched for reported epidemics using the search engine and the disaster type filter set to find epidemics. Reports of epidemics were assessed for the period 2010-2019. Metadata on location (country), year, month, pathogen were extracted.

For the PROMED database, only epidemics rated as 3 or higher in the 5-point rating system and in which incident cases and deaths were reported were considered for inclusion. Metadata on location (country), year, month, pathogen were extracted for the period 2010-2019.

Global Incident Map database was searched utilizing the inbuilt search function filtering results that were out of scope (wrong location, pathogen etc.) at the source. Metadata on location (country), year, month, pathogen were extracted.

We collated all epidemic records into a single database. We sorted by date (month and year) and location(country). We removed duplicate reports of an epidemic from a single source (e.g. an update on an earlier reported epidemic) as well as removed duplicate reports of a single epidemic reported amongst multiple sources. In the absence of data which would have precisely determined the linkage between epidemics within a geographic boundary (e.g. genomic sequencing of epidemic pathogens) we developed a decision rule to further refine and summarize the remaining reported epidemics. We utilized a decision rule in which reports of epidemics caused by a single pathogen occurring within a 4-month window and within the boundaries of a single country were viewed as a single epidemic.

Search terms

Medline search

1) Outbreak Terms

(Cholera OR Dysentery OR Diarrh*OR conjunctivitis OR dengue OR diphtheria OR viral hepatitis, Japanese encephalitis OR leishmaniosis OR malaria OR measles OR Meningococcal meningitis OR African sleeping sickness OR Typhoid OR Typhus OR yellow fever OR viral haemorrhagic fevers OR Communicable disease* OR Infectious disease*) adj2 (outbreak* OR epidemic* OR pandemic*)

2) Humanitarian terms

Humanitarian adj2 (cris#s OR emergenc* OR disaster* OR relief OR aid) OR humanitarian OR cris#s OR emergenc* OR disaster* OR relief OR aid OR refugee* OR evacuee OR evacuated OR displace* adj2 (population or internal*) OR war OR war adj2 (armed OR zone) OR conflict adj2 (armed OR zone) OR conflict affected adj3 (population OR communit*) OR earthquake OR flood* OR landslide* OR tidal waves OR tsunami* OR cyclon* OR typhoon* OR drought OR fragile state

3) Evaluation terms

(Evaluation* OR assessment* OR appraisal* OR Guidance* OR Lesson*)

Extraction Table

Citation (author, year)	Type of pathogen	Country	Humanitarian setting? (Y/N)	Type of document (guidance, evaluation report etc)	Type of evaluation (process, impact etc)	Timing (mid outbreak or post outbreak)	Commissioned by (e.g. internal/external or donor driven)	External or internal implementation	Evaluation framework if used	Type of data collection (primary or secondary) recommended or utilized	Type of indicators of focus	Type of data collection (Quant vs qual) utilized	Quality Score

Search Strategy- Medline, Embase and Global Health

1. (outbreak* or epidemic* or pandemic*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
2. ((Cholera or Dysentery or Diarrh*OR conjunctivitis or dengue or diphtheria or viral hepatitis, Japanese encephalitis or leishmaniosis or malaria or measles or Meningococcal meningitis or African sleeping sickness or Typhoid or Typhus or yellow fever or viral haemorrhagic fevers or Communicable disease* or Infectious disease*) adj2 (outbreak* or epidemic* or pandemic*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
3. (Evaluation* or assessment* or appraisal* or Guidance* or Lesson*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
4. (Humanitarian adj2 (cris#s or emergenc* or disaster* or relief or aid)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
5. ((humanitarian or cris#s or emergenc* or disaster* or relief or aid or refugee* or evacuee or evacuated or displace*) adj2 (population or internal*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
6. (war or (war adj2 (armed or zone))).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
7. (conflict adj2 (armed or zone)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
8. (conflict affected adj3 (population or communit*)).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
9. (earthquake or flood* or landslide* or tidal waves or tsunami* or cyclon* or typhoon* or drought or fragile state).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (economy or economies)).ti,ab.

11. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or population? or world)).ti,ab.
12. (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab.
13. (low adj3 middle adj3 countr*).ti,ab.
14. (lmic or lmic3 or third world or lami countr*).ti,ab.
15. transitional countr*.ti,ab.
16. global south.ti,ab.
17. Developing Countries/
18. "africa south of the sahara"/ or africa, central/ or africa, eastern/ or africa, southern/ or africa, western/
19. ("africa south of the sahara" or sub-saharan africa or central africa or eastern africa or southern africa or western africa).ti,ab.
20. "Democratic People's Republic of Korea"/
21. (north korea or (democratic people* republic adj2 korea)).ti,ab.
22. Cambodia/
23. cambodia.ti,ab.
24. Indonesia/
25. indonesia.ti,ab.
26. Micronesia/
27. Kiribati.ti,ab.
28. Laos/
29. (laos or (lao adj1 democratic republic)).ti,ab.
30. (marshall island* or caroline island* or ellice island* or gilbert island* or johnston island* or mariana island* or micronesia or pacific island*).ti,ab.
31. Mongolia/
32. mongolia.ti,ab.
33. Myanmar/
34. (myanmar or burma).ti,ab.
35. Papua New Guinea/
36. Papua New Guinea.ti,ab.
37. Philippines/
38. Philippines.ti,ab.
39. Timor-Leste/
40. Timor-Leste.ti,ab.
41. Vanuatu/
42. Vanuatu.ti,ab.
43. Vietnam/
44. (Viet Nam or Vietnam).ti,ab.
45. American Samoa/
46. american samoa.ti,ab.
47. exp China/
48. china.ti,ab.
49. Fiji/
50. fiji.ti,ab.
51. Malaysia/
52. malaysia.ti,ab.
53. marshall islands.ti,ab.

54. nauru.ti,ab.
55. samoa/
56. "independent state of samoa"/
57. ("independent state of samoa" or (samoa not american samoa) or western samoa or navigator islands or samoan islands).ti,ab.
58. Thailand/
59. Thailand.ti,ab.
60. Tonga/
61. tonga.ti,ab.
62. Tuvalu.ti,ab.
63. Armenia/
64. Armenia.ti,ab.
65. "Georgia (Republic)"/
66. Kosovo/
67. Kosovo.ti,ab.
68. Kyrgyzstan/
69. (kyrgyzstan or kyrgyz republic or kirghizia or kirghiz).ti,ab.
70. Moldova/
71. Moldova.ti,ab.
72. Tajikistan/
73. tajikistan.ti,ab.
74. Ukraine/
75. Ukraine.ti,ab.
76. Uzbekistan/
77. Uzbekistan.ti,ab.
78. Albania/
79. Albania.ti,ab.
80. Azerbaijan/
81. Azerbaijan.ti,ab.
82. "Republic of Belarus"/
83. (belarus or byelarus or belorussia).ti,ab.
84. Bosnia-Herzegovina/
85. (bosnia or herzegovina).ti,ab.
86. Bulgaria/
87. Bulgaria.ti,ab.
88. Kazakhstan/
89. (Kazakhstan or kazakh).ti,ab.
90. "Macedonia (Republic)"/
91. Macedonia.ti,ab.
92. Montenegro/
93. Montenegro.ti,ab.
94. Romania/
95. Romania.ti,ab.
96. exp Russia/
97. USSR/
98. (Russia or Russian Federation or USSR or Union of Soviet Socialist Republics or Soviet Union).mp.
99. Serbia/

100. serbia.ti,ab.
101. Turkey/
102. turkey.ti,ab. not animal/
103. Turkmenistan/
104. Turkmenistan.ti,ab.
105. Yugoslavia/
106. yugoslavia.ti,ab.
107. Haiti/
108. Haiti.ti,ab.
109. Bolivia/
110. Bolivia.ti,ab.
111. El Salvador/
112. El Salvador.ti,ab.
113. Guatemala/
114. Guatemala.ti,ab.
115. Honduras/
116. Honduras.ti,ab.
117. Nicaragua/
118. Nicaragua.ti,ab.
119. Belize/
120. Belize.ti,ab.
121. Brazil/
122. Brazil.ti,ab.
123. Colombia/
124. Colombia.ti,ab.
125. Costa Rica/
126. Costa Rica.ti,ab.
127. Cuba/
128. Cuba.ti,ab.
129. Dominica/
130. Dominica.ti,ab.
131. Dominican Republic/
132. Dominican Republic.ti,ab.
133. Ecuador/
134. Ecuador.ti,ab.
135. Grenada/
136. Grenada.ti,ab.
137. Guyana/
138. Guyana.mp.
139. Jamaica/
140. Jamaica.ti,ab.
141. Mexico/
142. Mexico.ti,ab.
143. Paraguay/
144. Paraguay.mp.
145. Peru/
146. Peru.ti,ab.
147. Saint Lucia/

148. (St Lucia or Saint Lucia).ti,ab.
149. "Saint Vincent and the Grenadines"/
150. Grenadines.ti,ab.
151. Suriname/
152. Suriname.ti,ab.
153. Venezuela/
154. Venezuela.ti,ab.
155. Djibouti/
156. (Djibouti or French Somaliland).ti,ab.
157. Egypt/
158. Egypt.ti,ab.
159. Jordan/
160. Jordan.ti,ab.
161. Morocco/
162. Morocco.ti,ab.
163. Syria/
164. (Syria or Syrian Arab Republic).ti,ab.
165. Tunisia/
166. tunisia.mp.
167. Gaza.ti,ab.
168. Yemen/
169. Yemen.ti,ab.
170. Algeria/
171. Algeria.ti,ab.
172. Iran/
173. Iran.ti,ab.
174. Iraq/
175. Iraq.ti,ab.
176. Jordan/
177. Jordan.ti,ab.
178. Lebanon/
179. Lebanon.ti,ab.
180. Libya/
181. Libya.ti,ab.
182. Afghanistan/
183. Afghanistan.ti,ab.
184. Nepal/
185. Nepal.ti,ab.
186. Bangladesh/
187. Bangladesh.ti,ab.
188. Bhutan/
189. Bhutan.ti,ab.
190. exp India/
191. India.ti,ab.
192. Pakistan/
193. Pakistan.ti,ab.
194. Sri Lanka/
195. Sri Lanka.ti,ab.

