Scoping review of interventions to maintain essential services for maternal, newborn, child and adolescent health and older people during disruptive events

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ACRONYMS AND ABBREVIATIONS

COVID-19	coronavirus disease
EVD	Ebola virus disease
HICs	high-income countries
ICU	intensive care unit
ICT	information and communications technology
LMICs	low- and middle-income countries
MNCAAH	maternal, newborn, child and adolescent health and ageing
NCDs	noncommunicable diseases
NGO	nongovernmental organization
PPE	personal protective equipment
SARS	severe acute respiratory syndrome
SRH	sexual and reproductive health
WHO	World Health Organization
ZVD	Zika virus disease

EXECUTIVE SUMMARY

For maternal, newborn, child, adolescent and older people's health (MNCAAH), the most important effects of the COVID-19 pandemic will be indirect. Recent modelling of the indirect effects in low- and middle-income countries has shown that, under certain service reduction scenarios, reduced coverage of essential maternal and child health interventions can lead to additional maternal and child deaths. To support governments and other actors in making difficult decisions to balance the demands of responding directly to the COVID-19 pandemic, while simultaneously maintaining essential services for MNCAAH, the World Health Organization (WHO) Department of Maternal, Newborn, Child and Adolescent Health and Ageing commissioned this scoping review of the literature to learn from actions taken in response to past disruptive events.

The objective was to review published and grey literature to identify interventions to maintain the provision and use of MNCAAH essential services during disruptive events and to summarize lessons learned from implementing these interventions. The scope of the review included outbreaks of Ebola virus disease (EVD), severe acute respiratory syndrome (SARS), Zika virus disease (ZVD), the ongoing COVID-19 pandemic, and natural disasters and humanitarian emergencies that disrupted health, transport and other services.

Between July and December 2020, we searched databases of peer-reviewed journal articles and repositories of grey literature. We included primary research, reports and any document describing an intervention conducted. We identified 29 810 references, of which 115 papers describing 120 interventions were included in the review (11 for EVD, 40 for natural disasters, 13 for humanitarian emergencies, three for SARS and 53 for COVID-19). Evaluations were identified for 65 of these interventions. Assessment of the quality of primary studies was not conducted. We summarized the problems commonly leading to disruption of essential health service provision and use. We linked the interventions described in papers to these problems, according to the time elapsed since the disruptive event (immediate, medium- or long-term). Lessons learned from implementing the interventions and evaluations were synthesized narratively according to their relevance to the COVID-19 pandemic.

The four main problems identified were: decreased provision of health services, decreased use of health services, increased and emerging needs for health care, and the need to adapt health service delivery to challenges, for example to minimize face-to-face contact. While not all problem types occurred to the same extent in all disruptive events, it appears that all four problems affected MNCAAH services during COVID-19. The disruptions and increased needs appeared to be largely due to the public health and social measures imposed to curb the spread of the virus. The inability to provide face-to-face care (to protect providers and care users from infection) was far more extreme and longer-lasting than during other disruptive events. However, given the dates of the searches conducted for this review, all the problems described for COVID-19 were immediate problems: persisting or slowly developing problems had not yet been captured in the literature. In events before COVID-19, the relatively few interventions addressing medium- to longer-term problems related to decreased provision of MNCAAH services and emerging needs for care, as well as to increased socioeconomic vulnerability, might be helpful for limiting disruption caused by COVID-19 and for "building back better".

The table below summarizes the distribution of interventions according to the populations targeted, the health service(s) involved and whether an evaluation was reported. Some interventions targeted more than one population group and related to more than one health service area. Of the interventions identified within the disruptive events reviewed, children were the most common target population with 41 interventions in total. Around half of these came from the literature on COVID-19. Older people's health was the least mentioned population group with a total of 16 interventions, 14 of which were from COVID-19. Interventions related to the disruptions in health services for

the general population were mostly present in studies of natural disasters. In terms of health services addressed by the interventions, areas most commonly described were mental health, maternal and newborn health and child health.

A variety of interventions were described across the disruptive events ranging from adaptations to service provision in one clinic or hospital to national-level changes of policy on provision of services.

Seven intervention categories were identified:

1. maintaining access to health services or finding alternatives to bring care closer to populations;
2. maintaining, strengthening and/or adapting the health workforce;
3. ensuring collaboration between different health services, institutions and health workers;

Overview of scoping review findings: number of papers, interventions, evaluations, population groups and health service area, by disruptive event

	Ebola	Natural disasters	Humanitarian emergencies	SARS	COVID-19	Total
Papers	11	39	9	3	53	**115**
Interventions	11	40	13	3	53	**120**
Evaluations	7	22	8	1	27	**65**
Population*						
Women	3	7	8	2	12	**32**
Newborns	3	6	2	3	10	**24**
Children	4	13	3	0	21	**41**
Adolescents	2	4	4	0	13	**23**
Older people	0	2	0	0	14	**16**
General population	4	16	2	0	3	**25**
Health service*						
Mental health	2	11	1	0	18	**32**
Maternal and newborn health	3	5	1	3	11	**23**
Child and adolescent health	1	5	1	0	21	**28**
General health service	1	5	2	0	5	**13**
Management of noncommunicable diseases	0	0	0	0	13	**13**
Reproductive health topics	0	3	5	0	3	**11**
Health services with <10 interventions in total across events: prevention and screening activities, nutrition, long-term care facilities and care homes, health worker training/ preparedness, self-care, vaccination, abortion and post-abortion care, school-based services, family planning and other	5	12	3	0	10	**30**

**The total number exceeds the number of interventions included because some interventions related to more than one category of population or health service.*

4. adapting interventions to the local context;
5. involving stakeholders and local communities;
6. using digital health; and
7. maintaining access to essential supplies and commodities (medicines, vaccines, nutrition etc.)

Interventions during COVID-19 were different to other events in that they were informal, organic adaptations to provision of services with very few externally implemented interventions. However, the interventions described were mainly from high-resource settings: they report little about coordination of adaptations, about which few lessons were learned. This may be partly due to the need for rapid adaptations. On the whole, COVID-19 was the only disruptive event where studies report predominantly on digital health interventions. Given that 47 of the 53 included papers presented interventions relying fully or partly on the use of digital health, this scoping review provides a synthesis of relevant considerations.

The lack of papers about interventions implemented by health authorities (district, regional, national) during the first months of the COVID-19 pandemic is an important gap, and contrasts with the literature on other disruptive events, where this element of response is clearly critical for removing barriers to accessing MNCAAH services. Further, interventions related to COVID-19 from low-resource settings were scarce so it was not possible to compare problems and interventions from a broad range of settings. It is likely that many other context-appropriate, innovative and promising interventions were implemented in low-resource settings that were not captured in this review.

Several key lessons can be learned about interventions to address disruptions to provision and use of MNCAAH services with relevance to COVID-19. Governance, coordination and open channels of communication between health-care providers and regional/national health authorities are critical during disruptive events, when the situation evolves rapidly, and care provision guidelines need to be adapted and disseminated speedily. Such coordination infrastructure should also include referral and coordination across providers within local areas, in order to coordinate closures and reopenings of services and health facilities, inter-facility transfers, and provision of information to service users.

Additionally, communication between health authorities and health-care providers must be two-way, so that providers are able to give rapid signals to health authorities about what factors are affecting health service provision and utilization, and what is needed to ensure continuous provision of services (e.g. ability of health personnel to get to work), accessibility for populations, and changing health needs.

We also identified several gaps in the documentation of interventions to address MNCAAH disruptions which could contribute to improved learning and future preparedness. Areas for which there were very few papers include interventions to communicate with populations about ongoing changes to health services (such as facility closures or new guidelines) and interventions by regional and national health authorities and governments, particularly in low-resource settings. Correcting the latter gap should be a priority: such interventions should be urgently strengthened and supported.

We note that the included primary studies use different methods, reveal many different types of learning and do not all contain formal evaluations. Notably, most included papers do not provide sufficient detail about the interventions. It would be useful if international organizations developed and applied standard criteria for reporting interventions and evaluations in the literature. Improved reporting could be used to compile a publicly accessible database of interventions. We also recognize that conducting high-quality research about interventions implemented during disruptive events is challenging, and we highlight here the suggestion of putting in place pre-prepared protocols and rapid reviews.

1

INTRODUCTION

For the great majority of pregnant women, mothers, newborns, children, adolescents and older people, the most important effects of the coronavirus disease (COVID-19) pandemic will be indirect. Modelling of the indirect effects of the pandemic in low-resources settings has shown that under certain service reduction scenarios, reduced coverage of essential maternal and child health interventions can lead to additional maternal and child deaths (*1–3*). Governments need to make difficult decisions about how to respond directly to the COVID-19 pandemic while maintaining essential services in the areas of maternal, newborn, child and adolescent health and ageing (MNCAAH).

To support countries in adapting their response to different COVID-19 scenarios, the World Health Organization (WHO) Department of Maternal, Newborn, Child and Adolescent Health and Ageing commissioned this scoping review of published and grey literature. The objective was to identify interventions implemented to maintain the provision and use of essential services for MNCAAH during disruptive events and to summarize lessons learned during these interventions. The review included outbreaks of Ebola virus disease (EVD), severe acute respiratory syndrome (SARS), Zika virus disease (ZVD), the ongoing COVID-19 pandemic, and natural disasters and humanitarian emergencies that caused disruption to services, transport and other activities.

2

METHODS

2.1 Target populations

This scoping review used the following definitions to describe the health of the target populations.

- **Maternal health:** the health of women during pregnancy, childbirth and the postnatal period (beginning immediately after the birth of the baby and extending to six weeks (42 days after birth). Broader sexual and reproductive health (SRH) services were also considered, including family planning and abortion care.
- **Newborn health:** the health of babies from birth and throughout the postnatal period.
- **Child health:** the health of children aged from one month to 10 years.
- **Adolescent health:** the health of young people aged from 10 to 19 years.
- **Older people's health:** the health of people older than the median life expectancy at birth, or aged 60 years and over (4).

2.2 Phases of the review

The scoping review was conducted in two phases. Phase 1 (July–October 2020) involved searches concerning disruptive events other than SARS and COVID-19 and resulted in the development of an initial typology of interventions based on data extracted from abstracts of relevant papers. In Phase 2 (November 2020–February 2021), searches for SARS and COVID-19 were added, and full-text data extraction from papers relevant to any disruptive event was conducted, based on the initial typology developed in Phase 1. As the objective of the scoping review was to understand the available literature, the inclusion criteria (see 2.4) allowed for a broad range of documents (collectively referred to hereafter as "papers"). Given this broad range, the quality of the included papers was not assessed. The scoping review protocol was made publicly available (5).

As described in the protocol (5), both phases of the review were guided by the standard principles of scoping reviews elaborated in Arksey & O'Malley's framework. This approach can be described as an iterative process involving post-hoc inclusion and exclusion criteria in five stages: 1) identifying the research question, 2) identifying relevant studies, 3) study selection, 4) charting the data, and lastly 5) collating, summarizing and reporting the results.

2.3 Search strategy

DATA SOURCES

In Phases 1 and 2, the following databases were searched: Medline, Embase, Global Health, Web of Science, LILACS (Latin American and Caribbean Health Sciences Literature), JSTOR and Open Edition (French language literature).

Searches of repositories of grey literature (reports, policy briefs, handbooks, guidelines etc.) included:

- international development cooperation agency websites: United States Agency for International Development; Foreign, Commonwealth & Development Office (formerly Department for International Development, Government of the United Kingdom of Great Britain and Northern Ireland; Canadian International Development Agency; and German Corporation for International Cooperation (GmbH);
- websites of international nongovernmental organizations (NGOs): Médecins Sans Frontières, Médecins du Monde, Cordaid International, Management Sciences for Health, Marie Stopes International, FHI 360, and others;
- Gavi, the Vaccine Alliance and the Global Fund to Fight AIDS, Tuberculosis and Malaria; and
- the Grey Literature Database (www.greylit.org).

Key terms were searched for using a general Internet search engine (Google). We also consulted colleagues and networks (such as WHO regional and country offices), reviewed presentation slides circulated among research networks, listened to live and recorded webinars, and published a call for relevant papers on Twitter. Finally, we reviewed references in included papers to identify additional relevant papers.

Phase 1 searches were conducted in July 2020; searches for SARS were conducted in November 2020 and for COVID-19 in December 2020.

SEARCH TERMS

An extensive list of search terms was compiled in Phase 1 in order to capture key populations, health services and disruptive events. After a first search on Medline, the search terms that revealed the most relevant papers were retained. The list of search terms used for Phase 1 (available in the Annex 3, Section 1) was adapted and used in the searches for SARS and COVID-19. Searches for references to SARS were restricted to those dated 2000–2018 and for references to COVID-19 from 2019 to the date of search. For COVID-19, we restricted the search terms to focus on specific problems related to COVID-19, and to reduce the total number of hits. Further details are available in the Annex 3, Section 2.

In both phases, where database functionality allowed, searches were filtered to find only references categorized as relevant to humans.

MANAGEMENT OF REFERENCES

All identified references were imported into a reference manager where duplicates were removed. Titles and abstracts were screened by two authors. A randomly selected 10–20% of excluded references were double-screened for quality assurance.

2.4 Inclusion and exclusion criteria

The following papers were included in the title/abstract and full-text screening:

- papers concerning health interventions targeting women, newborns, children, adolescents, older people or the general population;
- papers reporting on interventions to maintain an essential service during disruptive events;
- papers published since 2000;
- papers of any type, including research papers (any study design), reviews, editorials, commentary or opinion pieces, reports (whether peer-reviewed or not), webinars and newspaper articles; and
- papers concerning any country and in any language.

The following papers were excluded from the title/abstract and full-text screening:

- papers not discussing an intervention intended to maintain an essential service during a disruptive event, or focused exclusively on assessing the clinical outcomes or direct effects of a disruptive event on health outcomes;
- papers not addressing at least one of the target populations (women, newborns, children, adolescents, older people); and
- papers published before 2000.

2.5 Data extraction

To construct a framework for categorizing problems and interventions, a standard template (available in the Annex 3, Section 3) was developed and tested to extract key information from titles and abstracts of relevant references identified in Phase 1 searches. For several fields, we used standardized response codes in order to aid analysis. For papers without an abstract, information was extracted from the full text. Extraction was conducted in Excel and a randomly selected 10% of extracted records were double-checked by a second person. Any discrepancies were resolved through discussion.

In Phase 2, for all included papers, information was extracted from full text in Excel using an expanded template (available in the Annex 3, Section 4).

2.6 Steps in synthesizing findings

In Phase 1, descriptive information about interventions extracted from titles and abstracts was summarized. An initial framework of interventions was constructed and presented to expert groups. A revised framework aligned with existing WHO frameworks, including "Maintaining essential health services: operational guidance"(6) and health system building blocks (7), was developed based on their feedback.

In Phase 2, a synthesis of information extracted from full text was conducted using this framework. First, each disruptive event was summarized, including a description of the disruptive event and event-related problems, description of each intervention identified for the event, and information related to the methods used and lessons learned from any evaluation of interventions, where available. We defined an evaluation broadly as any assessment of the results of an intervention.

Second, a synthesis across all events was conducted, putting in contrast the differences and similarities between problems and interventions. In this process, we entered all the problems and related interventions into a table format according to the time elapsed since the disruptive event.

3

OVERVIEW OF SEARCH RESULTS

From the literature searches in Phase 1 we identified 23 361 potential references. After removal of duplicates, the titles and abstracts of 16 004 unique references were screened, and 590 of these were included in coding to identify key themes. A flowchart of Phase 1 is available in the Annex 3, Section 5.

Tables 1–3 below provide a summary of the 590 titles and abstracts reviewed in Phase 1 in regard to disruptive event and countries, target populations and health services.

Table 1. Titles and abstracts reviewed in Phase 1, by disruptive event and country

By event type	Number	Countries covered by papers
Humanitarian emergencies	123	Bangladesh, Colombia, Democratic Republic of the Congo, Lebanon, South Sudan, Syrian Arab Republic, USA, multiple contexts
Ebola	123	Burkina Faso, Côte d'Ivoire, France, Liberia, Gabon, Guinea, Nigeria, Sierra Leone, Uganda, USA, multiple contexts (West Africa)
Other natural disasters	103	Bangladesh, Philippines, Puerto Rico, USA
Earthquakes	92	Chile, China, Haiti, Iran (Islamic Republic of), Italy, Japan, Nepal, New Zealand, Pakistan, Peru, Spain
Respiratory infection outbreaks	46	Australia, China (Hong Kong Special Administrative Region and Taiwan), Saudi Arabia, Singapore, United Kingdom, USA
COVID-19	42	China, Singapore, USA, multiple contexts
Zika	26	Brazil, Puerto Rico, USA, multiple contexts (including Pacific Islands)
Tsunami	17	India, Indonesia, Japan, Sri Lanka, Thailand
Other infectious disease outbreaks	11	Canada, USA, multiple contexts
Resource-limited situations	5	Mexico, multiple contexts
Other	2	
TOTAL	590	

Table 2. Titles and abstracts reviewed in Phase 1, by target population

One population	
Women	63
Newborns	10
Children	88
Adolescents	15
Older people	34
General population	246
Of which: health workers	36
Subtotal	*456*

Two populations	
Women and newborns	54
Women and children	3
Women and adolescents	17
Newborns and children	4
Children and adolescents	16
Other combinations of two populations	8
Subtotal	*102*

Three populations	
Women, newborns and children	14
Women, children and adolescents	3
Women, newborns and health workers	6
Other combinations of three populations	9
Subtotal	*32*

TOTAL	590

Table 3. Titles and abstracts reviewed in Phase 1, by health service type*

General health service	196
Mental health	103
Maternal and newborn health	96
Child and adolescent health	50
Prevention and screening activities	41
Reproductive health topics	34
Family planning	29
Self-care	27
Nutrition	21
School-based services	19
Vaccination	17
Management of noncommunicable diseases	15
Abortion and post-abortion care	11
Long-term care facilities and care homes	7
Cancer treatment	4
Care for disabled patients	3
Other	14

**Each title and abstract could be coded with up to two service types, and thus the total is >590.*

From our review of 590 titles and abstracts, we identified 144 references describing an intervention (Annex 1), and categorized these into the following seven intervention types:

- maintaining access to health services or finding alternatives to bring care closer to populations;
- maintaining, strengthening and/or adapting the health workforce;
- ensuring collaboration between different health services, institutions and health workers;
- adapting interventions to the local context;
- involving stakeholders and local communities;
- using digital health;[1] and
- maintaining access to essential supplies and commodities (medicines, vaccines, nutrition etc.)