196. Indian Ocean Islands/
197. Maldives.ti,ab.
198. Benin/
199. (Benin or Dahomey).ti,ab.
200. Burkina Faso/
201. (Burkina Faso or Burkina Fasso or Upper Volta).ti,ab.
202. Burundi/
203. Burundi.ti,ab.
204. Central African Republic/
205. (Central African Republic or Ubangi-Shari).ti,ab.
206. Chad/
207. Chad.ti,ab.
208. Comoros/
209. (Comoros or Comoro Islands or Mayotte or Iles Comores).ti,ab.
210. "Democratic Republic of the Congo"/
211. ((democratic republic adj2 congo) or belgian congo or zaire).ti,ab.
212. Eritrea/
213. Eritrea.ti,ab.
214. Ethiopia/
215. Ethiopia.ti,ab.
216. Gambia/
217. Gambia.ti,ab.
218. Guinea/
219. (Guinea not (New Guinea or Guinea Pig* or Guinea Fowl)).ti,ab.
220. Guinea-Bissau/
221. (Guinea-Bissau or Portuguese Guinea).ti,ab.
222. Liberia/
223. Liberia.ti,ab.
224. Madagascar/
225. (Madagascar or Malagasy Republic).ti,ab.
226. Malawi/
227. (Malawi or Nyasaland).ti,ab.
228. Mali/
229. Mali.ti,ab.
230. Mozambique/
231. (Mozambique or Mocambique or Portuguese East Africa).ti,ab.
232. Niger/
233. (Niger not (Aspergillus or Peptococcus or Schizothorax or Cruciferae or Gobius or Lasius or Agelastes or Melanosuchus or radish or Parastromateus or Orius or Apergillus or Parastromateus or Stomoxys)).ti,ab.
234. Rwanda/
235. (Rwanda or Ruanda).ti,ab.
236. Senegal/
237. senegal.ti,ab.
238. Sierra Leone/
239. Sierra Leone.mp.
240. Somalia/
241. Somalia.ti,ab.

242. South Sudan/
243. south sudan.ti,ab.
244. Tanzania/
245. (Tanzania or Tanganyika or Zanzibar).ti,ab.
246. Togo/
247. (Togo or Togolese Republic).ti,ab.
248. Uganda/
249. Uganda.ti,ab.
250. Zimbabwe/
251. (Zimbabwe or Rhodesia).ti,ab.
252. Angola/
253. angola.ti,ab.
254. Cameroon/
255. Cameroon.ti,ab.
256. Cape Verde/
257. (Cape Verde or Cabo Verde).ti,ab.
258. Congo/
259. (congo not ((democratic republic adj3 congo) or congo red or crimean-congo)).ti,ab.
260. Cote d'Ivoire/
261. (Cote d'Ivoire or Ivory Coast).ti,ab.
262. Ghana/
263. (Ghana or Gold Coast).ti,ab.
264. Kenya/
265. kenya.mp.
266. Lesotho/
267. (Lesotho or Basutoland).ti,ab.
268. Mauritania/
269. Mauritania.ti,ab.
270. Nigeria/
271. Nigeria.ti,ab.
272. Atlantic Islands/
273. (sao tome adj2 principe).ti,ab.
274. Sudan/
275. (Sudan not south sudan).ti,ab.
276. Swaziland/
277. Swaziland.ti,ab.
278. Zambia/
279. (Zambia or Northern Rhodesia).ti,ab.
280. Botswana/
281. (Botswana or Bechuanaland or Kalahari).ti,ab.
282. Equatorial Guinea/
283. (Equatorial Guinea or Spanish Guinea).ti,ab.
284. Gabon/
285. (Gabon or Gabonese Republic).ti,ab.
286. Mauritius/
287. (Mauritius or Agalega Islands).ti,ab.
288. Namibia/
289. Namibia.ti,ab.

290. South Africa/
291. South Africa.ti,ab.
292. or/10-291 [ALL COUNTRIES DESIGNATED AS LMIC]
293. 1 or 2
294. 4 or 5 or 6 or 7 or 8 or 9
295. 292 or 294
296. 3 and 293 and 295
297. limit 296 to (yr="2010 -Current" and (english or french))

Search Strategy CINAHL

Interface - EBSCOhost Research Databases

Search Screen - Advanced Search

Database - Africa-Wide Information;CINAHL Plus with Full Text;GreenFILE;Library, Information Science & Technology Abstracts

1. (outbreak* or epidemic* or pandemic*)
2. ((Cholera or Dysentery or Diarrh* or conjunctivitis or dengue or diphtheria or viral hepatitis, Japanese encephalitis or leishmaniosis or malaria or measles or Meningococcal meningitis or African sleeping sickness or Typhoid or Typhus or yellow fever or viral haemorrhagic fevers or Communicable disease* or Infectious disease*) w2 (outbreak* or epidemic* or pandemic*))
3. (Evaluation* or assessment* or appraisal* or Guidance* or Lesson*)
4. (Humanitarian w2 (cris?s or emergenc* or disaster* or relief or aid))
5. ((humanitarian or cris#s or emergenc* or disaster* or relief or aid or refugee* or evacuee or evacuated or displace*) w2 (population or internal*)).
6. (war or (war w2 (armed or zone))).
7. (conflict w2 (armed or zone))
8. (earthquake or flood* or landslide* or tidal waves or tsunami* or cyclon* or typhoon* or drought or fragile state)
9. ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or underserved or deprived or poor*)
10. 1 OR 2
11. 4 OR 5 OR 6 OR 7 OR 8
12. 9 OR 11
13. 3 AND 10 AND 12

Search Strategy Web of Science

Indexes=SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, ESCI Timespan=2010-2019

1. TS=(outbreak* OR epidemic* OR pandemic*)
2. TS=((Cholera or Dysentery or Diarrh*OR conjunctivitis or dengue or diphtheria or viral hepatitis, Japanese encephalitis or leishmaniosis or malaria or measles or Meningococcal meningitis or African sleeping sickness or Typhoid or Typhus or yellow fever or viral haemorrhagic fevers or Communicable disease* or Infectious disease*))
3. TS=(Evaluation* or assessment* or appraisal* or Guidance* or Lesson*)
4. TS=(Humanitarian (cris?s or emergenc* or disaster* or relief or aid))
5. #2 OR #1
6. (#5 AND #4 AND #3) AND LANGUAGE: (English OR French)

WPRIM Search Strategy

1. All:appraisal OR All:assessment OR All:evaluation OR MeSH:appraisal OR MeSH:assessment OR MeSH:evaluation
2. MeSH:outbreak OR All:epidemic
3. 1 & 2

PDQ Search Strategy

(title:(outbreak* OR epidemic* OR pandemic*)) OR abstract:(outbreak* OR epidemic* OR pandemic*)) AND (title:(Evaluation* OR assessment* OR appraisal* OR Guidance* OR Lesson)) OR abstract:(Evaluation* OR assessment* OR appraisal* OR Guidance* OR Lesson))

1. (title:(outbreak* OR epidemic* OR pandemic*))
2. abstract:(outbreak* OR epidemic* OR pandemic*))
3. (title:(Evaluation* OR assessment* OR appraisal* OR Guidance* OR Lesson))
4. abstract:(Evaluation* OR assessment* OR appraisal* OR Guidance* OR Lesson))
5. 1 OR 2
6. 3 OR 4
7. 5 & 6

Reliefweb search strategy

1. Disaster.type:epidemic
2. Theme:health
3. Format: (assessment) OR (Evaluation or Lessons Learned) OR (Manual or Guideline)
4. 1 & 2 & 3

10.3 Supplementary Material for Paper 3

Interview Guides

Title of Project: Decision-making in epidemic response in humanitarian and low-resource settings

Name of PI/Researcher responsible for project: Abdihamid Warsame

Participant Identification Number: __ - __ __

(Careful! Make sure it corresponds exactly to that on the consent form)

I am going to ask you about decision-making in the covid-19 response in Somalia. Please do your best to reference specific instances in the covid-19 response. To assist you, I would like you to identify 2-3 major/critical decision points in the response. These can be points that you felt had potentially significant public health implications.

i) Opening Questions

- Can you describe your experience responding to previous public health emergencies or epidemics here or elsewhere?
- Can you describe how you became to be involved in the COVID-19 response?
- What in your opinion were the critical decision points in the response?

ii) Topic 1: Individual decision-making

- Can you describe in general what your role was in the critical decision points?**

- ☐ In these critical points, what factors contributed or helped you to arrive at your decision? What factors helped to influence the decision if it differed from yours?
- ☐ Which of these factors acted as a barrier to you as an individual in making good decisions at these critical points?

iii) Topic 2: Information for decision-making

- ☐ With regards to critical decision points, how did you deal with new information in making a decision during this pandemic?
- ☐ How did you deal with uncertainty and conflicting information?
- ☐ How did you grapple with urgency and stress in these critical points?
- ☐ In general, is there always a right decision? In this response?

iv) Topic 3: Response-level decision-making

- ☐ Did you feel there was adequate preparation before the first confirmed case?
- ☐ Were there particular aspects of the overall response you felt were especially well executed? Why? Who was involved?
- ☐ In your opinion, did the quality of decision-making improve throughout the critical decision points?
- ☐ Were there particular aspects that you felt did not perform as well? Why?
- ☐ In these critical decision points, was there disagreement on how to proceed? How was this navigated? How should it have been navigated?
- ☐ What other factors contributed to the quality of decision-making in these instances?
- ☐ Can you list any barriers that might have prevented better decision-making in the response overall?

v) Closing Questions

- ☐ How did you find the Interview?
- ☐ Was there anything more you'd like to add?
- ☐ Do you have any questions for me?

Group interview Information sheet

Title of Project: Exploring decision-making in the COVID-19 response: the case study of Somalia

Name of PI/Researcher responsible for project: Abdihamid Warsame

Dear Sir/Madam

You have been invited to participate in this brief study to provide information on your experience in responding to COVID-19 in Somalia

What the study is about

Responding effectively to the large numbers of epidemics in low resource settings is critical to reducing morbidity and saving lives. One key aspect of the response that is not well understood or documented is the process of decision-making. Through your participation in a group interview, we would like to better understand: epidemic decision-making norms and dynamics and how these may differ in group settings relative to individual interviews.

What is involved in the study?

We would like to invite you to participate in a group interview because of your role as member of an organization responding to the COVID-19 epidemic in Somalia. The group interviews will include 2 other participants in your field (e.g. other NGOs) and may not necessarily be part of your specific organization. The interviews will take approximately 60-80 minutes and will be undertaken in a private setting and will be audio recorded and then transcribed. The necessary COVID-19 precautions will be put in place to ensure your safety and that of the other participants. These group informant interview will be supplemented by a desk review of secondary data on epidemic response processes and outcomes as well as individual key informant interviews. Your input will be vital to mapping out key areas for improving decision-making in humanitarian emergencies and producing general recommendations for future epidemic responses.

Are there any risks or benefits for me in taking part in this study?

There are no direct benefits for you from taking part in the study, but your information may help improve evidence uptake on effective decision-making for epidemic response. You should feel free to take part only if you wish, or to take this sheet with you and think about it before deciding. If for any reason you prefer to stop the interview at any point, you can. Even after the interview, you may let us know before submission for publication, that you'd prefer us to not use or destroy the information. As this is a group interview, your anonymity cannot be guaranteed. We will emphasize to the participants to respect each other's anonymity by not discussing what was said in the focus group with those not involved. However, should you choose to continue, we will not quote you directly and the study report itself will not present any information through which people will be able to identify you. This means that your input will be treated with confidentiality. All of the data including audio and transcripts will be stored securely on encrypted devices first on the interviewer's device and then transferred to secure servers at the LSHTM. Only the study team will have access to this data. Once the analysis is complete, we will destroy the questionnaires. We will keep your signed consent forms under lock and key and also destroy them after some time, according to the law. Five year after the study is complete, we will also destroy the electronic files.

What if I have concerns or questions, now or after the interview?

Please do not hesitate to get in touch with Abdihamid Warsame (Abdihamid.Warsame@lshtm.ac.uk) in case of any concern or query.

Participant Information Sheet

Individual Key Informant Information sheet

Title of Project: Exploring decision-making in the COVID-19 response: the case study of Somalia

Name of PI/Researcher responsible for project: **Abdihamid Warsame**

Dear Sir/Madam

You have been invited to participate in this brief study to provide information on your experience in responding to COVID-19 in Somalia

What the study is about

Responding effectively to the large numbers of epidemics in low resource settings is critical to reducing morbidity and saving lives. One key aspect of the response that is not well understood or documented is the process of decision-making. Through your individual participation in a key informant interview, we would like to better understand: what are the critical decisions, who makes the decisions, how decisions are made, what are key considerations in decision-making and how these might effect on the timeliness and effectiveness of the response.

What is involved in the study?

We would like to interview you as a key informant because of your role as member of your organization responding to the COVID-19 epidemic in Somalia. The interviews will take approximately 45-60 minutes and will be undertaken in a private setting and will be audio recorded and then transcribed. The necessary COVID-19 precautions will be put in place to ensure your safety and that of the interviewer. These key informant interview will be supplemented by a desk review of secondary data on epidemic response processes and outcomes as well as group interviews. Your input will be vital to mapping out key areas for improving decision-making in humanitarian emergencies and producing general recommendations for future epidemic responses

Are there any risks or benefits for me in taking part in this study?

There are no direct benefits for you from taking part in the study, but your information may help improve evidence uptake on effective decision-making for epidemic response. You should feel free to take part only if you wish, or to take this sheet with you and think about it before deciding. If for any reason you prefer to stop the interview at any point, you can. Even after the interview, you may let us know before submission for publication, that you'd prefer us to not use or destroy the information. Your identity will not be disclosed to anyone outside of the study team and will not be published. In that case, the study report itself will not present any information through which people will be able to identify you. If you wish, we will not quote you directly. This means that your input will be treated with confidentiality. All of the data including audio and transcripts will be stored securely on encrypted devices first on the interviewer's device and then transferred to secure servers at the LSHTM. Only the study team will have access to this data. Once the analysis is complete, we will destroy the questionnaires. We will keep your signed consent forms under lock and key and also destroy them after some time, according to the law. Five year after the study is complete, we will also destroy the electronic files.

What if I have concerns or questions, now or after the interview?

Please do not hesitate to get in touch with Abdihamid Warsame (Abdihamid.Warsame@lshtm.ac.uk) in case of any concern or query.

Grey Literature Search Strategy

Search Engines: Google.com, scholar.google.com

Websites: reliefweb.int, humanitarianresponse.info , WHO Somalia, Ministry of Health Somalia, WHO EMRO, alnap.org,

Timeframe: 2020-2021

Search terms

Language: English

Table A Grey literature English search terms

Geographic	Disease	Decision	Documents
Somalia	COVID-19	Decisions	evaluation
Mogadishu	COVID	Options	Response plan
Puntland	Coronavirus	Decision-making	Sitrep/ Situation report
Somaliland	pandemic	Decision making	Bulletin
			assessment

Search queries

- 1) Somalia OR Mogadishu OR Puntland OR Somaliland
- 2) COVID-19 OR COVID19 OR COVID OR Coronavirus
- 3) Decision* OR Option OR Decision-making OR decision making
- 4) Evaluation or Response plan OR Sitrep OR Situation report OR Bulletin or Assessment

Combined: 1 & 2 & 3 & 4

Language: Somali

Table B Grey literature Somali search terms

Geographic	Disease	Decision	Documents
Somalia	COVID-19	Go'aan	qiimaynta
Mogadishu	COVID	Go'aama	Warbixinta xaalada
Puntland	Fayruska korona	go'aan qaadashada	
Somaliland			

- 1) Somalia OR Mogadishu OR Puntland OR Somaliland
- 2) COVID-19 OR COVID19 OR Fayruska Korona OR Coronavirus
- 3) Go'aan* OR Go'aama OR Go'aan qaadashada

4) Qiimaynta OR Warbixinta xaalda

Combined: 1 & 2 & 3 & 4

10.4 Supplementary Material for Paper 4

Participant Information Sheet

Title of Project: Decision-making in epidemic response in humanitarian and low-resource settings

Name of PI/Researcher responsible for project: Abdihamid Warsame

Dear Sir/Madam

You have been invited to participate in this brief study to provide information on your experience in responding to epidemics in humanitarian and low-income settings

What the study is about

Responding effectively to the large numbers of epidemics in low resource settings is critical to reducing morbidity and saving lives. One key aspect of the response that is not well understood or documented is the process of decision-making. Through your participation we would like to better understand: what are the critical decisions, who makes the decisions, how decisions are made, how is evidence used, what are key considerations in decision-making and how these might effect on the timeliness and effectiveness of the response.

What is involved in the study?

We would like to interview you as a key informant because of your role as member of your organization responding to the epidemic in Somalia. These key informant interviews will be supplemented by a desk review of secondary data on epidemic response processes and outcomes. Your input will be vital to mapping out key areas for improving decision-making in humanitarian emergencies and producing general recommendations for future epidemic responses

Are there any risks or benefits for me in taking part in this study?

There are no direct benefits for you from taking part in the study, but your information may help improve evidence uptake on effective decision-making for epidemic response. You should feel free to take part only if you wish, or to take this sheet with you and think about it before deciding. If for any reason you prefer to stop the interview at any point, you can. Even after the interview, you may let us know before submission for publication, that you'd prefer us to not use or destroy the information. Should you choose to maintain anonymity, your identity will not be disclosed to anyone outside of the study team and will not be published without your consent. This means that your input will be treated with confidentiality. All of the data will be stored securely. We will keep your signed consent forms under lock and key and also destroy them after some time, according to the law. Five years after the study is complete, we will also destroy the electronic files.

In that case, the study report itself will not present any information through which people will be able to identify you. If you wish, we will not quote you directly.

What if I have concerns or questions, now or after the interview?

Please do not hesitate to get in touch with Abdihamid Warsame (Abdihamid.Warsame@lshtm.ac.uk) in case of any concern or query.

Consent Form

Title of Project: Decision-making in epidemic response in humanitarian and low-resource settings

Name of PI/Researcher responsible for project: Abdihamid Warsame

Statement	Please initial or each box
I have had the information explained to by study personnel in a language that I understand. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason	
I wish to remain fully anonymous	
I agree for partial anonymity i.e., for my input to be directly quoted to me in my official capacity (e.g. a director of health stated...)	
I agree to waive my anonymity	
I understand that relevant sections of information collected during the interview may be looked at by authorised individuals from the London School of Hygiene & Tropical Medicine	
I agree to take part in the above-named study	

Printed name of participant	Signature of participant	Date

I attest that I have explained the study information accurately in _____ to and was understood to the best of my knowledge by, the participant and that he/she has freely given their consent to participate in the presence of the above named impartial witness (where applicable).

Printed name of person obtaining consent	Signature of person obtaining consent	Date

Email consent (in-case of remote interview)

Audio consent (in-case of remote interview)

A copy of this informed consent document and the Information Sheet have been provided to the participant.