1. *In this report, we use the term "digital health" in line with the WHO definition "the use of information and communications technology in support of health and health-related fields" (https://www.who.int/reproductivehealth/publications/digital-interventions-health-system-strengthening/en/). The original papers may refer to such interventions as "telehealth", "telemedicine", "mHealth" etc. Our use of the term digital health aims to encompass all such interventions.*

These 144 papers were reviewed in full text; 59 describing 64 interventions were included in this review (40 interventions related to natural disasters including earthquakes, tsunami and other natural disasters, 13 to humanitarian emergencies, and 11 to EVD) (see flowchart in the Annex 3, Section 5). None of the 26 papers related to ZVD met the inclusion criteria.

From the Phase 2 searches related to SARS, we identified 1017 references in databases; after deleting duplicate references, we screened 663 titles and abstracts, of which 86 were coded to identify key themes. Eleven papers were reviewed in full text; three describing an MNCAAH intervention were included in this review (see flowchart available in the Annex 3, Section 6). In searches related to COVID-19, we identified 5344 references in databases.

After deleting duplicates and adding 42 references identified in the searches from Phase 1, 470 titles and abstracts were coded to identify key themes. Of these, 118 were reviewed in full text; 53 describing an intervention were included in this review (see flowchart available in the Annex 3, Section 7).

In total, we identified 115 papers describing 120 interventions; 65 papers included an evaluation of the intervention. A schematic flowchart of the steps taken and references and papers included from Phases 1 and 2 is shown in **Fig. 1**. A narrative summary of the number of references screened and included for each disruptive event is provided in Chapter 4.

Fig. 1 Flowchart integrating inclusion of papers from Phases 1 and 2, and synthesis steps

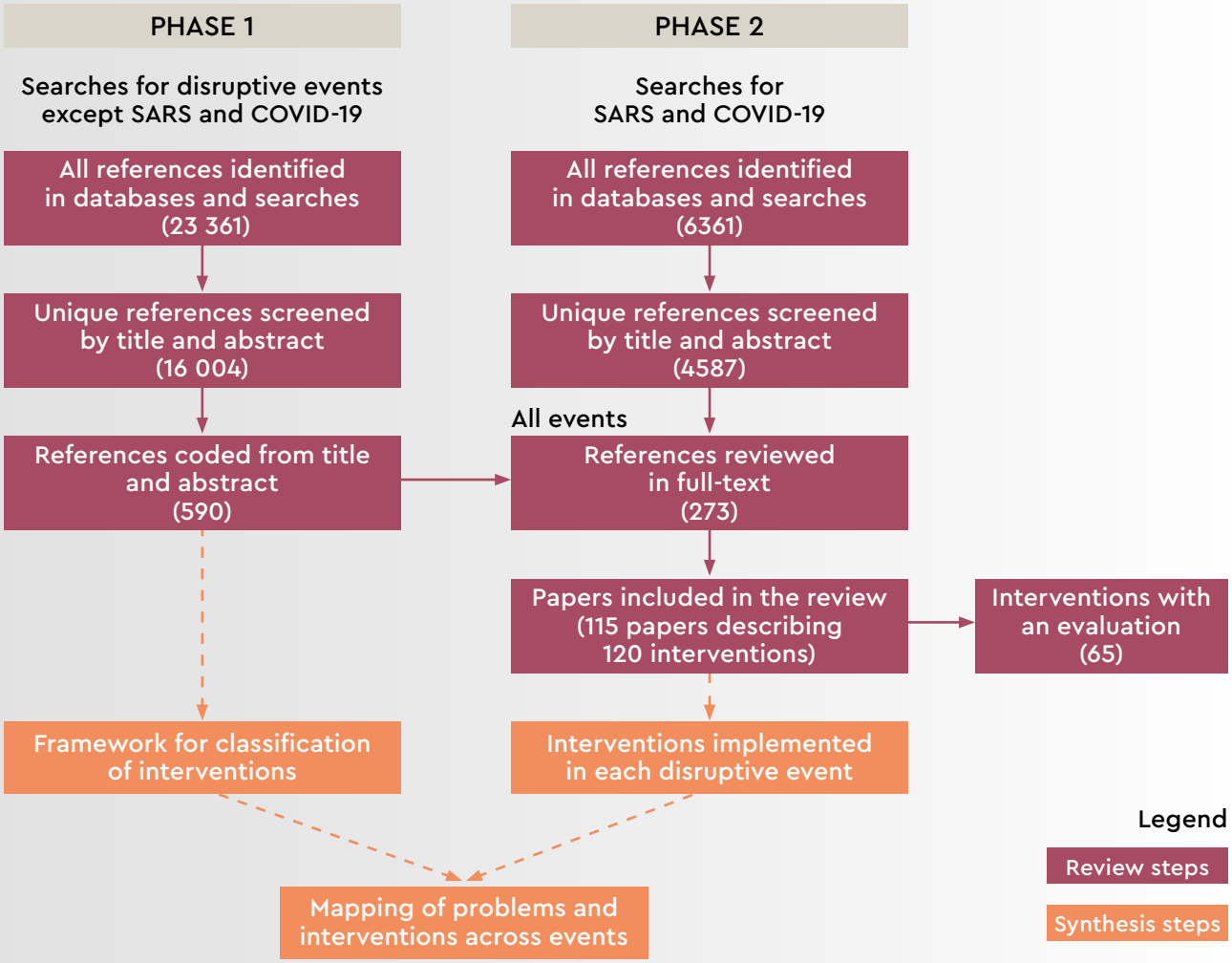


Table 4 shows the distribution of the 120 interventions according to the populations targeted, the health service(s) involved and whether an evaluation was reported.

Table 4. Overview of scoping review: number of papers, interventions, evaluations, population groups and health service area, by disruptive event

	Ebola	Natural disasters	Humanitarian emergencies	SARS	COVID-19	Total
Papers	11	39	9	3	53	**115**
Interventions	11	40	13	3	53	**120**
Evaluations	7	22	8	1	27	**65**
Population*						
Women	3	7	8	2	12	**32**
Newborns	3	6	2	3	10	**24**
Children	4	13	3	0	21	**41**
Adolescents	2	4	4	0	13	**23**
Older people	0	2	0	0	14	**16**
General population	4	16	2	0	3	**25**
Health service*						
Mental health	2	11	1	0	18	**32**
Maternal and newborn health	3	5	1	3	11	**23**
Child and adolescent health	1	5	1	0	21	**28**
General health service	1	5	2	0	5	**13**
Management of noncommunicable diseases	0	0	0	0	13	**13**
Reproductive health – topics	0	3	5	0	3	**11**
Prevention and screening activities	3	2	0	0	0	**5**
Nutrition	0	2	1	0	1	**4**
Long-term care facilities and care homes	0	1	0	0	3	**4**
Health worker training/preparedness	0	1	0	0	3	**4**
Self-care	1	2	0	0	0	**3**
Vaccination	1	2	0	0	0	**3**
Abortion and post-abortion care	0	0	2	0	1	**3**
School-based services	0	1	0	0	1	**2**
Family planning	0	0	0	0	1	**1**
Other	0	1	0	0	0	**1**

**The total number exceeds the number of interventions included because some interventions related to more than one category of population or health service.*

Health services identified in Phase 1 for which no interventions were found in Phase 2 (cancer treatment and care for disabled patients) do not appear in this table.

4

FINDINGS BY TYPE OF DISRUPTIVE EVENT

Below we summarize the results by disruptive event type, based on data extracted from the full text of 115 papers concerning 120 interventions. We first describe the nature of the event, then the problems experienced in delivering or accessing services during the event, followed by a description of interventions to maintain MNCAAH services, a summary of any evaluations identified for the interventions, and a discussion of the key findings. Detailed tables for each event type summarizing all interventions and evaluations included in this scoping review are available in the Web Annex.

4.1 Ebola

Among the 590 references identified in Phase 1, 123 unique titles and abstracts related to EVD were screened. We reviewed the full text of 27 papers and included 11 that described an intervention.

CONTEXT

EVD is a viral haemorrhagic fever affecting humans and other primates. Caused by ebolaviruses, it is severe and often fatal. After an incubation period of 2–21 days, symptoms include fever, fatigue, muscle pain, headache and sore throat. More severe symptoms follow, including vomiting, diarrhoea, rash, impaired kidney and liver function and, in some cases, internal and external bleeding. EVD first appeared in 1976 in both the Democratic Republic of the Congo and the Sudan. Between 1976 and 2012, it is estimated to have killed 1590 people (*8*).

Between 2014 and 2016, West Africa experienced the largest EVD outbreak yet recorded, claiming more than 11 000 lives; some countries saw case fatality rates of up to 67%. Guinea, Liberia and Sierra Leone were the worst affected countries (9). Clinically, it was difficult to distinguish EVD from other infectious diseases already present in the affected countries at the time of the outbreak. Malaria, typhoid fever and meningitis produce similar symptoms, making screening and diagnosis more complex.

During this outbreak, health systems suffered significant disruptions. Some findings suggest that the indirect consequences of the epidemic were more severe than the virus itself (9).

PROBLEMS

This section outlines the disruptions to health-care supply and demand experienced during the 2014–2016 EVD outbreak in West Africa. The main problems (summarized in **Fig. 2**) fall into four categories: decreased care provision, decreased demand for care, difficulty in distinguishing illness symptoms, and increased need for mental health care.

Decreased care provision

The EVD outbreak disrupted many elements of the health system. Maternal and newborn care, already fragile before the crisis, was severely affected (*10–12*). The challenge of maintaining health care for mothers and babies was exacerbated by the decrease in the health workforce due to absenteeism, illness and death, adding to the pre-existing problems of health worker shortages and uneven rural/urban distribution of health workers (*13*). Disruption to the provision of emergency obstetric care (caesarean sections), family planning, antenatal and postnatal care were among the most frequently mentioned problems related to the provision of essential care.

Decreased demand for care

Demand for health care decreased due to people fearing infection at health centres, and to increasing mistrust between communities, health facilities and governments; this had a particular impact on prevention and messaging (*14*). Flawed communication and cooperation with EVD-affected local communities at the start of the outbreak also deterred people from attending health facilities (*15*).

Difficulty in distinguishing EVD from symptoms of other conditions

Another problem affecting the provision of health care was the presence of other infectious diseases, such as malaria, with symptoms resembling those of early-stage EVD. This compromised patient triage, increasing the pressure on health facilities (*16,17*).

Increased mental health needs

The EVD outbreak resulted in mental health needs among children and adolescents for which the health system was not prepared. For example, an estimated 1600 children in Sierra Leone were orphaned during the EVD crisis (*18*). Families and communities in all the affected countries experienced high levels of stress, loss and trauma. Many children developed post-traumatic stress syndrome, depression, anxiety and behavioural change. They lost parents, relatives, teachers, neighbours and friends. Many were placed in quarantine, thereby losing many of their protective structures (relationships, school etc.) (*19*). Additionally, mental health services in most EVD-affected countries were severely insufficient before the EVD crisis (*20*). To maintain health care for children and adolescents, new ways were needed to address the effects of the outbreak on mental health. The included papers also showed that orphans were at increased risk of physical and sexual violence and that school closures also increased young people's vulnerability to violence (*18*).

Fig. 2 MNCAAH service provision and use in response to EVD outbreaks: key problems

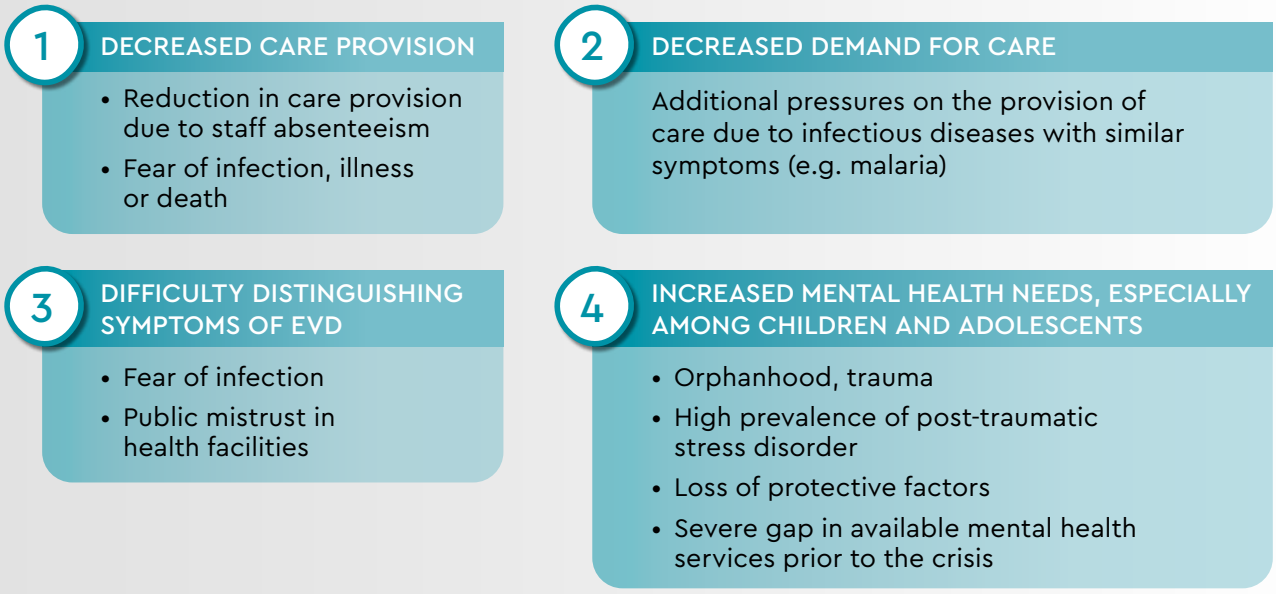
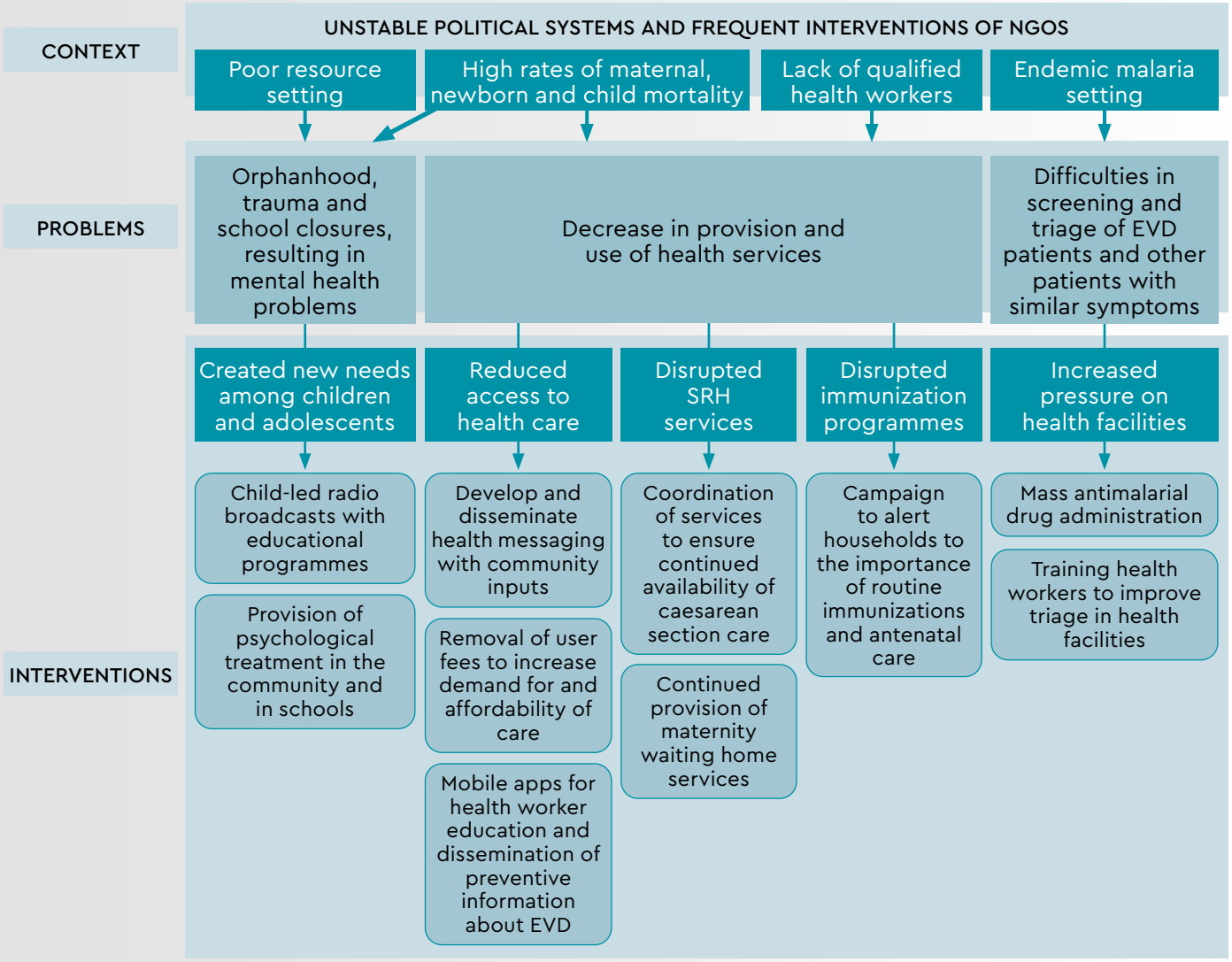


Fig. 3 MNCAAH service provision and use in response to EVD outbreaks: context, problems and interventions



INTERVENTIONS

Eleven papers describing interventions to maintain essential care for MNCAAH in the context of EVD were included: nine referred to Guinea, Liberia or Sierra Leone and two focused on the Democratic Republic of the Congo and Uganda. Most of these papers described interventions targeting children (n=4) and women and newborns (n=3). Adolescents were included in two papers. Health care for older persons was not directly discussed in any of the included papers, other than in those about maintaining care for MNCAAH generally. In terms of types of service covered in the included papers, maternal and newborn care and prevention/screening activities (three papers each) were the most common targets of the interventions. Mental health was discussed in two papers and one paper addressed routine vaccination services.