Interview Guide

Title of Project: Assessment of the utility and feasibility of the epidemic response evaluation tool/checklist

Name of PI/Researcher responsible for project: Abdihamid Warsame

Participant Identification Number: _ - _ _

(Careful! Make sure it corresponds exactly to that on the consent form)

This interview is intended to better understand how the tool was perceived and utilized by epidemic responders such as yourself. As much as possible, please provide specific examples in your response as this will help us in assessing its viability.

vi) Opening Questions

- Can you describe your experience responding to previous epidemics in this country or elsewhere?
- How would you describe your role in this response?

vii) Topic 1: Utility of the tool

- Was the objective of the evaluation approach and tools clear from the outset?
- How easy was it to understand the structure and logic of the tool?
- Did the findings of the tool change your understanding or approach to making decisions in this epidemic? Can you list specific examples?
- What challenges did you encounter in this evaluation?

viii) Topic 2: feasibility of the tool

- How efficient was the process of using the tool?
- Do you think the tool and overall approach provided results in a timely manner?
- Do you think the tool is more suitable for post-epidemic or mid-epidemic evaluation?

ix) Topic 3: Next steps

- Do you have any recommendations on what changes you would like to see in the tool and overall approach?
- Do you see making any changes in your response as a result of the findings? If so, which changes?
- Would you be willing and able to utilize this tool in future response?

x) Closing Questions

- How did you find the Interview?
- Was there anything more you'd like to add?
- Do you have any questions for me?

Part B- Selection of critical decision points

Guide

Considering the following guiding Characteristics, propose 3 -5 critical decision in the response to date. Justify your selection with specific with reference to the characteristics as well as specific examples. A decision does not need to meet all of the following characteristics to be considered critical. These can include decision on beginning, ending or scaling a response, deciding on response options, deciding on target population, as well as deciding on modality of response.

Characteristics of critical decision

- I. Consequential- critical decision is consequential and shapes the response to a significant degree
- II. Reversibility- a critical decision can be difficult to overturn or reverse at least in the short term)
- III. Strategic- entails shift in terms of action taken, resources committed or precedent set
- IV. Uncertainty –Wide range of uncertainty/ complex array of options
- V. Reputationally Risky- Entails a high level of organisational reputational risk

Decision 1

Description

Describe the decision

Rationale

Justify your proposed decision by selecting the relevant Characteristics

Characteristic 1

Characteristic 2

Characteristic 3

Characteristic 4

Characteristic 5

Narrative

Describe any other reason for considering this decision critical (maximum 200 words)

Decision 2

Description

Describe the decision

Rationale

Justify your proposed decision by selecting the relevant Characteristics

Characteristic 1

Characteristic 2

Characteristic 3

Characteristic 4

Characteristic 5

Narrative

Describe any other reason for considering this decision critical (maximum 200 words)

Decision 3

Description

Describe the decision

Rationale

Justify your proposed decision by selecting the relevant Characteristics

Characteristic 1

Characteristic 2

Characteristic 3

Characteristic 4

Characteristic 5

Narrative

Describe any other reason for considering this decision critical (maximum 200 words)



Rigour

Criteria	Fulfilment of criteria <i>To what extent was the criteria fulfilled in this particular decision</i>	Evidence of fulfilment <i>Provide reference to specific sources to support your assessment</i>
Explicit outcome ⁸	Choose an item.	
Feasible outcome ⁹	Choose an item.	
Strengthen healthcare system ¹⁰	Choose an item.	
Evidence based ¹¹	Choose an item.	

Guide

5. Was there any scope to revise and overturn a decision? How open was the discussion? Were alternatives debated? What were they? Was consensus achieved and if so, how was this reached?
6. What role did respondents in closest proximity to the epidemic (e.g. subnational level) or local technical experts play? What role did organizational leadership play? Who was the most junior decision-maker? Who was the most senior?
7. To what degree were the effected communities involved in the response? Who was involved from the effected community? Were they informed of the response activities? Did this notice make any difference for those notified?
8. Were intended outcomes of the decision clearly articulated? Were targets set? What were they?
9. Were alternatives debated? What were they?
10. Was there evidence that this decision was in-line with wider strategy? What pillar of the health system were targeted?

11. Was “Strong public health rationale and solid scientific information provided to justify health measures?” What evidence was utilized? What evidence was missing?

Part D- Summary Decision-making Score

Scoring formula

For each assessed decision, utilize the formulae below to populate the table

Transparency score = average of criteria 1-4

Contestability= average of criteria 5-6

Accountability= score of criteria 7

Rigour= average of criteria 8-11

Dimension	Average	Score
Transparency		
Contestability		
Rigour		
Accountability		

Recommendations

Based on the results above, briefly describe what specific steps you recommend in order to improve the decision-making process in this epidemic
(*maximum 300 words*).





Evaluating the quality of epidemic decision-making in epidemics & humanitarian crises

Standard Operating Procedures (SOP)

Version 1.0
June 30th, 2021
Abdihamid Warsame
Infectious Disease Epidemiology
London School of Hygiene & Tropical Medicine
Abdihamid.warsame@lshtm.ac.uk

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Abbreviations

CO- Country Office

COVID-19- Coronavirus disease 2019

RO- Regional Office

HQ- headquarters

Sitrep- Situation report

PHSA- Public Health Situation Analysis

RRA- Rapid risk assessment

SMT- Senior Management Team

KII- Key Informant Interview

FGD- Focus Group Discussion

Introduction

While epidemics of infectious disease continue to pose a considerable threat to populations in low-income and humanitarian settings, the evaluation of these epidemic responses are limited and heterogeneous¹. Populations in need of humanitarian assistance or living within low income settings continue to grow² and the ongoing COVID-19 pandemic has further exacerbated the impact of these crises³. Decision-making in the context of an ongoing epidemic is particularly challenging^{13,14}. Previous research has identified a limited number of decision-making factors contributing to poor response¹⁵⁻¹⁷. However, these findings need further study in order to confirm their relevance to a wider array of contexts experiencing ongoing epidemics

Such settings not only must deal with the epidemic directly and its indirect impacts but must also contend with a host of urgent competing emergencies. As such decision-makers are under heavier strain than those in better resourced and stable environments and require adequate support. COVID-19 is unlikely to be the last epidemic faced by decision-makers in such settings and therefore evaluations such as this are especially critical to strengthening future preparedness and improving response.

In decision-making research, there are two common approaches: process and evaluation.

Process oriented approach describes how decisions are actually made within a specific context whereas analytical oriented is more prescriptive and frames decision-making as a problem-solving approach intended to lead to the best outcome. In short the former looks at whether a decision is made correctly while the latter considers whether the correct decision is made. This evaluation is predicated on the former approach.

Rationale

- This SOP is intended to evaluate the process of epidemic decision-making rather than the impact of any specific decision. Improved decision-making practises can improve outcomes, timeliness and accountability in epidemic response in humanitarian settings.
- In order to contribute to better humanitarian performance, the UKRI awarded a consortium led by the London School of Hygiene & Tropical Medicine to undertake research and produce evidence to support humanitarian responders. This SOP includes stepwise actions required to be undertaken by evaluators as well as the necessary timeframes, roles and responsibilities and resources required.

Definitions

Decision making: choosing between number of options/course of action or a process of problem solving in a specific context (Campbell 2018)

Evaluation- assessment, as systematic and impartial as possible of an activity, project, programme, strategy, policy, theme, sector, operational area or institutional performance.

Target audience

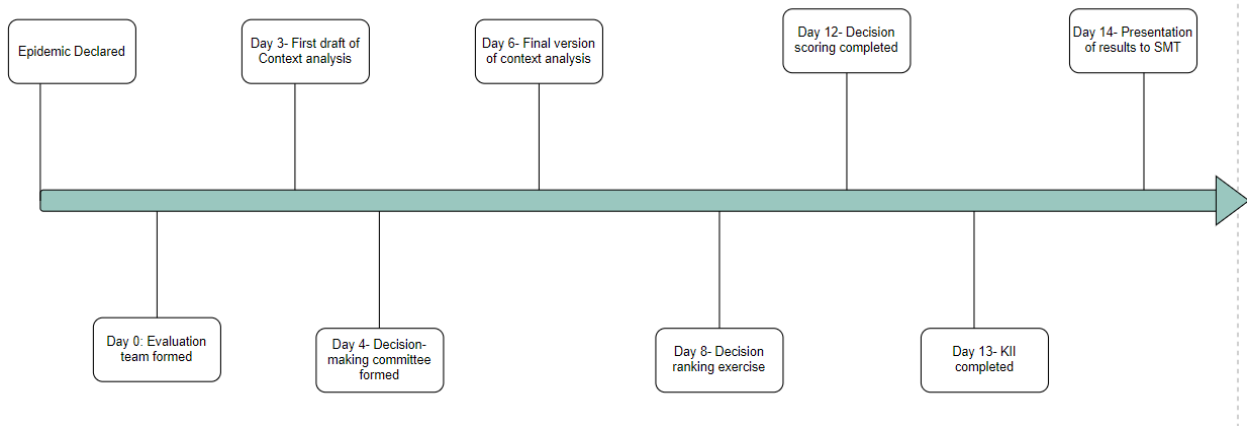
- This standard operating procedure is intended for the evaluation lead within the humanitarian organization. However, it can also be utilized by third party monitors as part of an overarching review of a humanitarian organizations epidemic response.

Evaluation team composition

Although evaluation should ideally be done by independent third party, staff members in the evaluated organization have a significant role to play in the planning, design, implementation and use of this evaluation.

Timeline

- The evaluation should ideally take place after the first X weeks since the onset of the epidemic. It may also take place immediately after the conclusion of the epidemic



Section 1- Context analysis

1.1 Purpose

- The purpose of the context analysis is to provide a common base from which to understand the epidemic setting and the actions that have been taken.

1.2 Roles and responsibilities

- The evaluation team lead will lead the exercise and convene the evaluation team to undertake the context analysis.
- The evaluation team will identify principle decision-makers to form decision-making committee

1.3 Procedures

- The evaluation team will undertake a secondary data review in order to produce the first draft of the context analysis
- The review should gather all relevant documentation including:
 - Previous Public Health Situation Analyses (PHSA)
 - Rapid risk assessments (RRA)
 - Response planning documentation
 - Organizational organograms
 - Sitreps
 - Health bulletins
 - Communication products
 - Meeting minutes
- The evaluation team will also identify key internal decision-makers involved in the particular epidemic response who have had significant input in the planning, implementation or evaluation of the epidemic response. These maybe situated within the country office or regional or HQ levels. These may include technical experts, organizational leaders and others
- These decision-makers will be invited to form a committee to contribute to the remaining sections of this evaluation
- The evaluation team lead will circulate the context analysis draft and solicit feedback in a timely manner from the decision-makers
- The evaluation team will consolidate context analysis feedback into a final version

1.4 Outputs

- Consolidated and agreed upon context analysis which summarizes epidemiological description of the epidemic, health resources and services available to the population, health system performance, organizational resources expended in the epidemic response to date, as well as challenges faced in the response

1.5 Associated Documents

See Annex for document checklist, participant list and section 1 of the tool

Section 2- Decision Selection

2.1 Purpose

The purpose of this section is to produce a unified list of key decisions to evaluate as prelude to evaluate decision-making in the epidemic response.

2.2 Roles and Responsibilities

- The evaluation team lead is responsible for sharing key documentation and producing an initial listing of key decisions
- The decision-making committee is responsible for reviewing, contributing and evaluating the criticality of decisions

2.3 Procedures

- The evaluation team lead will circulate the context analysis and introduce the characteristics for selecting key decisions to the evaluation team.
- In conjunction with the evaluation team, he/she will produce up to 5 key decisions for initial consideration by key decision-making committee identified through the context analysis
- The key decision-makers will review the proposed decisions
- Decision-makers may contribute further decisions for consideration
- Decision-makers will score each of the proposed decisions based on the scoring criteria
- Evaluation team will summarize (take the mean) the score for each decision and select the top 5 decisions using the following formula

2.4 Outputs

- Unified list of no more than 5 key decisions to be further assessed in section 3.

2.5 Associated Documents

See annex for section 2 of the tool

Section 3- Decision Scoring

3.1 Purpose

The purpose of this section is to ensure that selected critical decisions are evaluated consistently across the assessment criteria and to produce a summary score for the overall epidemic decision-making.

3.2 Roles and responsibilities

- The evaluation team lead is responsible for explaining the evaluation dimensions and criteria
- The evaluation team is responsible for assessing each decision on the criteria

3.3 Procedures

- For each of the selected decisions (maximum 5) the evaluation team will assess whether the necessary decision-making criteria has been met
- They will compile evidence through review of documentation and score the decision on a scale of 1 (no evidence/not met) to 5 (criteria fully met)
- Where there is little or no evidence of a criteria being met, the evaluation team may revert to decision-making committee to provide evidence
- The decision-making committee members are responsible for providing evidence for any specific criteria as requested by the evaluation team
- The evaluation team lead will review the final score for each decision as well compute an overall score for the exercise

3.4 Outputs

- An agreed upon set of scores for each of the critical decisions as well as an overall score

3.5 Associated Documents

Refer to annex for section3 of the tool

Section 4- Dissemination/ Review

4.1 Purpose

- The purpose of this section is to review and disseminate the findings of the evaluation in order to improve response processes

4.2 Roles and responsibilities

- The evaluation team lead is responsible for compiling the views of organizational members on the overall evaluation process
- The evaluation team lead is responsible for presenting the findings of the evaluation back to the organization
- The organizational leadership is responsible for working with relevant staff members in implementing improvements

4.3 Procedures

- The evaluation team lead should convene staff who have participated in the evaluation and implement focus group discussion (FGD) or key informant interviews(KII) to elicit feedback on the process
- The evaluation team should present the results of both the exercise and participant views to organizational leadership/ Senior Management Team (SMT)in a brief
- The SMT should implement recommendations derived from the exercise

4.4 Outputs

- Identification of decision rated as strong
- Recommendations of decision making dimensions that require strengthening
- Feedback on the utility and feasibility of evaluation
- Identification of areas of the evaluation process that require improvement

4.5 Associated Documents

- See annex for focus group guide and key informant interview guide

Reference

<https://jhumanitarianaction.springeropen.com/articles/10.1186/s41018-020-00068-2#Fn3>

https://www.who.int/hac/techguidance/tools/standard_operating_procedures_african_region_en_2014.pdf

https://healthcluster.who.int/docs/librariesprovider16/meeting-reports/updated-phsa-long-form-template-english-june-2019.docx?sfvrsn=81cd6a71_3

Annex

Document Checklist

No.	Document Type	Details (e.g.)
1	Organogram	<i>CO organogram March 2021</i>
2	Meeting Minutes	<i>Weekly minutes (may 2021-June 2021)</i>
3		
4		
5		

Evaluation Participants

Evaluation Team	Name (e.g.)	Role
1	<i>John Doe</i>	<i>Team lead</i>
2	<i>Pers Indi</i>	<i>M&E officer</i>
3		
Decision-making committee	Name	Role
1	<i>Fulan</i>	<i>Incident manager</i>
2	<i>Jama Yulo</i>	<i>Operations officer</i>
3	<i>Qofa Kale</i>	<i>Technical officer</i>

Decision-making Scorecard

WHO Somalia's COVID-19 response

Evaluation study

Nov 22nd- December 8th 2021

Abdihamid Warsame

Faculty of Epidemiology and Population health

London School of Hygiene and Tropical Medicine

Critical Decisions

Participants were advised to select important decisions for critical evaluation based on the following criteria on what constitutes a critical decision.

Characteristics

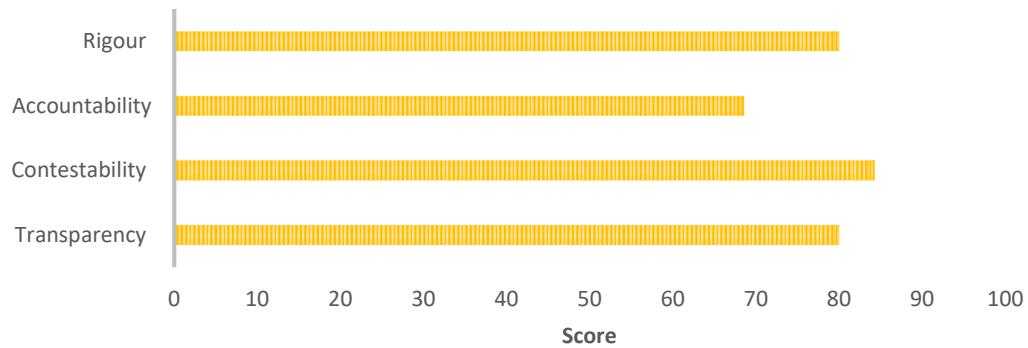
A critical decision is one which has one or more of the following characteristics:

- I. Consequentiality:- A critical decision is consequential and shapes the response to a significant degree
- II. Reversibility:- A critical decision can be difficult to overturn or reverse at least in the short term
- III. Strategic: A critical decision entails a significant shift in terms of action taken, resources committed or precedent set
- IV. Uncertainty: A critical decision entails a wide range of uncertainty or complex array of options
- V. Reputational Risk: A critical decision entails a high level of organisational reputational risk

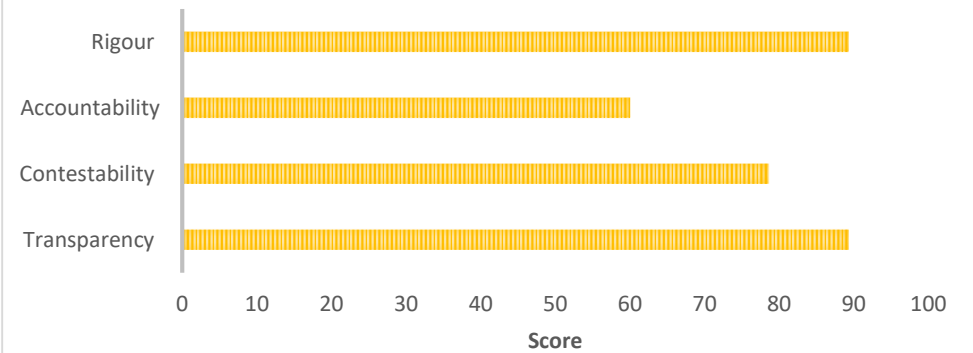
Decision	Criteria for Selection
i. Formation of Rapid Response Teams	<input checked="" type="checkbox"/> Characteristic 1 <input type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input checked="" type="checkbox"/> Characteristic 4 <input checked="" type="checkbox"/> Characteristic 5
ii. Establishment of 3 strategic PCR labs	<input checked="" type="checkbox"/> Characteristic 1 <input checked="" type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input checked="" type="checkbox"/> Characteristic 4 <input checked="" type="checkbox"/> Characteristic 5
iii. Launch of Incident Management System	<input checked="" type="checkbox"/> Characteristic 1 <input type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input checked="" type="checkbox"/> Characteristic 4 <input checked="" type="checkbox"/> Characteristic 5
iv. Focus on case management through scale up of Oxygen	<input checked="" type="checkbox"/> Characteristic 1 <input type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input checked="" type="checkbox"/> Characteristic 4 <input checked="" type="checkbox"/> Characteristic 5