Seven of the included papers referred to mitigation of demand and supply disruptions. While this disruptive event had emerged in an already fragile health system, with a lack of skilled health workers and high maternal and newborn morbidity and mortality, only one intervention explicitly addressed a problem pre-dating the outbreak (gender-based violence against girls in precarious social, familial and economic situations in Sierra Leone (18)). Nearly all references (10 of the 11) described interventions formally organized by international NGOs in partnership with national ministries of health and education. One intervention was spontaneously organized by a group of health workers in a maternity unit (*13*). Seven interventions were made within the first year after the disruptive event, and two involved pre-existing MNCAAH programmes that were adapted to mitigate the indirect effects of EVD on the targeted populations.

Fig. 3 summarizes these interventions, as well as the key contextual factors and problems encountered during EVD outbreaks. A table summarizing the included papers and interventions is available in the Web Annex, Section 1.1. Below we summarize the interventions according to health service area.

Maternal and newborn health

Three interventions directly addressed maternal and newborn care: two related to health-care professionals and one to pregnant women. One intervention related to maternity waiting homes located near hospitals in Liberia (*21*) where women could stay before and after giving birth. Another, using mobile phone applications to share information with midwives in Nigeria was implemented by a collaborative of communication companies and aimed to: educate the public about EVD, provide midwives and other health workers with tablets and connectivity to capture patients' medical information at the point of care, and assist in analysing and diagnosing clinical conditions (*22*). Lastly, an intervention organized by maternal and newborn health workers in Sierra Leone described how surgical and non-surgical staff responsible for caesarean sections found informal ways to avoid absenteeism, reduce fear and continue providing care, including caesarean sections, during the EVD outbreak (*13*).

Child and adolescent health

Four papers concerning child and adolescent health were identified. One addressed the promotion of vaccination services in Sierra Leone (*23*) and the other three addressed mental health and general well-being (education, stability of social and family lives, etc.). One of these was conducted using child-led radio broadcasts and related activities in Sierra Leone (*18*) and the other two papers described psychological healing and resilience among children in Liberia (*19,20*).

Health of the general population

Four references were included in the scoping review despite not addressing any specific population, because they concerned responses to problems in maintaining MNCAAH services. Three of these focused on maintaining prevention and screening activities, including mass malarial drug administration in Liberia (*17*) and an intervention in Sierra Leone incorporating direct community input into the development of messages aimed at preventing the spread of EVD and promoting treatment-seeking behaviours (*14*). Training nurses to triage patients at the entrance to clinics in Uganda was an intervention to identify infectious disease (*16*). Lastly, a temporary "free care policy" was introduced in the Democratic Republic of the Congo involving the temporary removal of user fees for consultations and medication for people with EVD or other health conditions living in three of the regions worst affected by EVD (*15*).

EVALUATIONS

Evaluations of the interventions, presented in seven of the 11 included papers, are summarized in a table available in the Web Annex, Section 1.2.

Different designs were used to evaluate the interventions, including pre- and post-intervention analysis (*19,20*), analysis of routine data (*15,21*) and use of qualitative methods (*22*). Two papers used qualitative and quantitative data analysis and other case study methods, such as review of project documentation and multistakeholder consultations (*13,18*).

DISCUSSION

This section focuses on the challenges encountered in interventions to maintain MNCAAH services during EVD outbreaks described in the EVD-related papers. A major challenge was lack of resources. This included lack of personal protective equipment (PPE), infrastructure insufficient to meet demand and to provide high-quality care, and lack of reliable salary payments for health workers which reduced their ability to carry out their tasks. Lack of reliable income was also a challenge for the teachers involved in some interventions, reducing their motivation to participate in educational and mental health interventions for children. Lack of resources and of reliable salary payments also reduced the ability to expand interventions and maintain long-term strategies. Finally, it was reported that the global community did not immediately respond to the EVD outbreak, with several donors stopping or reducing their funding. This challenge particularly affected interventions under pre-existing funded programmes.

Another challenge was the high rate of absenteeism among health workers due to their fear of infection. Public mistrust of health facilities and governments, common in the affected communities, also discouraged use. Moreover, it was reported that some interventions involving needles or blood collection were performed less commonly because they were refused by patients who feared transmission and/or mistrusted health-care procedures due to negative rumours.

During EVD outbreaks, most decisions about implementing mitigation strategies for MNCAAH were made by international NGOs in partnership with national ministries. Adapting interventions to the local context appeared to be essential. For example, in the Democratic Republic of the Congo the "free care policy" could be implemented readily because the region already had a structure allowing the government to pay public health providers directly (*15*). By contrast, Liberia's mass drug administration intervention showed that, in order to decrease pressure on health facilities, external support (in this case an international organization) was needed to organize the mass distribution (*17*). When deciding on mitigation interventions for MNCAAH, stakeholders should take account of all health system constraints, including lack of resources. Given the large number of international actors, it appears that interventions benefit from understanding the local context, which might be unfamiliar to those planning them. This was shown to be essential by the rumours and mistrust that circulated during the EVD crisis. As shown by the intervention in Sierra Leone to collect community input, leaflets and posters using colours associated with the government or political parties were mistrusted by the population (*14*). To increase trust and counter negative rumours, consideration of local views and interpretations of the disruptive event should be the starting point. Finally, most of the interventions were funded by external donors: good coordination and adaptability to changing needs and contexts are needed to implement mitigation strategies effectively.

4.2 Natural disasters

Of the 590 references identified in Phase 1, 213 concerned natural disasters and were screened in title and abstract. We reviewed the full text of 71 papers, and included 39 papers describing 40 interventions – two interventions were extracted from one report.

CONTEXT

According to the United Nations International Strategy for Risk Reduction, a natural hazard is "a natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage" and a disaster is defined as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (*24*). This scoping review includes papers covering the following 17 natural disasters.

Hurricane Iniki, Hawaii, United States of America (USA), 1992. Hurricane Iniki was the most powerful hurricane to strike Hawaii, in September 1992. Seven people died, and the hurricane damaged more than 70% of homes on the island of Kauai and caused more than US$ 3 billion worth of damage (*25*).

The 2003 earthquake in the Islamic Republic of Iran. On 26 December 2003, an earthquake measuring 6.6 on the Richter scale affected the southern Kerman Province, particularly Bam City. It is estimated that 85% of buildings were destroyed, 30 000 citizens died and over 30 000 were injured. Moreover, 45 000 people were left homeless after the event. The collapse of physical structures, including Bam's hospitals and several rural and urban health facilities, was a major cause of both short- and long-term disruption to health services and access (*26*). Survivors suffered emotional and psychological trauma and distress (*27*). Children were particularly affected by long-term psychological distress (*28*).

The 2004 Indian Ocean earthquake and tsunami. The 26 December 2004 Indian Ocean tsunami was caused by a 9.0 magnitude earthquake and is estimated to be the most devasting tsunami of modern times. It affected at least 18 countries, spanning from South-East Asia to Southern Africa. In total, nearly 250 000 people were killed. The worst death tolls were in Indonesia, Sri Lanka and Thailand. The tsunami is considered to be the first truly global natural disaster, due to the number of countries and continents affected. The event provoked a massive aid flow from governments, NGOs and the private sector, and a disaster response rarely seen before (*29*).

Hurricane Katrina, USA, 2005. Hurricane Katrina was the deadliest natural disaster to affect the Gulf Coast of the USA since 1928. It caused unprecedent damage, with over 1800 deaths, widespread population displacement and heavy infrastructure damage in late August 2005. Drowning was the principal cause of death; those aged over 75 were the worst affected (*30*). The hurricane also traumatically separated children from their families (*31*) with mental health consequences lasting for over a decade (*32*).

The 2010 Haiti earthquake. On 12 January 2010 the Haiti earthquake registered a magnitude of 7.0 on the Richter scale. Unprecedented in Haiti, it caused major damage and the death of more than 100 000 people (*33*). According to a 2011 Pan American Health Organization/WHO report, the earthquake affected an estimated 2.8 million people, left nearly 1.5 million people homeless and massively increased poverty in the affected area (*34*). Health-care facilities and drug supplies and deliveries were severely disrupted. The long-lasting disruption became even more challenging when NGOs began to leave and funding became scarcer. With great numbers of people living in displacement camps, outbreak control and disease surveillance were needed. This disaster occurred in an already vulnerable environment, particularly affecting the capital, Port-au-Prince.

The 2010 Chile earthquake. The 27 February 2010 earthquake in Chile had a magnitude of 8.8 on the Richter scale and was followed by aftershocks ranging in magnitude from 5 to 7.2. The disaster affected populations from Santiago to Temuco (in the middle of the country); 521 people lost their lives. According to a report by Save the Children, 813 634 homes were affected and 200 000 seriously damaged (*35*). In Cauquenes, the worst affected region, 8862 homes were declared unhabitable. There were also serious concerns regarding the protection of children in the aftermath of the disaster due to their considerable stress and their high exposure to gender and intrafamily violence.

The 2010 flood in Pakistan. In July 2010 Pakistan experienced an unprecedented monsoon: in just a few days, approximately one fifth of the country was submerged. The Government of Pakistan estimated that over 20 million people, including nearly 9 million children, were affected. Floods, including another in 2012, destroyed or heavily damaged more than 10 000 schools (*36,37*).

The 2011 earthquake in Tohoku, Japan. The Great East Japan Earthquake on 11 March 2011 had a magnitude of 9 to 9.1 and triggered a tsunami and a nuclear disaster at Fukushima (meltdown of reactors, discharging of radioactive water affecting hundreds of thousands of local residents has remained largely uninhabitable zones until today). Nearly 20 000 people died, 6424 were injured and 2556 went missing. The impacts on health and the health system were substantial (*38*). Two years after the disaster, 65% of the affected population were still living in temporary accommodation (*39*).

The 2011 earthquake in New Zealand. On 22 February 2011, the Canterbury region of New Zealand experienced an earthquake of magnitude 6.3. The epicentre was just 10 km from the city of Christchurch. 185 people died, 7000 were injured and more than 100 000 houses were damaged (*40*).

The 2011 earthquake in Lorca, Spain. An earthquake of magnitude 5.3 struck the south-east Spanish city of Lorca on 11 May 2011, resulted in nine deaths and dozens of injuries (*41*).

The 2013 floods in Dresden, Germany. In June 2013, the river Elbe flooded the city of Dresden in eastern Germany. Bridges were closed to traffic, transport infrastructure was damaged, and about 23 000 residents had to leave their homes (*42*).

Typhoon Haiyan in the Philippines, 2013 (Super Typhoon Yolanda). Typhoon Haiyan was the worst natural disaster in the Philippines for 20 years. On 8 November 2013, 6200 people died, 4 million Filipinos were subsequently displaced, and many buildings were damaged, including health facilities (*43*).

The 2015 Nepal earthquake. On 25 April 2015, an earthquake of magnitude 7.8 hit Nepal. This triggered an avalanche on Mount Everest and was followed by severe aftershocks until 12 May 2015. Nearly 9000 people were killed, 22 000 were injured and 600 000 displaced; over 1000 health facilities were destroyed or damaged by the disaster (*44–46*).

The 2015 floods in Southern Punjab, Pakistan. Heavy flooding in 2015 killed 15 people and submerged dozens of villages. Heavy rain fell for several weeks, eventually affecting about 800 000 people across 2200 villages (*36*).

Hurricanes Harvey and Irma in Florida, USA, 2017. Harvey, a Category 4 hurricane, made landfall near Cudjoe Key on 10 September 2017, followed by Category 3 Irma on Marco Island. Irma's sustained winds, in excess of 130 miles per hour, left 6.2 million Florida homes and 60% of the state without electrical power and disrupted access to local health facilities (*47,48*).

Earthquake in Lombok, Indonesia, 2018. An earthquake measuring 7 on the Richter scale struck West Nusa Tenggara province on 5 August 2018, causing damage to an estimated 80% of the structures in North Lombok. Officials estimated that over 500 people died and over 400 000 were displaced (*49*).

Hurricane Florence, North Carolina, USA, 2018. Florence made landfall in North Carolina as a Category 1 hurricane on 14 September 2018, causing catastrophic flooding throughout much of eastern North Carolina (*50*).

PROBLEMS

The most immediate consequences of natural disasters are human deaths and injuries and material destruction. Such events create short- and long-term disruption to the health system while increasing the need for health care. Depending on the pre-existing social and economic context of the area affected, resulting problems and interventions will differ. Most papers (n=24) described problems related to the mitigation of supply disruptions. Fewer than half (n=16) discussed both supply and demand problems. No paper addressed a problem related solely to demand disruption. We divided the problems described in the included papers into four interlinked categories (**Fig. 4**).

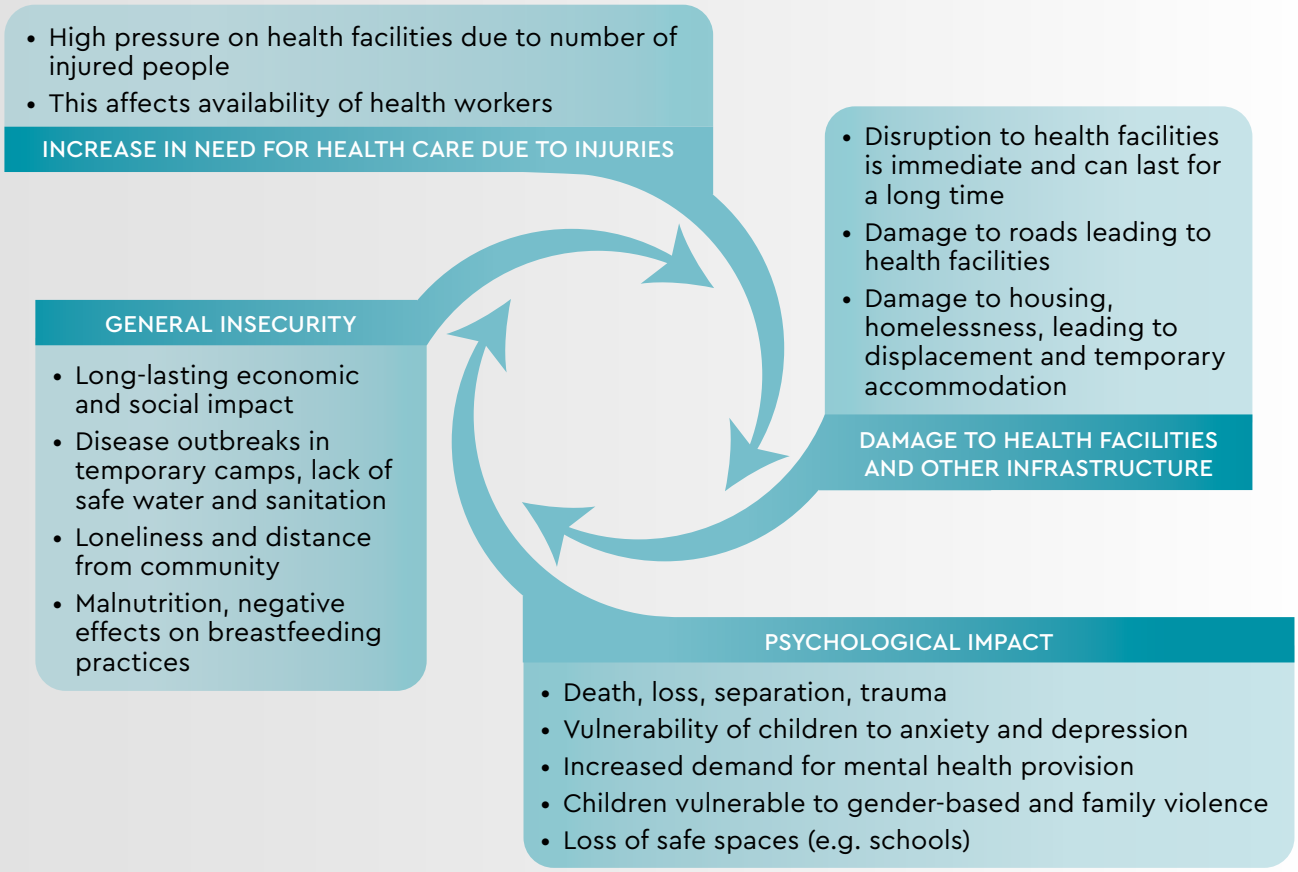
First, high numbers of injuries caused additional health care needs, increasing pressure on health facilities. Some health workers also suffered death or injury, and in low-resource settings where health workers were already scarce, this was particularly damaging to care provision.

Second, damage to health facilities disrupted health care for whole populations. In low-resource contexts, some facilities were left fully or partly dysfunctional for months after a disaster. Some disasters (e.g. the Great East Japan Earthquake) disrupted key infrastructure, such as roads and fuel distribution networks. Damage to housing, workplaces and schools caused displacement, further increasing health care needs. Some routine vaccination programmes in low-resource settings were disrupted for years after a disaster: this posed a particular risk for those in temporary accommodation, where high-density occupation and lack of hygiene facilities increased the risk of disease outbreaks.

Third, disasters produced adverse psychological reactions in victims and witnesses; children were particularly vulnerable to mental health issues. Death, loss and material insecurity increased anxiety and depression. Moreover, with the destruction of schools, children lost safe spaces. Children also faced higher risks of gender-based and family violence following a natural disaster, especially in fragile contexts. Many were orphaned or separated from parents and caregivers. Post-traumatic stress disorder posed an important risk for children after a natural disaster. In countries where mental health care was inadequate before the disaster, this presented an even greater challenge.

Fourth, natural disasters reduced personal security generally, due to factors including displacement, socioeconomic vulnerability, violence, loss of community links and loneliness. The risk of malnutrition was increased by food shortages and inability to breastfeed, and loss of access to clean water disrupted nutrition for newborns, especially those not being breastfed.

Fig. 4 MNCAAH service provision and use in response to natural disasters: key problems



INTERVENTIONS

We found 39 papers discussing 40 interventions to mitigate disruptions to MNCAAH health service provision or use during natural disasters. Most of the interventions targeted the general population (n=16) or children (n=13). Seven papers addressed maternal health, six concerned newborns and four targeted adolescents. We found two papers concerning older adults. Several papers addressed more than one category, most commonly both maternal and newborn care. The most commonly targeted health service was mental health care (n=11). Five papers concerned each of general health service provision and access, child health, and maternal and newborn care. Three interventions related to reproductive health. One paper focused on health worker training and preparedness. Finally, one paper assessed blood collection and distribution (classified here as "other health service").

The 40 interventions are described in a table, available in the Web Annex, Section 2.1 (sorted by population and health service). In this section, we present the types of interventions described in the papers. The interventions are divided into two categories, low- and middle-income countries (LMICs) and high-income countries (HICs), to reflect the fact that the level of resources available in a setting appeared to influence the type of intervention implemented.

Twenty-one papers described interventions to maintain essential MNCAAH services during natural disasters in LMICs: Haiti, Indonesia, Iran (Islamic Republic of), Nepal, Pakistan, the Philippines and Sri Lanka.

Maternal and newborn health

Five interventions related to maternal and newborn health in LMICs. These included: developing a more responsive health system to support midwives working in rural communities in Indonesia (*51*); training skilled birth attendants in Haiti (*52*); provision of baby tents in Haiti (two papers) (*53,54*); and maintaining provision of SRH and maternal health services in the Philippines (*43*).

Child and adolescent health

Ten papers described eleven interventions focusing mainly on child and adolescent health in LMICs; some of these also included elements relevant to the health of women, newborns and the general population. Complex interventions in Haiti (*55*) and Pakistan (*36*) involved the provision of a number of health services immediately after a disaster, including treatment of malnutrition and mobile clinic services. An intervention in Nepal focused primarily on nutrition (*44*). Another paper described the treatment of injuries among children after the Haiti earthquake on a ship sent from the USA (*56*). Interventions in Nepal (*45*), Pakistan (*37*) and Sri Lanka (*57*) targeted children's and adolescents' mental health by providing school-based mental health services; an intervention in Indonesia delivered similar services in the community (*49*). An intervention in the Islamic Republic of Iran provided spaces for children's activities after the Bam earthquake (*28*). Finally, two interventions (in Nepal and the Philippines, part of one paper) discussed SRH services for adolescents (*46*).

Health of the general population

No interventions in LMICs targeted older people. We found five interventions, all in Haiti after the 2010 earthquake, relevant to the general population. These included: improving blood collection and distribution *(58)*; providing ultrasound diagnostic services *(59)*; strengthening outbreak and disease surveillance *(60)*; maintaining routine vaccination services *(61)*; and providing vaccination services in temporary camps *(62)*.

Nineteen papers presented interventions to maintain essential MNCAAH services during disruptive events in HICs: Chile, Germany, Japan, New Zealand, Spain and the USA.

Maternal and newborn health

A local initiative in New Zealand, targeting maternal and newborn health, created space in a hospital for breastfeeding mothers and babies displaced by the earthquake *(40)*.

Child and adolescent health

Six interventions from HICs related to child and adolescent health, of which only one reported provision of general care (using digital health in the USA) *(47)*. The remaining five papers reported interventions to provide services to meet the increased mental health needs, predominantly in school-based settings and through provision of information, in Japan *(63)*, Chile *(35)* and the USA *(25, 64–65)*.

Health of older people

Two interventions were identified concerning older people's health in HICs. A paper from the USA reported on care of evacuees from nursing homes in the wake of Hurricane Katrina *(66)*, and a paper from Japan presented an intervention to protect older adults' well-being and mental health through community support and home visits after the 2011 earthquake *(39)*.

Health of the general population

Ten interventions in HICs related to the general population: in Germany, Japan, Spain and the USA. Interventions ranged from the self-organized (a Facebook group set up by a local citizen to coordinate response and preparedness activities in Dresden) to formal interventions by governments (e.g. exception from user fees for survivors of the Japan earthquake). Eight of the interventions focused broadly on immediate provision of general health care following a natural disaster or on overcoming barriers to care seeking *(42,48,50,67–71)*; the other two interventions related specifically to the provision of mental health services to meet increased need *(41,72)*.

EVALUATIONS

Of the 40 papers on MNCAAH interventions after natural disasters, 22 included an evaluation. A table summarizing each evaluation is available in the Web Annex, Section 2.2. Eight papers conducted quantitative analyses of routinely collected data *(47,48,50,54,56,59,60,68)*, and an additional paper used quantitative methods to analyse outcomes of provider training *(72)*. Eight papers used qualitative methods, several using more than one type of data collection (interviews, observations etc.) *(28,39,42,51,52,64–66)*. Four papers conducted randomized control trials *(25,37,45,57)*. The methods used in the remaining paper were not clearly described *(49)*.

DISCUSSION

Challenges encountered during interventions in LMICs included lack of understanding of the local context by implementers. This affected some interventions and even negatively affected the community which they intended to help. For example, Chib et al. (2011) discussed an intervention that distributed mobile phones to rural midwives: although this increased the midwives' knowledge and skills, it also made them uncomfortable about the fact that their patients could not afford mobile phones *(51)*. Lack of understanding also affected the design of safe spaces, such as breastfeeding tents, which caused dissatisfaction among many beneficiaries. Design and architectural problems can cause a space to overheat or be destroyed by strong winds. In breastfeeding tents it proved challenging to maintain privacy. Lack of training and resources were also reported as challenges. In poorly resourced settings, lack of technological competence and inability to access information and communications technology (ICT) training compromised the positive outcomes of an intervention.

The scale of natural disasters posed critical challenges; for example, large population displacement was an issue for interventions requiring community participation. The displacement of a population also hinders disease surveillance and public health data collection. Lastly, interventions addressing increased mental health needs noted that mitigation strategies for mental health and to protect children's well-being may be insufficient for the worst affected children, some of whom need long-term, individualized treatment, which is often unavailable in low-resource settings.

Challenges reported in papers from HICs include those encountered during remote provision of health services, which was hindered by lack of technical support and financial affordability. Wifi and mobile phone coverage were often lacking after disasters, making access to digital health interventions impossible for many. Other issues included shortage of qualified staff (especially for provision of mental health services), lack of public engagement in disaster response, lack of disaster preparedness in health facilities (e.g. nursing homes), and lack of privacy, heightened vulnerability and stress among displaced people housed in temporary accommodation.

4.3 Humanitarian emergencies

This section presents the findings of interventions following events which affected the health and well-being of local populations but were not classified as an EVD outbreak or a natural disaster. Of the 590 references identified in Phase 1, we screened 127 related to humanitarian emergencies on the basis of title and abstract, reviewed the full text of 34 papers and included nine papers which described 13 interventions.

CONTEXT

The 13 interventions took place in the Democratic Republic of the Congo (South Kivu), Jordan, Myanmar, Nigeria, Pakistan, Somalia, South Sudan, Syria, Thailand and Yemen. One paper concerned the Democratic Republic of the Congo, Somalia and Yemen and another covered Colombia and Kenya. The contexts included population displacement and insecurity due to armed conflict, political and economic instability (often protracted) and the consequent exacerbation of vulnerability and of health and nutrition needs *(73)*.

The Democratic Republic of the Congo (South Kivu) presents a context of a protracted humanitarian emergency with inadequate access to health services and with high levels of poverty and mortality *(74)*.

Myanmar has a long history of internal conflict, with the highest number of internally displaced people in the WHO South-East Asia Region. Around 76% of the region's internally displaced people are concentrated in Myanmar, including along its border with **Thailand** *(46,75)*.

Nigeria's conflict with Boko Haram has led to more than 2.2 million people being internally displaced, 20 000 civilians being killed, and as many as 7000 women and girls being abducted. An estimated 92% of displaced people in north-eastern Nigeria live within host communities, among whom are over half a million women of reproductive age *(46)*.

Pakistan: as of 2014, nearly 1 million internally displaced people were in need of humanitarian assistance in North Waziristan's Federally Administered Tribal Areas due to military and security operations. An estimated three quarters of these people were women and children *(46)*.

Somalia presents one of the largest humanitarian crises in the world, with around 3 million people in need of humanitarian assistance, including an estimated 1.1 million people internally displaced by recurrent droughts, floods and conflict. This is occurring in a context of high maternal mortality, rape, female genital mutilation, violence against women and child marriage *(46)*.

South Sudan saw armed conflict erupt in December 2013, resulting in mass displacement, food shortages and violence. An estimated 2 million internally displaced people arrived in areas with already high maternal and neonatal mortality, severe shortages of health workers and health services, and ongoing violence against civilians *(76,77)*.

Syria has long had large-scale population displacements due to armed conflict. Internally displaced people face a severe lack of health services and health workers, and many refugees live in host communities and refugee camps in neighbouring countries such as **Jordan** *(78,79)*.

Yemen has suffered from internal conflicts for several years, resulting in disrupted health-care provision, lack of security for the population and over 3 million internally displaced people, in a context of pre-existing poverty and economic instability (rising prices of basic commodities, food insecurity, high levels of unemployment), all of which have exacerbated poverty and malnutrition. Nearly 300 health facilities have been destroyed or damaged and remaining health services face acute shortages of medicines, equipment and staff *(80)*.

The two papers from multiple settings affected by poverty, violence and political instability included the **Democratic Republic of the Congo**, **Somalia** and **Yemen** *(81)* and in **Colombia** and **Kenya** *(82)***.**

PROBLEMS

Nine papers identified problems related to demand and supply disruptions, and four identified problems only related to supply disruptions. Access to primary health care by displaced populations was disrupted. Some refugee camps provided health services, but high morbidity and mortality were often recorded, as in a Syrian refugee camp in Jordan *(78)*. Insecurity in conflict settings, where venturing outdoors could be life-threatening, prevented people from seeking care. In some settings this had a particular impact on abortion and post-abortion care *(75,81)*.

Humanitarian crises commonly resulted in food shortages, often leading to acute malnutrition or famine *(74,80)*. Disrupted supplies of equipment and basic medicines also hindered the provision of health care. In the most violent settings, such as South Sudan, civilians, physicians and humanitarian workers were killed, exacerbating health worker shortages that often pre-dated the crisis *(76,77,79)*. Conflict also destabilized governments, a key challenge for the organization of primary health care and the maintenance of supplies, including those necessary for MNCAAH.

One paper reported that child mental health was overlooked in humanitarian emergencies *(82)*.

Children exposed to violence, poverty and displacement suffered conditions such as anxiety, depression and somatoform disorders. Another paper showed that adolescents faced increased risks of gender-based violence, unwanted pregnancy, HIV infection, maternal death and disability, early and forced marriage, rape, trafficking and sexual exploitation and abuse *(46)*.

These problems are summarized in **Fig. 5**.

INTERVENTIONS

The 13 interventions during humanitarian emergencies addressed the needs of the following populations: women (n=8), newborns (n=1), children (n=3), adolescents (n=4) and the health of the general population (n=2). No interventions targeting older people's health were identified. Reproductive health (n=5), general health service (n=2) and abortion and post-abortion care (n=2) were the health services most commonly targeted by the interventions in the included references. One intervention was found for each of child health and adolescent health, maternal and newborn health and for nutrition. A table with details of each intervention is available in the Web Annex, Section 3.1.

Maternal and adolescent health

The eight interventions concerning maternal, newborn and/or reproductive health services included: provision of a minimum initial service package *(78)*; safe abortion and post-abortion care *(75,81)*; improving provision of maternal care (supplies, health workers and facilities) *(74)*; provision of family planning and counselling on gender-based violence in Myanmar, Nigeria and Pakistan *(46)*; and mobile/outreach activities in Somalia *(46)*.

Newborn health

An intervention to prevent neonatal deaths involved designing a training curriculum and adapting materials for an educational course for health professionas on knowledge and practice to prevent and manage the main causes of neonatal death *(76)*.

Child health

The two interventions concerning children involved developing a screening tool for mental health issues among children *(82)*, and adapting an ongoing programme to prevent common childhood illnesses in a conflict setting *(77)*.

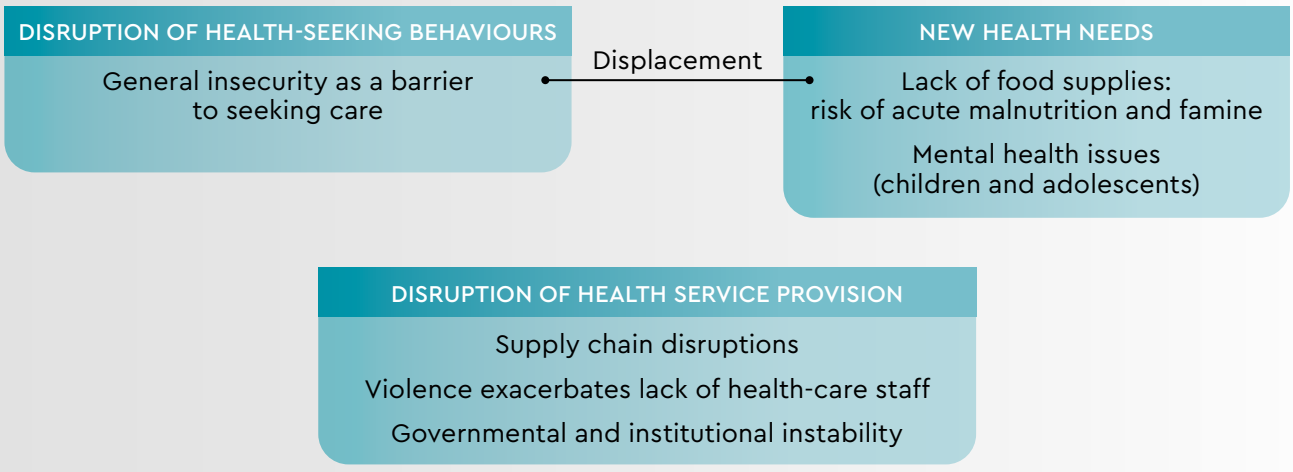
Health of the general population

One intervention focusing on children and the general population targeted management of acute malnutrition *(80)*. Lastly, an intervention in intensive care units (ICUs) to supervise and support health workers in a conflict area used Skype (via satellite Internet) to disseminate protocols, educate nurses and make on-call medical subspecialists available for consultations *(79)*.

EVALUATIONS

A table providing details of the eight papers that included an evaluation is available in the Web Annex, Section 3.2. The methods used in the evaluations included: quantitative analysis of routine or programmatic data *(46,80)*, a quantitative validation study *(82)*, other qualitative designs, including interviews with health workers and stakeholders *(77,78)* or with service users *(75)*, and mixed methods approaches *(76,81)*.

Fig. 5 MNCAAH service provision and use in response to humanitarian emergencies: key problems



DISCUSSION

Several lessons learned were mentioned, as well as challenges to maintaining MNCAAH during humanitarian emergencies. Inadequate infrastructure presented obstacles, including lack of access for clients with disabilities, and lack of lighting in camps for displaced people (diminishing women's and children's safety). Shortages of both medical supplies and health workers were mentioned, together with insufficient funding. In general, the included papers discussed the inability of interventions to mitigate the effects of conflict sufficiently, for example, in regard to the large needs of displaced populations, safety issues, other urgent issues such as cholera outbreaks, and limits on movements of populations and health workers, which also affect NGOs' capacities because of difficulties in obtaining visas to bring humanitarian personnel into a country.

The ability of interventions to achieve intended outcomes was also hampered by: health-care topics being unfamiliar to local communities (abortion/post-abortion care); insufficient previous training of health workers involved in interventions (traditional birth attendants being unable to use partographs, guidelines or instruments); and, in general, difficulties in adapting practices requiring significant sociobehavioural changes. Evaluations of interventions also reflected some contextual difficulties, such as inability to achieve a sufficiently large sample due to population movements and insecurity, lack of data about the situation prevailing before the intervention, and inability to assess the intervention's long-term impact.

4.4 SARS

We screened 663 unique titles and abstracts, reviewed the full text of 11 papers, and included three that described an intervention.

CONTEXT

The outbreak of SARS is included in this scoping review because it affected health-care provision in several settings. Local outbreaks chiefly affected health-care settings, and to some extent residential areas, and were generally rapidly contained. SARS has a high mortality rate, with the case fatality ratio estimated at between 11–15% *(83)*. The outbreak, a series of epidemics between November 2002 and July 2003, primarily affected Canada and China (including Hong Kong Special Administrative Region (SAR)), with some cases in Singapore, Taiwan, China, Viet Nam and elsewhere.