Summary Decision Scorecard

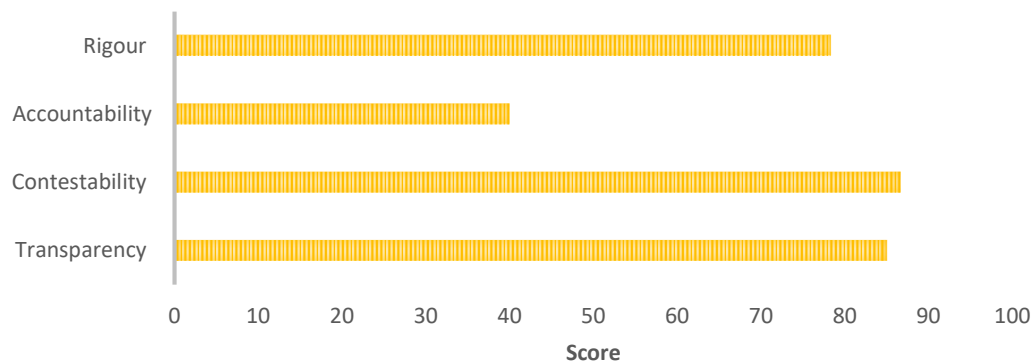
FORMATION OF RAPID RESPONSE TEAMS



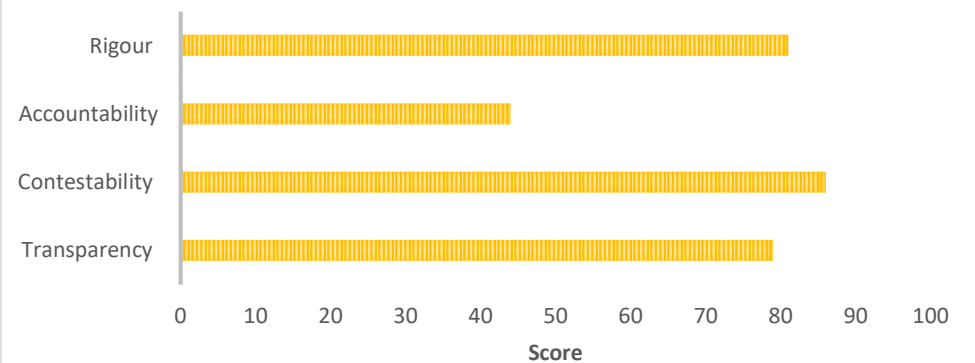
ESTABLISHMENT OF 3 STRATEGIC PCR LABORATORIES



LAUNCH OF INCIDENT MANAGEMENT SYSTEM



FOCUS ON CASE MANAGEMENT THROUGH SCALE UP OF OXYGEN



Detailed Scores & Interpretation

i. Formation of Rapid Response Teams

The Rapid Response Teams (RRT) and Community Health Workers (CHW) were recruited early in the COVID-19 response in order to strengthen and expand the surveillance capacity in high priority districts. A decision was undertaken to train and equip members of the RRTs and CHWs for case detection, notification, testing and contact tracing.

Inclusivity 86%	Decision criteria 74%	Process 77%	Public rationale 83%
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Participants scored the transparency of this decision as high citing existing documentation such as response plan, IMST meeting minutes and proposal documents. They stated that there was strong evidence of inclusive decision-making as the decision included WHO staff from all programs as well as program managers. They also stated that some of the decision-makers were assigned to liaise/coordinate with the stakeholders including MoH and other partners and discuss the decision with them and publicise the rationale. They also noted following clear method for arriving at this decision including utilizing risk assessments. Participants referenced the usage of COVID-19 transmission classification for Somalia drawn from the interim guidelines by WHO for considerations for implementing and adjusting public health and social measures in the context of COVID-19 as providing clear criteria for this decision.

Devolution 74%	Revision 94%	Community engagement 69%	Explicit outcome 77%
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Contestability was the highest scored dimension. Participants noted there were sufficient opportunities to revise the decision and cited the inter-action review of November 2020 as evidence. Additionally, the decision was discussed in various IMST meeting with document shared and commented, feedbacks incorporated into the final decision. The MoH was also said to be involved in the selection of RRTs and CHWs, implementation and modification of the structure and role and responsibilities. They also noted that revision of this decision resulted in expansion of the RRT mechanism to further district. Participants also noted that the IMST structure allowed for devolution in the decision-making in which decision-making was shared amongst senior decision-makers (country level IMST team members under the leadership of the WR) and junior decision makers (state level and district level staff)

In terms of accountability, this was scored lower as there was difference of scoring amongst participants as to the degree of engagement with the effected communities. Some participants stated that there was strong engagement with communities in implementing the RRT strategy but limited engagement in the decision to use this mechanism.

Feasibility 88%	Strengthen Health system 74%	Evidence based 77%
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Participants noted this decision was taken with a high degree of rigour. In particular, they noted that strengthening healthcare system was among the objectives. Furthermore, they noted that the outcomes of this decision were explicitly articulated and include bridging the gap between health facilities and communities. They also noted that feasibility criteria were considered to be high due to staffing the RRT via the existing network of CHWs. Lastly they noted that targets were set and tracked through an interactive dashboard.

ii. Establishment of 3 strategic PCR labs

At the outset of the pandemic in Somalia, there did not exist national capacity to test samples for COVID-19. Responders relied in the first weeks, upon sending samples for testing abroad which were found to be time consuming and expensive. The lack of national labs to undertake this critical function was found to be a gap which required urgent attention. As a result, the decision was taken to establish three strategic PCR capable laboratories in Mogadishu, Garowe and Hargeisa.

Inclusivity 91%	Decision criteria 89%	Process 89%	Public rationale 89%
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The transparency score is comprised of 4 criteria. In terms of inclusivity, participants scored this decision highly. In terms of transparency, the decision was taken in conjunction with the MoH and UN partners. The rationale behind this decision was said to have been shared in internal coordination meetings as well as external coordination meetings with partners. A number of documents were cited as evidence including WHO Somalia Technical Program Update Quarterly, IMST meeting minutes, CERF Project Action Plan and WCO FCDO report.

Devolution 65%	Revision 91%	Community engagement 60%	Explicit outcome 91%
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In terms of contestability, this decision was reviewed in the initial proposal development meeting with the MoH in which there was opportunity for revision. Additionally, participants stated that a review of the decision prompted further procurement of PCR machines and scaling up of PCR testing capacity to remaining states.

Participants expressed mixed scoring on the accountability dimension. Some stated that there was high accountability through interaction with state level MoH while others expressed that there was limited/no consultation with communities in these 3 cities regarding the establishment of PCR capacity in these labs. Some participants stated this criterion was inapplicable as the labs were pre-existing and upgrading did not require further engagement.

Feasibility 91%	Strengthen Health system 89%	Evidence based 89%
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Participants scored this decision highly in terms of scientific rigour. They stated that the usage of PCR is global standard to detect COVID-19. Additionally, they stated the decision was built on evidence extracted from a previous 2019 influenza testing lab assessment which provided rationale and process for the decision to set up these labs for COVID-19 testing. Participants also cited the National Action Plan for Health Security as providing evidence for this decision. The decision was also found to have satisfied the strengthened the health system criteria as the establishment of these 3 labs allowed for testing beyond COVID-19.

iii. Launch of Incident Management System

As part of efforts to enhance the effectiveness of the Health Emergencies response and in line with the Emergency response framework, WHO Somalia launched the Incident Management Support Team to coordinate and guide the response to the COVID-19 pandemic within Somalia.

Inclusivity 90%	Decision criteria 83%	Process 80%	Public rationale 87%
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Participants scored the inclusivity of this decision as high as they stated this decision was taken after a series of consultation with staff led by the WR. These deliberations were captured in meeting minutes and which detailed the process and rationale. The final decision was communicated by WR to all staff through an office memo. Participants also noted the engagement with the MoH in the formation of the IMST system as evidence of inclusivity.

Devolution 80%	Revision 93%	Community engagement 40%	Explicit outcome 77%
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In terms of revision, participants noted that there was some opportunity which resulted in the change of incident managers but not in the structure itself. With regards to accountability, participants noted limited to no engagement with effected communities. However other participants stated that parallel state and district-level IMST did engage with the local community. While these lower level IMST did not feed into the formation of the national IMST, they maintain a certain level autonomy.

Feasibility 83%	Strengthen Health system 80%	Evidence based 73%
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Participants cited a number of routine information products as evidence of decision outcomes and feasibility considerations. They cited COVID-19 Response plan and action trackers as evidence for the articulation of clear outcomes and evidence based targets. They also cited this response plan which articulated health system strengthening as an explicit goal and an important pillar in the IMST approach. Participants also cited the WHO Global guidance on strategic response to C19 as providing evidence to support this decision.

iv. Focus on case management through scale up of Oxygen

Due to the presentation of symptoms and the aetiology of the disease as well as gaps in case management capacity, WHO Somalia undertook concerted effort to scale up oxygen therapy across the country in order to improve outcomes.

Inclusivity 76%	Decision criteria 76%	Process 76%	Public rationale 88%
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The decision-making was scored as somewhat inclusive by participants. They cited the IMST meeting minutes in June 2020 as evidence as well as the COVID-19 response plan which detailed the discussion and decision criteria. They noted close deliberation with the case management focal persons within the MoH. Participants also noted that the rationale was communicated clearly through specific information products and web stories on WHO and other websites.

Devolution 84%	Revision 88%	Community engagement 44%	Explicit outcome 76%
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Participants noted close discussion with federal member states on the modality of scale up as evidence of devolved decision-making. Participants mentioned that there were several opportunities to revise this decision in which the need for oxygen provision was reaffirmed but the modality was revised. They noted that the initial decision was for WHO to support procurement of oxygen locally. This changed to procurement of cylinders and ventilators and eventually to supporting the establishment of oxygen plants. Participants mentioned limited evidence of community engagement in the decision itself but significant engagement through health messaging after the fact. They cited dashboards as containing evidence of clear outcomes and targets that underlay this decision.

Feasibility 80%	Strengthen Health system 84%	Evidence based 84%
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Participants noted that this decision supported strengthening of the health system by fortifying performance of isolation facilities and optimizing case management. They also cited later documents as providing evidence that underlay this decision such as the technical update on survival among hospitalized COVID-19 patients.