PROBLEMS

The main problems for the provision and use of essential health services described in the literature identified were closures of hospitals (or hospital wards) due to exposure to SARS, and the need to reduce nosocomial transmission of SARS between workers and patients in health-care settings. For example, one Toronto hospital opened a SARS ICU in the second wave of SARS in 2003, and the maternity ward was closed completely for some days. More broadly, the hospital was unable to provide care such as outpatient follow-up visits (to monitor premature and high-risk infants) *(88)*.

None of the papers reviewed identified SARS infection, diagnosis or management among target populations as the problem. Such problems arose immediately, and rapid response was required, but after the immediate outbreak services reverted to normal. None of the papers reviewed were from low-resource settings, and the return to normal provision of services or health care functioning was not described as a problem.

Papers from China (Hong Kong SAR and Taiwan), highlighted increased levels of stress among health workers during the SARS outbreaks and associated incidences of extreme stress and burnout (84,85). Although not included in this scoping review because they did not describe an intervention, the lessons learned and reflections on the effects of these outbreaks on health workers, for example, the views of maternity staff on using additional PPE, coping strategies and resilience, are informative for the COVID-19 pandemic (84,86,87).

INTERVENTIONS

All three papers that met the inclusion criteria were from Canada (Toronto) and all related to maintaining provision of maternal and/or newborn care (summarized in a table available in the Web Annex, Section 4.1). All were written by health-care providers involved in service provision, two from the perspective of a hospital/clinic *(88,89)* and one from the perspective of a network of hospitals in the city *(90)*. All three described immediate changes to service provision made necessary by the closure of hospital wards and outpatient clinics. One also reported lessons learned from the reopening of services after the SARS outbreak was declared to be over.

The interventions described in these papers include several elements of rapid response; these elements are described below.

Maternal and newborn health

Adapting service provision to minimize risk of infection in maternity wards *(89)*. This included developing PPE guidelines for health workers and maternity service users, screening of women before admission onto a maternity ward, changes to rules on companion of choice at birth (only one allowed) and postnatal ward visits (none allowed). Mothers of newborns in neonatal ICUs were allowed to stay in hospital. The length of postnatal hospital stays was reduced. Staff-related interventions included rota changes (duration of shifts) to minimize cross-exposure and quarantining among staff and minimum possible staffing of maternity wards (nurses and one obstetrician in person, all other doctors working on call from home by telephone) until all maternity ward inpatients were discharged and the ward was closed.

Processes for closing down and reopening services in maternity wards *(88,89)*. These included providing information to every woman booked to give birth in the affected hospital, making an ambulance available to transfer women arriving in labour to other hospitals, and follow-up by letter or telephone to monitor high-risk infants whose outpatient visits were cancelled.

Coordination with other facilities for inpatient referrals and transfers *(89,90)*. Hospitals with SARS ICUs closed maternal and newborn care units; other hospitals in the Toronto area were then overwhelmed with SARS cases. There was an immediate need for all Toronto hospitals with neonatal ICUs to coordinate regarding patient capacity, especially to organize safe transfers, including the handover of transported patients because workers transporting patients from hospitals with a SARS ICU were not allowed to enter receiving hospitals.

EVALUATIONS

One of the three included papers included a self-evaluation of the decision by a neonatal neuro-developmental follow-up clinic to tell parents not to attend scheduled appointments but instead to use mail or telephone to answer the Ages and Stages Questionnaire (a standardized parent-completed survey to assess five domains of development) or to postpone or cancel their visit (88). The retrospective study compared the developmental assessment and its outcomes (diagnostic accuracy, appropriate referral and return to follow-up rate) in two groups of the clinic's patients, one during the SARS outbreak and the other two years later. The study sample was 95 patients during SARS, and 99 patients later. The evaluation concluded that the decrease in follow-up rate was much greater during the SARS period than it was two years later. The authors discussed the importance of telephone follow-up after remote completion of the questionnaire. They concluded that in the absence of planning, patient care was disorganized in this non-urgent outpatient clinic.

DISCUSSION

There was little literature on the nature of interventions to maintain the provision and use of essential health services for the target populations of this review during SARS outbreaks in 2003. All three included papers were from a high-income setting (Canada), and related to provision (supply) of maternal and newborn care. It is possible that, given the localized SARS outbreaks, few formal interventions were put in place, and few of the informal/spontaneous interventions were published. From the 11 papers extracted from full text, several lessons can be learned. Haphazard and ill-prepared service provision resulted in low follow-up of outpatients during clinic closures, and in lack of remuneration of health workers for providing services virtually. A clear need to coordinate health facility closures and redirect patients to other facilities was identified, including informing patients about closures and follow-up contacts. Several papers reported that health workers experienced stress and trauma during the SARS outbreak, whether or not they cared for SARS patients. Contributory factors included lack of knowledge about the emerging disease, not knowing whether the outbreak was over and thus when and how to restore services, and the additional burden of PPE requirements. Several papers suggested that lessons from SARS would be useful in any future flu pandemic, including the needs for advance planning and coordination of all elements of health service provision, including staffing (88,89,91,92).

4.5 COVID-19

The search for literature related to COVID-19 included additional terms, but was limited to problems arising from the pandemic and affecting the continued provision and utilization of MNCAAH health services. We screened 3968 unique titles and abstracts, reviewed the full text of 118 papers and included 53 that described an intervention. Due to the timing of the literature search (December 2020), most of the papers concerned care provision during the first waves of the COVID-19 pandemic, in the first half of 2020.

CONTEXT

COVID-19 is the disease caused by a new coronavirus called SARS-CoV-2. WHO first learned of this new virus on 31 December 2019, following a report of a cluster of cases of "viral pneumonia" in Wuhan, China. Following its rapid global spread, WHO declared COVID-19 to be a pandemic in March 2020. While the highest mortality rates from COVID-19 occurred among older people and those with co-morbidities, the measures taken to reduce its spread, and the shortages of PPE and health workers, led to the widespread disruption of many health services. In June 2020, WHO issued operational guidance on maintaining essential health services, including practical actions to be taken by countries at national, subnational and local levels to reorganize and maintain safe access to essential health services during the pandemic (*6*).

Most of the included papers are from HICs: 20 from the USA, four from Spain, three from Singapore, two papers each from Canada, France, Germany, Italy and the United Kingdom, and one paper each from Australia, Ireland and New Zealand. LMICs were represented by six papers from India, two from China and one each from Argentina, Lebanon, Nigeria, Tunisia and Zimbabwe.

PROBLEMS

The following synthesis of the problems encountered during the COVID-19 pandemic includes the 118 papers extracted from full text. Not all papers clearly explained the specific problem underlying the intervention, or the problem(s) most relevant to the intervention they describe. Most papers focused on the limitation of face-to-face care provision. The main reason for this, in all contexts, was the urgent need to prevent infections in health facilities among and between care providers and care users, including the need to shield vulnerable people from infection (e.g. children with kidney failure, people with reduced immunity). More context-specific problems were lack of demand for health services because people were wary of seeking care, as well as movement restrictions during lockdowns, lack of available transport and lack of finances to pay for transport. Overall, most papers focused on problems with both supply and demand. No papers specified that the problem was caused solely by reduced demand for health services, but this might be due to the specific search terms used.

The inability to provide face-to-face care, described as a sudden and immediate suspension or reduction, was due predominantly to the risk of infection by SARS-CoV-2 in health facilities. Staff shortages due to health workers being re-assigned in response to COVID-19 were not cited in any of the included papers as a reason for limiting health-care provision. School-based health services were suspended, together with in-class education. Papers also described particular difficulties in providing care to new patients, especially when diagnosis required facility-based equipment (e.g. MRI scan) and in making treatment changes (e.g. linkages between providers, referral pathways, prescriptions for medications). For health care requiring face-to-face care, the papers covered issues concerning: identifying which patients needed face-to-face care; how to test patients for SARS-CoV-2 symptoms in advance of face-to-face care; and how to make face-to-face care safe for both health workers and patients. The last issue includes how to keep patients with suspected SARS-CoV-2 infection apart from other patients (e.g. in maternity wards), how to increase the physical distance between providers and patients during personal interactions, and how to safely reduce the number of visits (e.g. antenatal care), length of face-to-face consultations and duration of inpatient stays.

In terms of care utilization, the reviewed papers noted that the need for care increased during COVID-19, for example, the need for health education and preventive care such as exercise among older people. Both new and pre-existing problems (poverty, lack of employment, isolation during lockdowns, domestic violence) exacerbated the need for health care. The occurrence of and linkages between these issues were complex and context-specific, and affected different target populations differently: this had implications for finding effective solutions. For example, mental health needs among children, adolescents and older people were affected differently by measures such as lockdowns and limits on face-to-face care. In addition, willingness and ability to use health services declined: patients and their caregivers were more hesitant to seek face-to-face care and/or less able to reach health providers or facilities.

INTERVENTIONS

A table presenting details of the 53 included papers describing health service interventions during COVID-19 is available in the Web Annex, Section 5.1. All the target populations to which the health services were relevant were captured, with children

being most frequently targeted. The most commonly described health services were child health (n=21), mental health (n=18) and management of noncommunicable diseases (NCDs) (n=13), with significant overlap between these issues. For example, seven papers concerned the intersection of child health and mental health, and five described health care for children with NCDs.

Many of the papers described complex and rapidly changing interventions made in order to continue providing care during the pandemic. With a few exceptions, most of these interventions involved digital health, and the papers described in detail how teams and facilities rapidly organized and adapted, and the enablers of this transition. Almost entirely reported by clinicians, care teams and hospital teams, none of the papers described external interventions or evaluations. Many of these clinical teams, especially those from HICs, reported having some digital health provision in place before COVID-19. The literature on digital health interventions also stressed that the option of providing face-to-face care must be maintained at all times, for example, to treat emergencies, to provide care that cannot be exclusively virtual (e.g. childbirth) and to conduct diagnostic tests.

The following summarizes the interventions for each health area.

Reproductive, maternal and newborn health

Interventions concerning maternal and newborn health included medical abortion, in vitro fertilization care, antenatal and childbirth care, and inpatient newborn care. The 13 included papers described interventions with various components, such as fully or partly replacing face-to-face antenatal care with virtual appointments, providing supplies to women at home (medical abortion kits), health worker training, development of screening and triage protocols, and reducing the number of staff providing care to newborns *(93–105)*. The only paper from sub-Saharan Africa (Zimbabwe) covered obstetric care and described a digital health intervention in which volunteer clinicians' telephone numbers were publicly posted so that people with obstetric emergencies could contact them if lockdown travel restrictions prevented them from reaching care *(104)*. The patient would be attended in the nearest hospital by contacting an obstetrician or gynaecologist working in or near the facility. Interventions that did not rely on digital health included: setting up a drive-through antenatal care outpatient service in Texas (USA) *(99)*; adapting a staff shift system to reduce exposure of staff in India *(103)*; and adapting a health facility to provide care for women with COVID-19, including considerations such as staff accommodation and transport *(101)*. Lastly, one paper from a region of Italy described interventions in and between health facilities for ongoing provision of maternal and newborn care where extensive coordination of available capacity was required *(100)*.

Child and adolescent health

Interventions to maintain the provision and use of health services for children and/or adolescents were covered by 23 papers. Provision of outpatient mental health care was described by 18 papers, including specific issues such as neuropsychiatry, epilepsy, migraines, eating disorders, NCDs (diabetes), ophthalmology, laryngology, general health care and SRH *(106–123)*. All these interventions involved a transition to virtual care provision for some or all consultations. Some of these papers also reported the development of protocols for triaging patients to identify those most urgently needing a face-to-face consultation, to fill or change prescriptions, and/or to continue accepting new patients requiring diagnostic procedures or equipment (MRI scans, eye tests).

One paper from the United Kingdom described a digital health adaptation of paediatric hospice care *(124)*. Four papers discussed interventions to maintain inpatient care. This was done either by opening separate COVID-19 wards *(125)* or by shortening length of stay and reducing risks of infection (e.g. no visitors) *(126)*. A paper from Italy described an intervention in a paediatric emergency department to triage and prioritize urgent cases, using diagnostic protocols, a computer algorithm and clinical input *(127)*. Lastly, a paper from New Zealand responded to increased need for mental health support (due to closure of school-based services) by launching a mobile phone application *(128)*.

Health of older people

We included 14 papers describing interventions concerning care for older people during the COVID-19 pandemic *(129–142)*. These were implemented in various settings, including in general practice and long-term care facilities (including staffing and training), and for care specific to NCDs and mental health. Issues related to COVID-19 screening, management and prevention were identified. Many of the interventions described adopted a holistic approach to patients' health and well-being, including consideration of housing, social and mental health needs, multiple comorbidities and movement restrictions (due to lockdown or old age), and also components of education and awareness-raising about COVID-19, its symptoms, prevention and treatment (examples include Singapore *(140)* and New York *(130)*). Virtual care provision featured in many of the interventions and involved a wide range of both platforms and objectives.

Health of the general population

Three papers described health service interventions for the general population, including outpatient care for epilepsy *(143)*, ophthalmology *(144)* and diabetes *(145)*. All these featured virtual consultations and triaging for emergency care.

Interventions using digital health to maintain the provision of care during the COVID-19 pandemic

Given the extensive use of digital health care interventions in the 53 included papers, a synthesis of relevant considerations is provided. Of the 53 papers, 47 presented interventions relying fully or partly on the use of digital health. The remaining six papers discussed predominantly staffing practices *(142)* or patient flow management *(99)* to reduce risk during in-person care, or provision of separate care pathways for inpatients with COVID-19 infection *(101,103,125,141)*.

All the interventions involving digital health described rapid changes, within days or weeks after the initial disruption of face-to-face care: *"The good news is that it took only 6 weeks for a large training programme to move from beginning considerations to actual implementation of a stable HB-TMH [home-based telemental health] programme. The bad news is that it took 6 weeks to do so" (120)*. The papers described the need to work in teams (clinicians, administrators, ICT professionals, billing staff, volunteers, etc.) where coordination was essential to set up and continue to provide health care virtually. Despite the fact that in many settings some form of digital technology was already used for various elements of care *(107,128,135)*, the speed and scale of adaptation were extremely resource-intensive in terms of both time and money. For example, Jiang et al. (2021) noted that *"[o]ur early experience with this large-scale telemedicine adoption process made us realize that, to complete a successful telemedicine encounter, the scheduling and previsit workflow is extremely labour- and time-intensive" (109)*. Additionally, setting up clinical care guidelines, screening protocols and triage decision-trees played important roles in this process. These documents also needed to be updated frequently (sometimes daily), requiring extensive coordination and effective communication with the many members of the health-care team.

Types of digital health interventions

The majority of papers reported interventions put in place by actors within the first level of care (i.e. clinical teams, clinics, hospitals) providing one well defined service. A small number of papers described interventions by health workers to provide comprehensive care (e.g. general practice) *(123)* or a continuum of care (e.g. including linkages to social or mental health care for older people) *(130)*. One paper reported digital adaptations to health-care provision from a regional perspective (Lombardy, Italy *(100)*) and one described national provision of abortion care using self-administered, home-based medical abortion supported by virtual consultations in the United Kingdom *(93)*.

The digital interventions needed were described as being either patient-facing or practice-related (clinic, provider) *(134)*. A third type of digital intervention identified was the adaptation of a provider network or, more broadly, of the connections within a health system. Practice-facing interventions included setting up virtual processes to ensure continuity in electronic health records and billing, and to address the needs of health workers (e.g. by disseminating updated guidelines, providing training, and managing stress among staff) *(134)*. Adaptations to connections between health services and the broader health system covered issues such as communicating updated medical prescriptions to pharmacies, ensuring successful referrals to other providers, and making connections with social care agencies.

The majority of papers described patient-facing interventions. Within this category, digital health approaches were used for various reasons. First, standard operating procedures and remote diagnosing helped to ensure successful triage of patients for face-to-face care. Second, patients were contacted and screened remotely for COVID-19 symptoms before face-to-face interactions. Third, existing patients were followed up remotely where face-to-face consultations might be cancelled or delayed, predominantly for outpatient clinics. Examples of such follow-up included: telephone calls to check on patients' needs (e.g. due to social vulnerability) and to disseminate information about COVID-19, and virtual sessions to support caregivers (e.g. family members) and to review prescriptions. Fourth, digital health was used to enrol new patients, although this was complicated by the limited access to diagnostics available only in face-to-face settings (e.g. eye examinations, MRI scans) and by other requirements, such as the need for patients to sign consent forms *(110)*. Fifth, adaptations were put in place to shorten the duration of face-to-face encounters (e.g. by taking patient histories virtually with only the physical examination taking place in person). Sixth, virtual consultations, phone calls and messaging were used to check that patients were using medications correctly, including the type and dosage (usually by sending to the clinician a photograph of the filled prescription via WhatsApp) *(115)*. Last, virtual care was provided in place of some face-to-face visits (e.g. some of a series of antenatal care appointments were in-person while others were virtual). Virtual visits were often accompanied by home-administered measurements, such as blood pressure during pregnancy or blood sugar of diabetic patients (examples include antenatal care in China *(94)* and in the USA *(102)* and diabetes management in Germany *(116)*).

Modality of digital health care provision

Digital health interventions involved three main types of interaction with patients: one-on-one, between a health worker and a patient only; between a health worker and a patient plus the patient's caregiver (e.g. a child and an adult) and/or language interpreter; and group interactions, for example, caregiver support sessions or patient group education sessions. Authors noted that, unlike the first two types, the third type of interaction was extremely rare before COVID-19, but was highly appreciated by caregivers because it allowed for mutual support and knowledge sharing *(138)*.

The included papers captured a broad range of digital health provision, including synchronous contacts (such as scheduled appointments), check-up calls (unscheduled, provider-initiated contact), and patient-initiated contacts (via an open hotline or contact number), as well as asynchronous contacts (including providing information via television programmes or YouTube videos, exchanging information via text messages or applications such as WhatsApp), collection of clinical information through monitoring or diagnostic applications, and data collection using an online survey of patients' needs. The platforms for contact were varied, and included telephone calls (audio-only), text messages, virtual teleconferencing (audio and video, via Zoom etc.), mobile device applications (telephones and tablets), television broadcasting and an online survey. Several authors noted that, in order to ensure high patient engagement, flexibility of platforms and types of interaction was highly desirable *(110)*. Some patients preferred audio-only calls; some transitioned to video calls as they developed trust in the connection. Others were not able to download and operate unfamiliar platforms. Despite their advantages, in many settings the type of virtual platform used was limited by legal and privacy issues.

The length of synchronous digital health consultations was reported by some papers, and was mostly short (8–10 minutes, 20 minutes for antenatal care). However, some longer interactions (50 minutes) were also noted, e.g. for new patient enrolment *(130)*. The need for simultaneous interpretation was noted as an additional complication in virtual interactions, but where this service was available, it seemed possible to integrate it into the interaction between health-care providers and patients (with their caregivers). Some papers also analysed the extent of patient "no-shows" for virtual appointments *(102,110)*.

Factors enabling digital health interventions

In addition to the human and financial resources required to implement new digital health interventions, several more structural enablers were highlighted. The first related to whether care provision without face-to-face contact was legally permissible. This was highlighted in papers concerning medical abortion in the United Kingdom *(93)* and changes to medicine prescriptions in India *(115)*. Second, many countries required the platform(s) used for patient-provider contact to be approved by national authorities, and to fulfil safety, confidentiality and privacy requirements. Early approval of platforms in some settings was attributed to the overall success in transitioning care away from face-to-face interactions. Third, some reports concluded that providers of virtual care should be paid for those services, for example, by health insurance companies, in order to make such care sustainable. In addition to these three main enabling issues, other considerations were also noted, such as provision of cost-free wireless networking technology to households for educational purposes being beneficial for remote provision of health care, and the critical role of access to and general support for ICT, including software. None of the papers discussed sharing of interventions with multiple providers or internationally, although the benefits of such exchange and learning might have resulted in substantial resource savings. On the whole, most authors were enthusiastic about the opportunities created by relaxing rules concerning virtual care provision, and expressed hope that the barriers that were removed due to the urgency of COVID-19 would increase the acceptability of remote care in future.

EVALUATIONS

Of the 53 papers related to COVID-19 interventions, 27 provided an evaluation. The findings from each evaluation are summarized in a table available in the Web Annex, Section 5.2.

The most commonly used method, used in 15 papers, was to analyse routinely collected data, for example, the number of consultations provided, service user outcomes, or service user non-attendance for scheduled telephone calls *(93,95,100,108–110,118–120,123,130,131,143–145)*. The second most common evaluation method was assessment of service user or caregiver satisfaction, used in six papers *(98,104,111,114,115,121)*. One paper measured both service users' and health workers' attitudes and experiences *(102)*, and two papers conducted qualitative research with health workers (focus groups) *(103)* and volunteers involved in providing care *(135)*. Authors of two other papers conducted qualitative research with provider networks or a range of stakeholders (patients, families, health workers) *(129,134)*. One paper presented a trial design *(132)*. Only one intervention not involving any component of digital health was evaluated *(103)*.

DISCUSSION

The 53 included papers described many lessons learned, predominantly about interventions using digital health. Some of the most important enablers mentioned were: removal of legal barriers (e.g. privacy on virtual platforms, home medical abortion); availability of electronic health records; receipt of payments from insurers for digital health consultations; administrative support for transition to and scheduling of virtual appointments; and guidelines or algorithms to screen and triage those needing face-to-face emergency care. Provision of care using digital health was lauded by providers and appreciated by patients as a vital means of maintaining care and contact with health services. This mode of provision required frequent adaptations and changes to protocols on the patient-facing side. A video connection was not always necessary: audio calls were often the first step towards establishing patients' trust in remote contact, particularly for patients and caregivers previously unfamiliar with ICT.

Beyond digital health, several other lessons were reported. First, maintaining health services was hampered by the disruption of medical training in health facilities. Second, interventions reducing the number of health workers or the duration of face-to-face contact with patients often involved task-shifting from doctors to nurses, putting nursing at higher risk. Of the papers screened for inclusion, a substantial number described interventions addressing health workers' stress and resilience: unless these related specifically to services for MNCAAH, they were excluded. However, given the relevance to COVID-19 of experiences from the EVD and SARS outbreaks, it seems that lessons learned from those interventions will be highly relevant for coping with COVID-19 in the future.

5

SYNTHESIS OF INTERVENTIONS AND LESSONS LEARNED DURING DISRUPTIVE EVENTS THAT ARE RELEVANT TO COVID-19

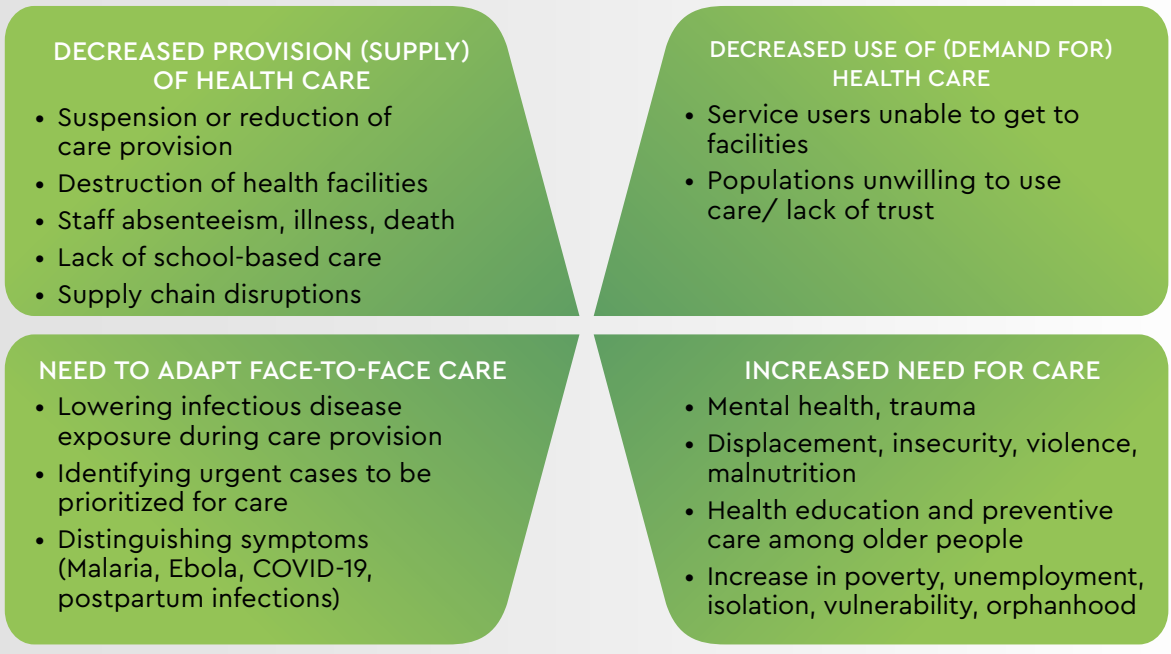
This section of the report summarizes the interventions related to problems identified across the various events (problem–solution mapping) and reflects on the lessons learned that are relevant to the COVID-19 pandemic.

In conceptualizing the initial framework of the scoping review during Phase 1, the focus was on developing a typology of interventions. In Phase 2, based on full text extraction, the framework was expanded by integrating problems. **Fig. 6** summarizes the four main types of problems identified in the literature related to all the included disruptive events.

We note that infectious disease outbreaks, such as EVD, SARS and COVID-19, present all four problems, although this was not always clearly stated in the papers. Additional problems caused by COVID-19 included, for example, a new need among target populations for information and knowledge (about mode of transmission of the unknown disease, recommended preventive behaviours, availability of health services, etc.).

We also listed the categories of problems chronologically from the date of the disruptive event. Annex 2 shows links between problems and relevant interventions from all included papers and their citation.

Fig. 6 Key problems in maintaining MNCAAH service provision and use in response to disruptive events



Below is a summary of the lessons learned in this scoping review from disruptive events that are relevant to COVID-19.

First, while not all four key problems were present to the same extent in all disruptive events, all four appear to have affected MNCAAH services during COVID-19. This was particularly the case for increased need for services, which in other disruptive events was due mainly to injuries and other direct impacts, such as disruption in food distribution leading to malnutrition. During COVID-19, the disruptions to services and care appears to be due largely to the public health and social measures imposed to curb the spread of the virus, such as school closures and lockdowns. Likewise, the inability to provide face-to-face services (to protect providers and service users from infection) was far more extreme and longer-lasting during COVID-19 than in other disruptive events. On the other hand, the papers on interventions during other events can help in preparing for and addressing the medium- and long-term effects of disruptions to MNCAAH services during COVID-19. This is because all the problems described for COVID-19 were immediate problems: interventions described in the included papers occurred mainly between February and June 2020, during the first wave of COVID-19. Persistent and slowly developing problems had not yet arisen or been reported at the time of the last search in December 2020. We identified few interventions for the medium- or longer-term. However, those that were identified are relevant to decreased provision of MNCAAH services and emerging needs, as well as increased socioeconomic vulnerability, and contain useful lessons for ongoing efforts to limit disruptions due to COVID-19 and to "build back better".

Second, we identified interventions in response to the reviewed disruptive events that addressed the health of all target populations. Children were the most common target population, with 41 interventions in total, around half of which were not COVID-19 related. Older people were the least commonly targeted population group, with a total of 16 interventions, 14 of which related to COVID-19. Interventions addressing disruptions in health services for the general population occurred mostly in the papers concerning natural disasters. When looking at health services in relation to problems identified, the areas most frequently addressed by interventions were mental health, maternal and newborn health and child health.

Third, the interventions varied greatly across disruptive events, ranging from adaptations of service provision in one clinic or hospital to national-level changes of policy on service provision. For EVD, natural disasters and humanitarian emergencies, the interventions in LMICs were often organized by external actors. This contrasted with interventions during COVID-19, which were exceptional in that many included papers described informal, organic adaptations to service provision with very few externally implemented interventions. Such interventions tended to be highly suitable for their context, being developed for a particular setting, including its policy, administrative and social context. However, the COVID-19 literature offers fewer lessons about coordinating and adapting interventions. This may be partly due to the need for rapid adaptations, but could also relate to lack of coordination mechanisms and national guidance on changes to service provision.

Most included papers concerning COVID-19 covered interventions to maintain specialized care provision (e.g. adolescent diabetes clinic, child epilepsy care); far fewer papers addressed the needs of a broader continuity of care (e.g. maternal/newborn continuum of care, including antenatal, childbirth and postnatal care; coordinated care such as collaborations between health services and social services). The few examples of interventions to provide continuous or comprehensive care services are very valuable.

COVID-19 was the only disruptive event where most of the reported interventions were made through digital health. We note that the literature reviewed does not adequately capture interventions by health authorities (district, regional, national), especially those for coordinating care provision and to maintain demand. This is an important gap, since included papers from other disruptive events showed that this element of response is essential for removing barriers to accessing MNCAAH services. Further, digital health interventions related to COVID-19 from low-resource settings were scarce, preventing comparison of problems and interventions from a broad range of settings. For example, a study from Zimbabwe reported that clinicians' mobile phone numbers were provided to pregnant women who needed help to access care for complications. This type of intervention was not reported in high-resource settings. It is likely that many other context-appropriate, innovative digital health interventions have been implemented but not yet captured in the literature.

Fourth, we summarize several key lessons about interventions to mitigate disruptions to provision and use of MNCAAH services. Reviewing evidence spanning several types of events revealed the importance of the pre-existing context for both the problems that developed and the interventions that were well suited to addressing them. Pre-existing conditions include specific vulnerabilities in health systems which are likely to be exacerbated by a disruptive event. Governance, coordination and open channels of communication between health-care providers and regional/national health authorities are critical during an event such as

COVID-19, when a rapidly evolving situation requires service provision guidelines to be adapted and disseminated speedily. The importance of sharing information within a health system had already been highlighted, for example, by unnecessary duplication of interventions in health facilities. Infrastructure coordination should also include referral and coordination between providers within a local area to coordinate closures and reopenings of health facilities, interfacility transfers and provision of information to service users. A positive example of coordinated intervention was reported in the literature on SARS.

Communication between health authorities and health providers must be two-way, so that providers can rapidly tell health authorities what factors are affecting health-care provision and utilization, and what is needed to maintain service provision (e.g. ability of health personnel to get to work), to ensure accessibility for different populations, and to meet emerging health needs. Coordinated channels of communication and learning are also important when preparing for future disruptive events: for example, lessons learned during SARS were shared among nurses during COVID-19 *(140)*; lessons from the Zika response were applied to COVID-19 *(146)*; and a digital health platform developed in New Zealand after the Christchurch earthquake was quickly adapted for use in the COVID-19 response *(128)*.

Several gaps were identified in the documentation of interventions addressing MNCAAH service disruptions that could contribute to improved learning and preparedness in the future. Areas reported in very few papers include: evidence about which interventions were used to communicate with populations about ongoing changes to service provision (facility closures, new guidelines); and interventions by regional and national health authorities and governments, particularly in low-resource settings. Documenting and disseminating lessons learned from the latter should be a priority.

Lastly, the included papers reported many different forms of evidence and learning, not always presented as formal evaluations. Papers that included an evaluation use different study designs, even randomized controlled trials. However, many papers did not fully describe interventions. Given the scarcity of reliable evidence, any kind of stock-taking during and after a disruptive event can be very useful for learning across settings, across disruptive events, and for preparedness activities. We synthesized the lessons reported in the literature, and mapped the problems and interventions which can help inform preparedness and actions to maintain essential MNCAAH services.

To enhance the understanding of interventions that can mitigate disruptions to essential services, it would be useful to develop and apply standard criteria for reporting such interventions and evaluations in the literature. Improved reporting and signposting (terms from the Medical Subject Headings thesaurus, key words) of such papers would also make future literature searches more efficient. The results of studies (e.g. description of intervention, assessment of quality, information about the evaluation) could then be used to compile a publicly accessible database of interventions. Although conducting high-quality research about interventions implemented during disruptive events is challenging, work can be done now to make available pre-prepared research protocols, instruments and supporting documents.

ANNEXES

ANNEX 1

Framework of interventions developed in Phase 1, based on 144 references describing an intervention

INTERVENTION TYPE	SUBTHEMES	EVENT TYPE	HEALTH SERVICE TYPE	INTERVENTION	POPULATIONS
1. Maintaining access to health services or finding alternatives to bring care closer to populations	Access to and maintenance of health facilities	All	Mental health	School-based care	Children, adolescents
				Psychological first aid	All
			Abortion care	Referral structures for safe abortion and post-abortion care	Women
		Humanitarian emergency (conflict, displacement, terrorism, nuclear accident)	General health service	Disaster shelters	All
				Mobile clinics	All
			Nutrition	Breastfeeding tents	Women, newborns
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)	General health service	Disaster shelters	All
				Mobile clinics	All
				Investing in flood resistant infrastructures	All
			Nutrition	Breastfeeding tents	Women, newborns
		Ebola	Maternal and newborn care	Maternity waiting homes	Women, newborns
	Transportation	All	General health service	Ambulance system	All
				Evacuation support	All
	Economic barriers	All	General health service	Cash transfer	All
				Removal of user fees	All
				Co-payment	All
2. Maintaining, strengthening and/or adapting the health workforce		All	General health service	Training of medical teams	All
				Regular training for nurses, midwives, obstetricians, paediatricians, general practitioners and other health workers	All
				Access to mental health counselling for health workers	All
				Group debriefings	All
				Medical relief team	All
				Building capable and sustainable auxiliary workforce	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)	General health service	Increasing health workers' motivation and feeling of safety at work	All
				Improving data collection for care and referral: scorecard with performance targets that are collectively discussed	All
				Providing incentives to health workers	All
			Maternal and newborn care	Intrapartum training package	Women, newborns
		Ebola, SARS, COVID-19	General health service	Providing adequate personal protective equipment	All
				Increasing health workers' motivation and feeling of safety at work	All
3. Ensuring collaboration between different health services, institutions and health workers		All	General health service	Designing adapted protocols (also for mental health teams)	All
				Actively involving stakeholders	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)		Pre-event planning with community partners (preparedness)	All
		Zika	Family planning	Delivering contraceptives with local partners	Women, adolescents
		Ebola (and other infectious disease outbreak)	General health service	Early Warning Scores implementation to improve referrals to intensive care	All

INTERVENTION TYPE	SUBTHEMES	EVENT TYPE	HEALTH SERVICE TYPE	INTERVENTION	POPULATIONS
4. Adapting interventions to the local context		All	General health service	Gender-sensitive approach	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)		Age-sensitive approach	All
		Ebola		Culturally-adapted public health messaging	All
				Social workers at facilities to increase use of facility-based care	All
		SARS, COVID-19		Use of social science for better understanding of context	All
5. Involving stakeholders and local communities		All	Mental health	Involving schools	Children, adolescents
			General health service	Community health workers (implementing or training)	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)	Mental health	Community informant detection tool for mental health	All
				Community-based therapists	All
		Ebola	Prevention and screening activities	Training and communicating with traditional healers for prevention, screening and referring to health-care facilities when needed	All
6. Using digital health		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)	General health service	Teleradiology	All
				Portable ultrasound	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon) specific to high-income countries	Mental health	Online anxiety treatment/management programme	All
				Web-based mental health counselling	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon) specific to low- and middle-income countries	General health service	Mobile phones distribution	All
		Ebola (but applicable to all respiratory infectious outbreaks)	General health service	Building an oxygen factory to supply reliable high flow piped oxygen	All
		COVID-19	General health service	Digital health	All
7. Maintaining access to essential supplies and commodities (medicines, vaccines, nutrition, etc)		All	General health service	Optimizing resource allocation	All
				Mass media campaigns and strategies to maintain blood donation	All
		Natural disaster (earthquake, tsunami, flood, hurricane, typhoon)	Reproductive health and family planning	Reusable menstrual pads	Women, adolescents
				Distribution of contraceptives and/or shelters or mobile units dispensing modern contraceptives	Women, adolescents
				Implants and injectable contraceptives (long-term family planning)	Women, adolescents
		Resource limited situations	Vaccination	Cold boxes for transportation of vaccines	Women, newborns, children
				Vaccine vial temperature monitors (to check if vaccines are still usable)	

Note: All = women, newborns, children, adolescents, adults/older people, general population

ANNEX 2

Mapping problems and interventions by time since disruptive event

This Annex lists all 120 interventions included following full text review in Phase 2. Each intervention appears only once, next to the most relevant problem. Problems are chronologically arranged from the time of the disruptive event (immediate, mid-term and long-term). Each intervention is shown according to the type of event and the targeted population(s). Some interventions had multiple components; those for which it was not possible to capture the components in a short description are listed in the separate category "Complex interventions" under the problem type "Multiple specific issues". For these interventions, only the unique components (i.e. those not appearing elsewhere in the table) are listed.