Recommendations

A number of recommendations were put forward by participants in order to strengthen the decision-making process within the organisation. They include the following:

- Improve documentation on decision-making deliberations as participants were aware of many discussions that were not reflected in official internal or external records.
- To further strengthen decision mechanisms by clearly outline who is involved, their responsibilities and the mechanisms by which they arrived at the decision.
- Strengthen engagement with affected communities in addition to government officials *during* the decision-making process rather than solely communicating finalised decisions. This will strengthen accountability.
- Consider sustainability as a potential criterion for good decision-making
- Repeat this decision-making exercise on a more routine basis by adopting it as a component of internal evaluation

Annex

Score Criteria

Dimension	Criteria	Description
Transparency	Inclusivity	The extent to which the process was inclusive, reflected in heterogeneity in rank and roles amongst decision makers involved.
	Use of explicit decision-making criteria	The extent to which the goals and objectives of the decision were clearly pre-specified. The absence of post-decision rationalization.
	Following clear process or method	The extent to which a priority setting process was in place, reflected in demonstrated use of priority setting frameworks, decision trees or other mechanism.
	Use of mechanism to publicise rationale	The extent to which clear documentation on the decision exists as well as the method used to communicate decisions.
Contestability	Opportunity for revision	The extent to which there existed scope to revise and overturn a decision including the debating of alternatives and description of how consensus was reached.
	Was the decision devolved?	The degree to which participants in closest proximity to the epidemic (e.g. subnational level) or local technical experts participate in the decision, including consideration of rank.
Accountability	Engagement with affected communities	The degree to which affected communities were involved in the response decision-making including at a minimum whether they were informed of the response activities and what effect this notification had on the communities.
Rigour	Explicit outcome	The extent to which intended outcomes of the decision were clearly articulated, including through setting of targets.
	Feasible outcome	The extent to which feasibility was considered in decision-making including debating of alternatives.
	Strengthens healthcare system	The extent to which the decision was in-line with wider strategy including the strengthening of the health system
	Evidence based	The extent to which the decision was based on strong public health rationale and robust scientific information.

Decision-making audit scorecard CARE Somalia's COVID-19 response

Evaluation study

November 8th -Nov 22nd 2021

Abdihamid Warsame

Faculty of Epidemiology and Population health

London School of Hygiene and Tropical Medicine

21 January 2022

Background

On the 30th of January 2020, the World Health Organization (WHO) declared the emergence of SARS-CoV-2 corona virus as a Public Health Emergency of International Concern (PHEIC) because of evident human-to-human transmission and renamed it COVID-19. On the 16th of March 2020, Somalia reported its 1st COVID-19 confirmed case, a Somali national with travel history to China. As of the 20th of January 2022, Somalia had 24,261 confirmed cases of COVID-19 with 1335 deaths. The Federal Ministry of Health launched the National COVID-19 Preparedness & Response Plan on the 26th March 2020 with a budget of USD 57 million and estimated caseload of 6,000 confirmed cases.

Somalia's capacity to prevent, detect, and respond to any global health security threat scored six out of 100 on the 2016 Health Emergency Preparedness Index. Poor urban communities, internally displaced persons (IDPs), the elderly, households of minority clans, riverine communities, women and child headed households, and children are most at risk due to social exclusion and decreased accessibility to health services, sanitation and water.

The COVID-19 pandemic weakened Somalia's already fragile health system that has been negatively impacted by protracted conflict, cyclic drought, and locust infestation. The Somali health system has not been able to cope adequately with the demands of a COVID-19 response with poor and few testing facilities, low capacity of health care workers and poor funding. Social cultural practices, rumours, misconceptions, poor hygiene practices and communal caring for the sick in homes and communities, have additionally amplified the spread of the virus.

Methods

The evaluation occurred in Garowe, Somalia from 8- 18th of November 2021. A total of 8 participants from various units within CARE Somalia took place in this evaluation.

The evaluation was undertaken following the standard operating procedures (SOP) developed by the LSHTM research team (See annex) and with the appointment of a CARE focal point. The CARE focal point gathered the necessary background documentation as well as supported the formation of the decision-making committee through recruitment of evaluation participants from the organization. The focal point completed the first draft of the contextual analysis as well as consolidated input from the other participants. He was also instrumental in facilitating the group work sessions.

Critical Decisions

Participants were advised to select important decisions for critical evaluation based on the following criteria on what constitutes a critical decision.

Characteristics

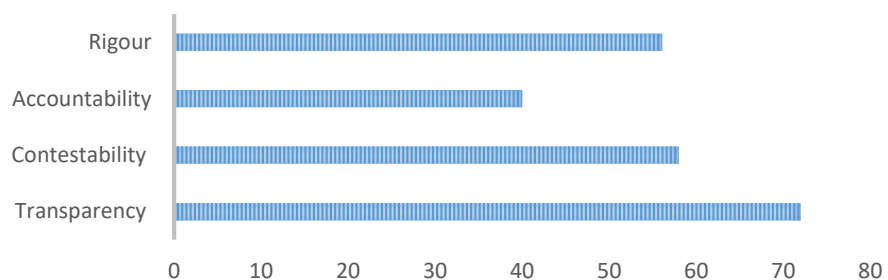
A critical decision is one has one or more of the following characteristics:

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- II. Reversibility:- A critical decision can be difficult to overturn or reverse at least in the short term
- III. Strategic: A critical decision entails a significant shift in terms of action taken, resources committed or precedent set
- IV. Uncertainty: A critical decision entails a wide range of uncertainty or complex array of options
- V. Reputational Risk: A critical decision entails a high level of organisational reputational risk

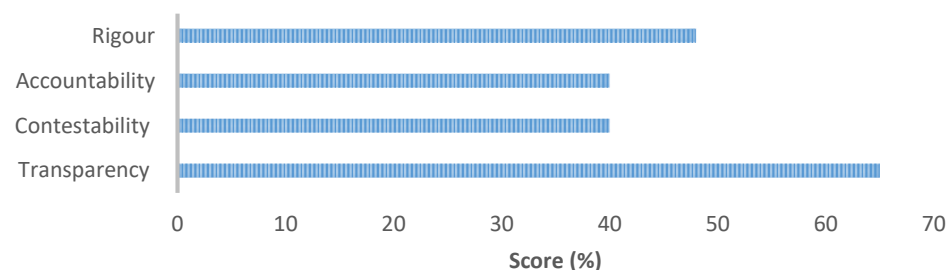
Decision	Criteria for Selection
i. Adaptation of nutrition programming to COVID-19	<input type="checkbox"/> Characteristic 1 <input checked="" type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input type="checkbox"/> Characteristic 4 <input type="checkbox"/> Characteristic 5
ii. Closure of CARE offices and restriction of staff movement	<input checked="" type="checkbox"/> Characteristic 1 <input type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input type="checkbox"/> Characteristic 4 <input checked="" type="checkbox"/> Characteristic 5
iii. Implementation of COVID-19 project in Sool and Sanaag	<input checked="" type="checkbox"/> Characteristic 1 <input checked="" type="checkbox"/> Characteristic 2 <input checked="" type="checkbox"/> Characteristic 3 <input checked="" type="checkbox"/> Characteristic 4 <input type="checkbox"/> Characteristic 5

Summary Decision Scorecard

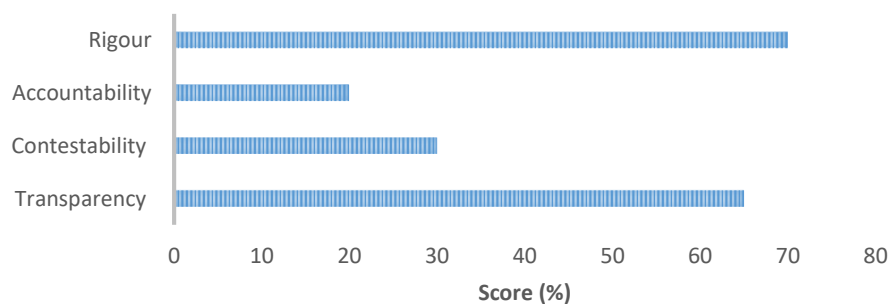
NUTRITION TREATMENT GUIDELINE MODIFICATION



CLOSURE OF OFFICE AND MOVEMENT RESTRICTION



FOCUS OF COVID-19 INTERVENTIONS IN SOOL AND SANAAG



Detailed Scores & Interpretation

1. Nutrition treatment guideline modification

Inclusivity 72%	Decision criteria 76%	Process 64%	Public rationale 76%
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In terms of transparency, the decision to modify nutrition programme guidelines to be COVID-19 compatible was found to be fairly transparent. However, participants described a deficit in accountability as these modifications were reportedly made at the cluster level without the input of all partners. Additionally, participants reported that the affected communities were not consulted and could not feed into this decision-making process.

Devolution 44%	Revision 72%	Community engagement 40%	Explicit outcome 56%
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Moreover, participants noted they did not have opportunity to contest these adaptations before they were adopted. They did however agree that there was a clear rationale to minimize transmission risk to the population. Nevertheless, participants did make clear the missed opportunity in engaging with the community to prepare them for these modifications.

Feasibility 55%	Strengthen Health system 60%	Evidence based 53%
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Participants expressed concern that these adaptations would reduce patient follow-up, risk missing eligible program beneficiaries and could lower the effectiveness of the program.

2. Closure of Office and movement restriction

Inclusivity 60%	Decision criteria 76%	Process 64%	Public rationale 60%
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The closure of CARE offices and restriction of staff movement was done early in the response. The decision was taken by the senior management and communicated via email to all staff. As a result, evaluation participants felt that this approach lessened the transparency as an opportunity was not provided to staff to feed into this decision. There was no clear documentation provided on the deliberations of this decision and the various options considered.