PROBLEM	INTERVENTION	TYPE OF EVENT	POPULATION(S) TARGETED BY THE INTERVENTION	REFERENCES
IMMEDIATE: DECREASED SUPPLY/PROVISION OF CARE				
Cannot provide face-to-face care due to risk of infection (between health workers and patients and between health workers)	Providing outpatient care through (or partly through) digital health	COVID-19	Children, adolescents, general population	O'Hara et al. 2020 *(107)*, Jiang et al. 2020 *(109)*, Ziegler 2020 *(116)*, Charfi et al. 2020 *(119)*, Sharma et al. 2020 *(120)*, Barney et al. 2020 *(123)*, Willems et al. 2020 *(143)*
	Enabling elements of care to be self-administered at home	COVID-19	Women	Parsons et al. 2021 *(93)*, Merhi et al. 2020 *(95)*
	Providing virtual channels for caregivers to contact health workers	COVID-19	Children	Semprino et al. 2020 *(111)*
Need to determine who requires urgent face-to-face care	Triage protocols enabling prioritization of patients requiring in-person care, non-urgent cases provided through digital health consultations	COVID-19	Children, general population	Govil et al. 2020 *(110)*, Pritchard et al. 2020 *(113)*, Ferretti et al. 2020 *(127)*, Das et al. 2020 *(144)*, Joshi et al. 2020 *(145)*
Need to adapt care that needs to continue face-to-face to reduce risk of infection	Drive-through antenatal care provision	COVID-19	Women	Turrentine et al. 2020 *(99)*
	Parts of inpatient care provided through digital health interventions	COVID-19	Children, adolescents	Baweja et al. 2020 *(117)*
	Adaptations to both inpatient and outpatient care (reducing number of visits, reducing length of inpatient stay, transitioning to digital health interventions for outpatient care)	COVID-19	Children, adolescents	Graell et al. 2020 *(118)*, Davis et al. 2020 *(126)*
	Comprehensive adaptation to screening, care provision, length of stay and staffing of obstetric ward	SARS	Women, newborns	Owolabi et al. 2004 *(89)*
	Reducing the number of health workers attending to inpatients, virtual means of discussing treatment in the team	COVID-19	Newborns	Umoren et al. 2020 *(105)*
	Coordination and adaptation of health worker staffing, shifts, practices in inpatient/residential settings where separation of COVID-19 suspects is required	COVID-19	Older people	Patel et al. 2020 *(136)*, Arevalo et al. 2020 *(141)*, Gilbert 2020 *(142)*
	Screening of patients and organizing two pathways (COVID-19 positive versus negative) for provision of inpatient care, including adaptations to staffing arrangements	COVID-19	Women, newborns, children, adolescents	Mahajan et al. 2020 *(101)*, Mahey et al. 2020 *(103)*, Cohen 2020 *(125)*
	Physical distancing adaptation to outpatient consultations	COVID-19	Adolescents	PSI 2020 *(122)*
	Adaptation of staff shifts to reduce infection risk (in a setting with continued home visits to vulnerable adults)	COVID-19	Older people	Yi et al. 2020 *(140)*
Health facilities destroyed or damaged	Mobile phones given to health workers to enable care provision outside of health facilities and to link to communities	Natural disaster	Adolescents	Chib et al. 2011 *(51)*
	Provision of care using digital health interventions	Natural disaster	General population, children	Murren-Boezem et al. 2020 *(47)*, Uscher-Pines et al. 2018 *(48)*, Grover et al. 2020 *(50)*
	Adapted means of transport (tricycles) to reach health facilities	Natural disaster	Women, newborns	Barmania 2014 *(43)*

PROBLEM	INTERVENTION	TYPE OF EVENT	POPULATION(S) TARGETED BY THE INTERVENTION	REFERENCES
Closure of health facilities to reduce risk of infection	Coordination of care and referral to use other facilities	SARS, COVID-19	Women, newborns	Whyte et al. 2003 *(90)*, Ferrazzi et al. 2020 *(100)*
Insufficient health workforce, including health workers injured/ unable to work	Coordination of services to ensure continued availability of caesarean section care	Ebola	Women, newborns	Drevin et al. 2019 *(13)*
	Support in provision of intensive care using digital health interventions	Humanitarian crisis	General population	Moughrabieh et al. 2016 *(79)*
Disruption in supply of medical equipment and supplies	Blood collection coordination	Natural disaster	General population	Noel et al. 2012 *(58)*
Inability to provide outpatient follow-up visits after discharge	Cancelling of outpatient visits and follow-up through questionnaire mailed to parents	SARS	Newborns	Nasef et al. 2010 *(88)*
School-based provision of services suspended	Game (app) adapted to be a mental health screening tool, linking to care provision	COVID-19	Children, adolescents	Merry et al. 2020 *(128)*
Disruption in routine childhood immunizations	Campaign to alert households on the importance of routine immunizations and antenatal care	Ebola	Children	Jalloh et al. 2015 *(23)*
	Provision of routine immunizations to displaced populations	Natural disaster	General population	Rainey et al. 2013 *(62)*
IMMEDIATE: DECREASED DEMAND FOR/USE OF CARE				
Health communications and interventions not adapted to local context (e.g. burial practice changes) causing people to avoid health facilities	Develop and disseminate health messaging with community inputs	Ebola	General population	Kinsman et al. 2017 *(14)*
Lack of access to health facilities (lack of transport, lockdown, financial barriers)	Free specialist consulting services (by phone) to members of the public who could no longer access health facilities due to lockdown measures; facilitate connection to health facility if needed	COVID-19	Women, newborns	Moyo et al. 2020 *(104)*
	Removal of user fees to increase demand for and affordability of care	Ebola	General population	Hung et al. 2020 *(15)*
Lack of information about health service availability	Facebook group with information on services created	Natural disaster	General population	Albris 2017 *(42)*
IMMEDIATE: INCREASED NEED FOR CARE				
Increased mental health needs due to stress, loss, trauma, post-traumatic stress disorder, behavioural issues, stigma from quarantine and school closures; pre-existing shortage of mental health provision	Child-led radio broadcasts with educational programmes	Ebola	Children, adolescents	Barnett et al. 2018 *(18)*
	Provision of psychological treatment in the community	Ebola	Children, adolescents	Decosimo et al. 2019 *(20)*
	Provision of psychological treatment in the community, including in child tents	Natural disaster	Children, general population	Gamini et al. 2019 *(28)*, Sumasto et al. 2019 *(49)*
	Provision of psychological treatment in schools	Ebola	Children, adolescents	World Bank 2018 *(19)*
	Provision of psychological treatment in schools, including task-shifting of screening and treatment to teachers (some of the interventions were also in the mid-term timespan)	Natural disaster	Children, adolescents	Save the Children 2010 *(35)*, Dhital et al. 2019 *(45)*, Berger et al. 2009 *(57)*, Cohen et al. 2009 *(64)*
	Information campaigns on mental health combined with organizing activities for children	Natural disaster	Children	Kikuchi et al. 2012 *(63)*
	Integrating psychologists in primary care	Natural disaster	General population	Martin et al. 2015 *(41)*
	Provision of psychological first aid	Natural disaster	General population	Hamblen et al. 2010 *(72)*
	Screening children for psychological distress in the community and referral	Humanitarian crisis	Children	Marquer et al. 2015 *(82)*

PROBLEM	INTERVENTION	TYPE OF EVENT	POPULATION(S) TARGETED BY THE INTERVENTION	REFERENCES
High number of injured people requiring urgent treatment	Organizing a rapid deployment workforce	Natural disaster	General population	Iskander et al. 2018 *(69)*
	Rapid provision of surgical care for injuries sustained in natural disaster	Natural disaster	Children	Walk et al. 2011 *(56)*
	Provision of diagnostic care (ultrasound)	Natural disaster	General population	Shorter et al. 2012 *(59)*
People living in temporary or damaged housing are vulnerable to disease and poor hygiene	Outbreak / disease surveillance	Natural disaster	General population	Polonsky et al. 2013 *(60)*
Increased need for care means higher expenses incurred by patients	Removal of health-care user fees for disaster survivors	Natural disaster	General population	Matsuyama et al. 2018 *(68)*
Need for additional health education (knowledge of COVID-19)	Health education using on-demand TV programming	COVID-19	Older people	Goodman-Casanova et al. 2020 *(132)*
Increased social isolation	Volunteers make contact with facility-dwelling and community-dwelling residents to identify needs and link to services	COVID-19	Older people	Office et al. 2020 *(135)*
	"Forward triage" or check-in calls: in the absence of regular outpatient care, contacting older/vulnerable people living in the community, rapidly assessing risk and providing tailor-made care recommendations	COVID-19	Older people	Benaque et al. 2020 *(131)*, Beauchet et al. 2020 *(133)*
Malnutrition	Provision of food and nutrition supplements, health education and house-to-house screening for malnutrition	Natural disaster	Women, newborns, children	Aguayo et al. 2015 *(44)*
	Community-based management of acute malnutrition through health facilities, mobile teams, integrated immunization campaigns and outreach and community health volunteers.	Humanitarian crisis	Children, general population	Al-Dheeb et al. 2018 *(80)*
Disruption in breastfeeding (maternal malnutrition, stress, insecurity, lack of safe spaces)	Baby tents or breastfeeding spaces	Natural disaster	Women, newborns, children	Hargest-Slade et al. 2015 *(40)*, Ayoya et al. 2013 *(53)*, Talley et al. 2013 *(54)*
Women's and adolescent girls' heightened vulnerability to poor maternal, sexual and reproductive health and to gender-based violence	Creation of safe spaces in camps as an entry point for reproductive health information and services including family planning and psychosocial counselling for gender-based violence in displaced peoples' camps	Humanitarian crisis	Women, adolescents	UNFPA 2016 (Nigeria and Pakistan) *(46)*
	Provision of reproductive and maternal care through a mobile clinic and a temporary fixed clinic	Humanitarian crisis	Women, adolescents	UNFPA 2016 (Myanmar and Somalia) *(46)*
	Provision of the "Minimum Initial Service Package for Sexual and Reproductive Health" in crisis situations, including family planning and health education	Humanitarian crisis	Women	Krause et al. 2015 *(78)*
	Distribution of reproductive health kits and educational seminars	Natural disaster	Adolescents	UNFPA 2016 (Nepal and Philippines) *(46)*
IMMEDIATE: INCREASED DIFFICULTY DISTINGUISHING SYMPTOMS				
Difficulty in triage, screening, diagnosing and treatment pathways potentially delaying treatment and causing crowding in health facilities	Provision of mobile phones to rural health workers, including midwives, to disseminate information about Ebola and to assist in diagnosis and treatment of common illnesses	Ebola	Women, newborns	West 2015 *(22)*
	Mass antimalarial drug administration	Ebola	General population	MSH 2014 *(17)*
	Training health workers to improve triage in health facilities	Ebola	General population	Parkes-Ratanshi et al. 2014 *(16)*

PROBLEM	INTERVENTION	TYPE OF EVENT	POPULATION(S) TARGETED BY THE INTERVENTION	REFERENCES
IMMEDIATE: MULTIPLE PROBLEMS				
Large-scale population displacement	Provision of / referral to safe abortion and post-abortion care to displaced populations	Humanitarian crisis	Women	Tousaw et al. 2017 *(75)*, Gallagher et al. 2019 *(81)*
	Adaptation of a community health worker intervention to provide treatment for common childhood illnesses in a conflict setting	Humanitarian crisis	Children	Kozuki et al. 2018 *(77)*
	Provision of temporary housing to the most vulnerable people	Natural disaster	General population, older people	Laditka et al. 2008 *(66)*, Saunders 2007 *(71)*
Care provision needs to be adapted to reduce risk in care settings and patients are fearful and less likely to seek care	Hospice care provision adapted to virtual home-based care	COVID-19	Children	Ellis et al. 2020 *(124)*
	Adaptations to provision of care through part digital health and home-based monitoring for antenatal care	COVID-19	Women	Chen et al. 2020 *(94)*, Zork et al. 2020 *(96)*, Aziz et al. 2020 *(97)*, Holcomb et al. 2020 *(98)* Jeganathan et al. 2020 *(102)*,
Issue with diagnosing when high-level equipment only available in health facilities is required	Triage of who needs care urgently and using digital health interventions in outpatient settings for non-urgent cases	COVID-19	Children	Kapoor et al. 2020 *(108)*
Need for additional health education, such as knowledge of COVID-19, preventive physical and mental health behaviours related to COVID-19 and lockdowns	Health education provision, digital health appointments and referral if needed	COVID-19	Older people	Wang et al. 2020 *(137)*
	Home-based visits adapted to digital health consultations	COVID-19	Older people	Franzosa et al. 2021 *(134)*
	Outpatient visits adapted to digital health consultations, with some degree of caregiver involvement and virtual caregiver support sessions	COVID-19	Children, adolescents, older people	Clary et al. 2020 *(106)*, Gurwitch et al. 2020 *(112)*, Sharawat et al. 2021 *(114)*, Lim et al. 2020 *(121)*, Weiss et al. 2021 *(130)*, Khoury et al. 2020 *(138)*
Disruption in medication prescription practices	Virtual engagement with patients, including drug dosage adjustment and/or home delivery of prescriptions	COVID-19	Children, adolescents, older people	Panda et al. 2020 *(115)*, Flint et al. 2020 *(139)*
Multiple specific issues	Complex intervention involving various events, populations and adaptations, with specific components listed below:	Natural disaster, humanitarian crisis, COVID-19	General population, women, newborns, older people	Tadashi 2013 *(67)*, Save the Children 2011 *(36)*, Save the Children 2010 *(55)*, Gzil et al. 2020 *(129)*, GIZ 2019 *(74)*
	Improving water, sanitation and hygiene infrastructure	*Natural disaster*		Save the Children 2010 *(55)*
	Medication delivery	*Natural disaster*		Tadashi 2013 *(67)*
	Free bus service to transport people to health facility	*Natural disaster*		Tadashi 2013 *(67)*
	Temporary employment for cash	*Natural disaster*		Save the Children 2010 *(55)*
	Training health workers using YouTube, activities for relieving boredom of long-term care facility residents, exchanges between health workers and other staff	COVID-19	*Older people*	Gzil et al. 2020 *(129)*
	Improving the supply of medicines and the quality of health services and bonuses paid to increase motivation of staff	*Humanitarian crisis*	*Women, general population*	GIZ 2019 *(74)*
IMMEDIATE: NO CLEAR EVENT-RELATED PROBLEM SPECIFIED				
Pre-existing weak health system exacerbated by disruptive event	Continued provision of maternity waiting home services	Ebola	Women, newborns	Perosky et al. 2020 *(21)*
	Preventing neonatal death through training of health providers	Humanitarian crisis	Newborns	Sami et al. 2017 *(76)*

PROBLEM	INTERVENTION	TYPE OF EVENT	POPULATION(S) TARGETED BY THE INTERVENTION	REFERENCES
MEDIUM-TERM (MONTHS SINCE EVENT): DECREASED PROVISION OF CARE				
Dysfunctional health facilities post-disaster (slow rebuilding) in low-resource settings	Training local health workers (midwives)	Natural disaster	Women, newborns	Floyd 2013 *(52)*
Coordination within the health system	Including public health nurses in disaster preparedness and response	Natural disaster	General population	Okuda 2018 *(70)*
MEDIUM-TERM (MONTHS SINCE EVENT): INCREASED NEED FOR CARE				
Mental health needs	School-based mental health programmes	Natural disaster	Children, adolescents	Lee et al. 2017 *(65)*
LONG-TERM (YEARS AFTER EVENT): DECREASED PROVISION OF CARE				
Disruptions in immunization programmes	Activities to monitor vaccine-preventable diseases and to catch up on coverage of immunization disrupted by natural disaster	Natural disaster	General population	Tohme et al. 2017 *(61)*
LONG-TERM (YEARS AFTER EVENT): INCREASED NEED FOR CARE				
Mental health needs, continued high levels of trauma and pre-existing shortage of mental health service provision	Provision of psychological treatment in schools, including task-shifting of screening and treatment to teachers	Natural disaster	Children	Chemtob et al. 2002 *(25)*, Amin et al. 2020 *(37)*
LONG-TERM (YEARS AFTER EVENT): INCREASED SOCIOECONOMIC VULNERABILITY				
Loneliness especially among older single people and isolated households	Community support, home visits	Natural disaster	Older people	Yotsui et al. 2015 *(39)*