Participants did concede that it was possible that there were prioritization and decision-frameworks utilized but they were not disseminated to all staff.

Feasibility 60%	Strengthen Health system 40%	Evidence based 36%
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Participants noted that in terms of supporting evidence, WHO and other international guidelines were possibly followed. No specific document was cited. However, the driving factor was to preserve business continuity and an abundance of caution as there were limited evacuation options for staff who felt ill.

Devolution 36%	Revision 44%	Community engagement 40%	Explicit outcome 60%
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Participants mentioned that the decision to close offices was not devolved to sub-offices but was made at the country level. Additionally, there was limited community engagement with participants noting that as this could possibly affect program delivery, there should have been some level of community engagement.

3. Focus of COVID-19 Interventions in Sool and Sanaag

Inclusivity 40%	Decision criteria 80%	Process 80%	Public rationale 60%
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CARE has largely been conducting its humanitarian and development programming in rural areas prior to the pandemic. When the pandemic occurred, fundraising and response resources were focused to areas which CARE had a strong field presence. These were in Sool and Sanaag regions in largely rural areas. However, the majority of COVID-19 cases were in urban centres and in higher density areas of the country. Thus there was a mismatch between where resources were directed and where they were most required. Participants explained that as a result of this prioritization of existing programme areas, there was inadequate strategic focus and limited contestability in the decision.

Devolution 40%	Revision 20%	Community engagement 20%	Explicit outcome 60%
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Participants reported limited community engagement. However, there was ample opportunities to revise this decision according to some participants. There was also sufficient devolution with the design of the COVID-19 intervention done by both senior management as well as some technical staff based in the sub-offices.

Feasibility 80%	Strengthen Health system 80%	Evidence based 60%
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Participants did not feel that this decision strengthened the health system as much as it could have if resources were more precisely directed where needed. They did cite usage of early available WHO guidelines as having a role in how the decision was undertaken. Participants rated the feasibility criteria as high based on the consideration by decision-makers to implement the COVID-19 interventions in existing program areas.

Conclusion

Overall very few primary or secondary documents were specifically cited by participants as evidence for the decision-making criteria. Participants were aware to varying degrees that some documents such as minutes and guidelines did influence decisions but were largely unable to cite them for this evaluation. They instead relied primarily on their recollection of events and discussions with fellow participants to piece together the events that transpired.

Recommendations

Decision-making

In order to improve the quality of decision-making in CARE's COVID-19 response and more broadly in its humanitarian responses, the following recommendations have been put forward:

- 1) Improve the inclusivity of key critical decision-making through expanding the membership of decision-makers to include junior staff and field staff.
- 2) Improve trust and buy-in of decisions through strengthening reporting of decision rationale and criteria.
- 3) Strengthen documentation of response activities to allow for more in-depth real-time or post response evaluation.
- 4) Consider more critically the relevance of scientific evidence and public health measures to the context rather than blanket adoption.
- 5) Allow for more contextually specific factors to shape decisions rather than blanket decisions

Evaluation Process

- 1) Allow for more time pre-evaluation in order for evaluation team to orient themselves with the methodology.
- 2) Translate evaluation tools and documentations into local language to allow for better understanding and involvement of evaluation participants
- 3) Allow for remote or asynchronous completion of evaluation tools by participants
- 4) Broaden the evaluation participants to include non-emergency staff and representatives of the community and local government
- 5) Consider practise scenario to allow for better uptake by evaluation team prior to commencing evaluation

Annex

Evaluation Schedule

Step	Action	Responsible	Date
1	Recruitment of evaluation team and signing of consent forms	All participants	November 8th
2	First Part A- Draft of Context Analysis	CARE Evaluation Focal Person	November 11
3	Review of Part A- Context Analysis	All Participants	November 13th
4	Set up Meeting	LSHTM & CARE focal person	November 14 th
6	Completion of Part B- Decision Selection	All participants	November 16
7	Decision Ranking Exercise	All Participants as group	November 16
8	Completion of Part C- Scoring of Decisions	All Participants separately	November 17
8	Completion of Part D- Overall Scoring	LSHTM	November 25th
9	Key Informant Interview	All Participants	November 18- 21st

Score Criteria

Dimension	Criteria	Description
Transparency	Inclusivity	The extent to which the process was inclusive, reflected in heterogeneity in rank and roles amongst decision makers involved.
	Use of explicit decision-making criteria	The extent to which the goals and objectives of the decision were clearly pre-specified. The absence of post-decision rationalization.
	Following clear process or method	The extent to which a priority setting process was in place, reflected in demonstrated use of priority setting frameworks, decision trees or other mechanism.
	Use of mechanism to publicise rationale	The extent to which clear documentation on the decision exists as well as the method used to communicate decisions.
Contestability	Opportunity for revision	The extent to which there existed scope to revise and overturn a decision including the debating of alternatives and description of how consensus was reached.
	Was the decision devolved?	The degree to which participants in closest proximity to the epidemic (e.g. subnational level) or local technical experts participate in the decision, including consideration of rank.
Accountability	Engagement with affected communities	The degree to which affected communities were involved in the response decision-making including at a minimum whether they were informed of the response activities and what effect this notification had on the communities.
Rigour	Explicit outcome	The extent to which intended outcomes of the decision were clearly articulated, including through setting of targets.
	Feasible outcome	The extent to which feasibility was considered in decision-making including debating of alternatives.
	Strengthens healthcare system	The extent to which the decision was in-line with wider strategy including the strengthening of the health system
	Evidence based	The extent to which the decision was based on strong public health rationale and robust scientific information.



Somali Federal Republic
Ministry of Health & Human Services

ETHICAL APPROVAL

This is to certify that the proposal submitted by:

Principal Investigator

Name of PI/Researcher responsible for project: Abdihamid Warsame

Reference No:

MOH&HS/DGO/0994/Aug/2020

Full project Title:

**Exploring decision-making in the COVID-19 response: the case study
of Somalia**

**To be undertaken in
Somalia**

Starting: Date June 01, 2020

Finishing Date: October 31, 2020

For the proposed period of research

**Has been approved by the Research & ethics committee at the Ministry of Health
On the 30 Aug 2020**

Director of Policy & Planning

[Redacted Signature]

Secretary

[Redacted Signature]

Chairman



Ministry of health, Somalia

Tell:

Email: dg@moh.gov.so / P.O BOX 22



FEDERAL REPUBLIC OF SOMALIA

National Institute of Health

ETHICAL APPROVAL

This is to certify that the proposal submitted by:

Name of PI responsible for project: Abdihamid Warsame

Ref No: NIHS0102208

Full project title:

Evaluating epidemic decision-making in Somalia through use of a novel tool and assessment approach

For the proposed period of research

Start date: September 01, 2021

End date: March 31st, 2022

Has been approved by the research and ethics committee of the National Institute of Health

On August 21st, 2021

Abdifatah Diriye Ahmed
Executive Director, National Institute of Health
Chair of ethics committee



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LSHTM Ethics Approval Paper 3

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Observational / Interventions Research Ethics Committee

Mr Abdihamid Warsame
LSHTM

2 November 2021

Dear Abdihamid,

Study Title: Evaluation of a decision-support tool for epidemic responders in humanitarian settings

LSHTM Ethics Ref: 26369

Thank you for responding to the *Observational Committee's* request for further information on the above research and submitting revised documentation.

The further information has been considered *on behalf of the Committee by the Chair*.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

Approval is dependent on local ethical approval having been received, where relevant.

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document Type	File Name	Date	Version
Investigator CV	Abdihamid Warsame CV_2021	14/07/2021	1
Local Approval	Somalia Ethical approval-signed	23/08/2021	1
Investigator CV	CV_Francesco_Checchi_LSHTM_template_21Jun2019	01/09/2021	1
Other	Research_Ethics_online_training_certificate	01/09/2021	1
Protocol / Proposal	Pilot Consent Form	01/09/2021	1
Information Sheet	Pilot Consent Form	01/09/2021	1
Protocol / Proposal	Evaluation tool_v1.0	02/09/2021	1
Protocol / Proposal	SOP for evaluating epidemic decision-making	06/09/2021	1
Information Sheet	KII Consent Form	07/10/2021	1
Protocol / Proposal	Protocol- Evaluating decision support tool v2	07/10/2021	2
Protocol / Proposal	KII Interview Guide for evaluation of instrument v2.0	07/10/2021	2
Protocol / Proposal	Pilot participation information sheet v2	07/10/2021	2
Protocol / Proposal	Cover Letter LSHTM Ethics submission REF 26369	07/10/2021	1
Information Sheet	Pilot participation information sheet v2	07/10/2021	2
Information Sheet	KII Information sheet v2	07/10/2021	2
Protocol / Proposal	KII Consent Form v2	20/10/2021	2
Covering Letter	Cover Letter LSHTM Ethics submission REF 26369_3	22/10/2021	3
Protocol / Proposal	KII Information sheet v4	22/10/2021	4

After ethical review

The Chief Investigator (CI) or delegate is responsible for informing the ethics committee of any subsequent changes to the application. These must be submitted to the Committee for review using an Amendment form. Amendments must not be initiated before receipt of written favourable opinion from the committee.

The CI or delegate is also required to notify the ethics committee of any protocol violations and/or Suspected Unexpected Serious Adverse Reactions (SUSARs) which occur during the project.

by submitting a Serious Adverse Event form.

An annual report should be submitted to the committee using an Annual Report form on the anniversary of the approval of the study during the lifetime of the study.

At the end of the study, the CI or delegate must notify the committee using an End of Study form.

All aforementioned forms are available on the ethics online applications website and can only be submitted to the committee via the website at: <http://leo.lshtm.ac.uk>

Additional information is available at: www.lshtm.ac.uk/ethics

Yours sincerely,



Professor Jimmy Whitworth
Chair

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<http://www.lshtm.ac.uk/ethics/>

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