ANNEX 3

Details of methods

1. SEARCH TERMS FOR PHASE 1

Search algorithm: (population AND health services AND circumstances)

POPULATION

Maternal OR antenatal OR ante-natal OR prenatal OR pre-natal OR gestati* OR childbirth OR birth OR intrapartum OR obstetric* OR labo?r OR pregnancy OR vertical OR postpartum OR post-partum OR puerper* OR perinatal OR maternity OR reproductive OR family planning OR contraception OR abortion OR miscarriage OR postabortion OR post-abortion OR birth attendant OR skilled birth OR c?esarean OR c?section OR eclampsia OR pre-eclampsia OR preeclampsia OR fertil* OR fundal OR f?tal OR Newborn OR new-born OR new born OR postnatal OR post-natal OR neonatal OR kangaroo OR low birthweight OR low birth-weight OR pre?term OR prematur* OR post?term OR skin-to-skin OR breastfeeding OR breast-feeding OR lactat* OR formula-feeding OR bottle-feeding OR breastmilk substitute OR Child* OR childhood OR infant OR postneonatal OR under five OR under-five OR underfive OR under 5 OR p?ediatric* OR growth OR infant feeding OR infant nutrition OR Adolescent* OR teen* OR youth* OR young adult* OR school-age OR young mother* OR young person* OR young people OR young wom?n OR Ageing OR aged OR older OR elderly OR elder* OR retire* OR senior* OR Vulnerable population*

HEALTH SERVICES

(Health adj3 delivery) OR (health adj3 utili?ation) OR (health adj3 services) OR (care adj3 provision) OR health-care OR healthcare OR (care adj3 worker*) OR (community adj3 worker*) OR obstetrician* OR midwife OR midwives OR nurse* OR (medical adj2 officer*) OR (clinical adj2 officer*) OR Health system* OR health facilit* OR maternity OR referral OR facility-based OR home-based OR school-based OR community-based OR Provision OR essential services OR essential healthcare OR indirect effect* OR collateral damage OR maintain* OR resilien* OR strengthen* OR sustain* OR mitigation strateg* OR cash transfer* OR user fee* OR helpline* OR digital OR telemedicine OR tele-health OR routine service*

CIRCUMSTANCES

Ebola OR EVD
Zika OR ZVD
Natural disaster OR hurricane* OR tsunami OR earthquake OR flood*
Disease outbreak* OR humanitarian

2. SEARCH TERMS FOR PHASE 2: SARS AND COVID-19

SARS

Search algorithm: (population AND health services AND circumstances)

POPULATION

Maternal OR antenatal OR ante-natal OR prenatal OR pre-natal OR gestati* OR childbirth OR birth OR intrapartum OR obstetric* OR labo?r OR pregnancy OR vertical OR postpartum OR post-partum OR puerper* OR perinatal OR maternity OR reproductive OR family planning OR contraception OR abortion OR miscarriage OR postabortion OR post-abortion OR birth attendant OR skilled birth OR c?esarean OR c?section OR eclampsia OR pre-eclampsia OR preeclampsia OR fertil* OR fundal OR f?tal OR Newborn OR new-born OR new born OR postnatal OR post-natal OR neonatal OR kangaroo OR low birthweight OR low birth-weight OR pre?term OR prematur* OR post?term OR skin-to-skin OR breastfeeding OR breast-feeding OR lactat* OR formula-feeding OR bottle-feeding OR breastmilk substitute OR Child* OR childhood OR infant OR postneonatal OR under five OR under-five OR underfive OR under 5 OR p?ediatric* OR growth OR infant feeding OR infant nutrition OR Adolescent* OR teen* OR youth* OR young adult* OR school-age OR young mother* OR young person* OR young people OR young wom?n OR Ageing OR aged OR older OR elderly OR elder* OR retire* OR senior* OR Vulnerable population*

HEALTH SERVICES

(Health adj3 delivery) OR (health adj3 utili?ation) OR (health adj3 services) OR (care adj3 provision) OR health-care OR healthcare OR (care adj3 worker*) OR (community adj3 worker*) OR obstetrician* OR midwife OR midwives OR nurse* OR (medical adj2 officer*) OR (clinical adj2 officer*) OR Health system* OR health facilit* OR maternity OR referral OR facility-based OR home-based OR school-based OR community-based OR Provision OR essential services OR essential healthcare OR indirect effect* OR collateral damage OR maintain* OR resilien* OR strengthen* OR sustain* OR mitigation strateg* OR cash transfer* OR user fee* OR helpline* OR digital OR telemedicine OR tele-health OR routine service*

CIRCUMSTANCES

SARS

COVID-19

Search algorithm: (population AND health services AND circumstances AND specific terms)

POPULATION

Maternal OR antenatal OR ante-natal OR prenatal OR pre-natal OR gestati* OR childbirth OR birth OR intrapartum OR obstetric* OR labo?r OR pregnancy OR vertical OR postpartum OR post-partum OR puerper* OR perinatal OR maternity OR reproductive OR family planning OR contraception OR abortion OR miscarriage OR postabortion OR post-abortion OR birth attendant OR skilled birth OR c?esarean OR c?section OR eclampsia OR pre-eclampsia OR preeclampsia OR fertil* OR fundal OR f?tal OR Newborn OR new-born OR new born OR postnatal OR post-natal OR neonatal OR kangaroo OR low birthweight OR low birth-weight OR pre?term OR prematur* OR post?term OR skin-to-skin OR breastfeeding OR breast-feeding OR lactat* OR formula-feeding OR bottle-feeding OR breastmilk substitute OR Child* OR childhood OR infant OR postneonatal OR under five OR under-five OR underfive OR under 5 OR p?ediatric* OR growth OR infant feeding OR infant nutrition OR Adolescent* OR teen* OR youth* OR young adult* OR school-age OR young mother* OR young person* OR young people OR young wom?n OR Ageing OR aged OR older OR elderly OR elder* OR retire* OR senior* OR Vulnerable population*

HEALTH SERVICES

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CIRCUMSTANCES

COVID OR SARS-CoV-2 OR coronavirus

SPECIFIC TERMS FOR COVID-19 SEARCH

Mental health OR Disruption OR PPE or Protection OR IPC OR transport OR transportation OR access OR lockdown OR quarantine OR isolation OR self-isolation OR confinement

3. DATA EXTRACTION TEMPLATE FOR ABSTRACTS

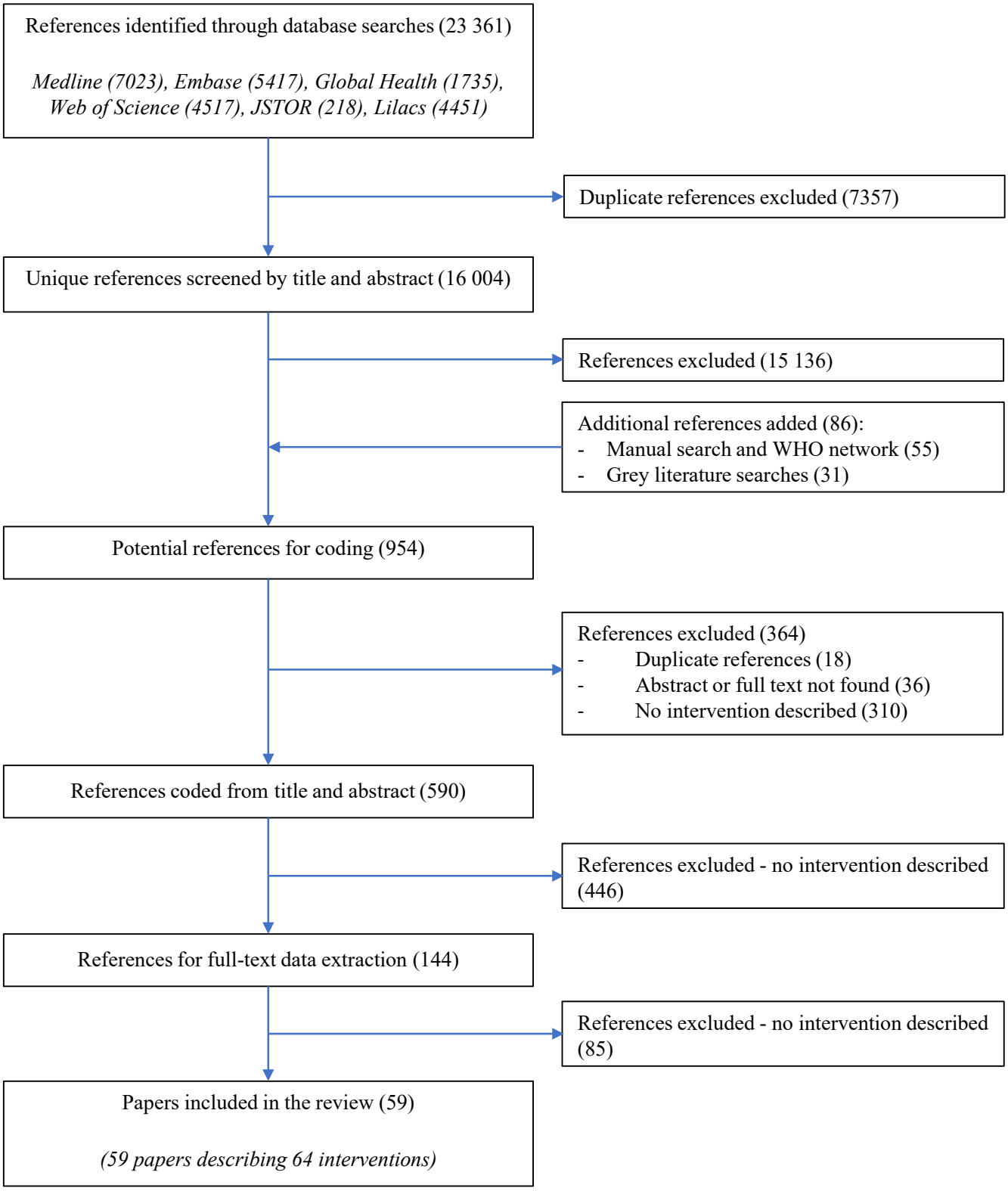
DIMENSION	ELEMENT	STANDARD CODE, IF USED
Details of reference	Title	
	Authors	
	Abstract	
	Year of publication	
	Journal	
	Volume	
	Issue	
	Pages	
	DOI	
Circumstance	Event type	COVID-19 Earthquake Ebola Humanitarian emergency Other Other infectious disease outbreaks Other natural disasters Resource-limited situations Respiratory infection outbreaks Tsunami Zika
	WHO Region	African Region, Region of the Americas, South-East Asia Region, European Region, Eastern Mediterranean Region, Western Pacific Region
	Country/countries	
Population	Women	Yes or No
	Newborns	Yes or No
	Children	Yes or No
	Adolescents	Yes or No
	Older people	Yes or No
	Unspecified/general population	Yes or No
	Related to health workers?	Yes or No
Health services	Health-service type	General health service Mental health Maternal and newborn health Child and adolescent health Prevention and screening activities Reproductive health topics Family planning Self-care Nutrition School-based services Vaccination Management of NCDs Abortion and post-abortion care Long-term care facilities and care homes Cancer treatment Care for disabled patients Health worker training/preparedness
	Health-service type (secondary)	Same as above
	Maintaining care provision	Yes or No
	Maintaining use of care	Yes or No
Problem and intervention	Problem(s) described?	Yes or No
	Intervention proposed?	Yes or No
	If yes, intervention type	
	Intervention implemented?	Yes or No
	If intervention implemented, was it evaluated?	Yes or No
	Scale of intervention (if implemented)	
	Other notes	

4. DATA EXTRACTION TEMPLATE FOR FULL TEXT PAPERS

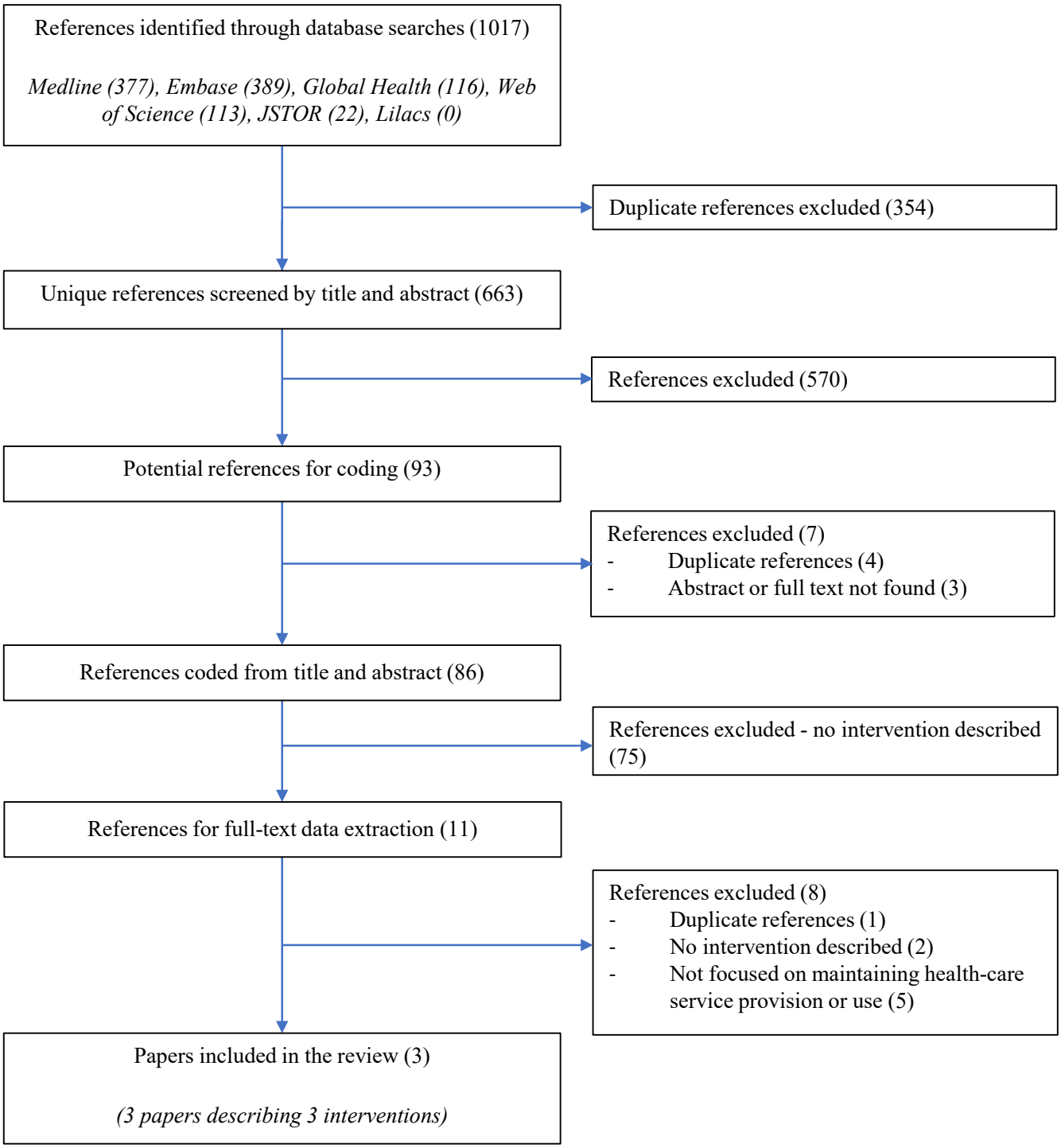
DIMENSION	ELEMENT	STANDARD CODE, IF USED
Details of reference	Reference of PDF document	
	Reference in title and abstract table	
	Title	
	Author(s)	
	Author(s) background and country	
	Did the authors perform the intervention OR the evaluation OR other (describe)	
Circumstance	Event type	Ebola
		Tsunami
		Earthquake
		Other natural disasters
		Zika
		Humanitarian emergencies
		Respiratory infectious disease outbreaks (excluding SARS and COVID-19)
		SARS
		COVID-19
		Other and resource limited situations
	Country/countries	
Population	Women	Yes or No
	Newborns	Yes or No
	Children	Yes or No
	Adolescents	Yes or No
	Older people	Yes or No
	Unspecified/general population	Yes or No
Health services	Health-service type	General health service
		Mental health
		Maternal and newborn health
		Child and adolescent health
		Prevention and screening activities
		Reproductive health topics
		Family planning
		Self-care
		Nutrition
		School-based services
		Vaccination
		Management of NCDs
		Abortion and post-abortion care
		Long-term care facilities and care homes
		Cancer treatment
		Care for disabled patients
		Health worker training/preparedness
	Health-service type (secondary)	Same as above

DIMENSION	ELEMENT	STANDARD CODE, IF USED
Problems	What was the problem?	
	Problem of demand (D), supply (S) or both (B)?	D or S or B
	Who suffers from the problem?	
	When did the problem occur regarding the disruptive event?	
Intervention and evaluation of the intervention	Description of the intervention (detailed)	
	Was the intervention formally organized? Explain	
	Single or multiple (complex) intervention?	
	Who implemented the intervention?	
	Timing of the intervention in regard to the disruptive event?	
	What was the duration of the intervention?	
	Who benefited from the intervention (directly)?	
	Who benefited from the intervention (indirectly)?	
	Was it evaluated? If so, what methods were used for evaluation?	
	Scale of evaluation	
	Limitations of evaluation	
	Outcome 1	
	Outcome 2	
	Outcome 3	
	Outcome 4	
	Positive aspects revealed by the evaluation	
	Negative aspects revealed by the evaluation	
	Improvements suggested by author(s) and/or lessons learned	
	Improvements suggested by intervention beneficiaries	
Inclusion or exclusion reasons and other notes	Included or excluded?	INCL or EXCL
	If excluded, reasons for exclusion	
	If no intervention, problem or experience description?	Problem or Experience
	Preparedness description	Yes or No
	Potential interest and other notes	

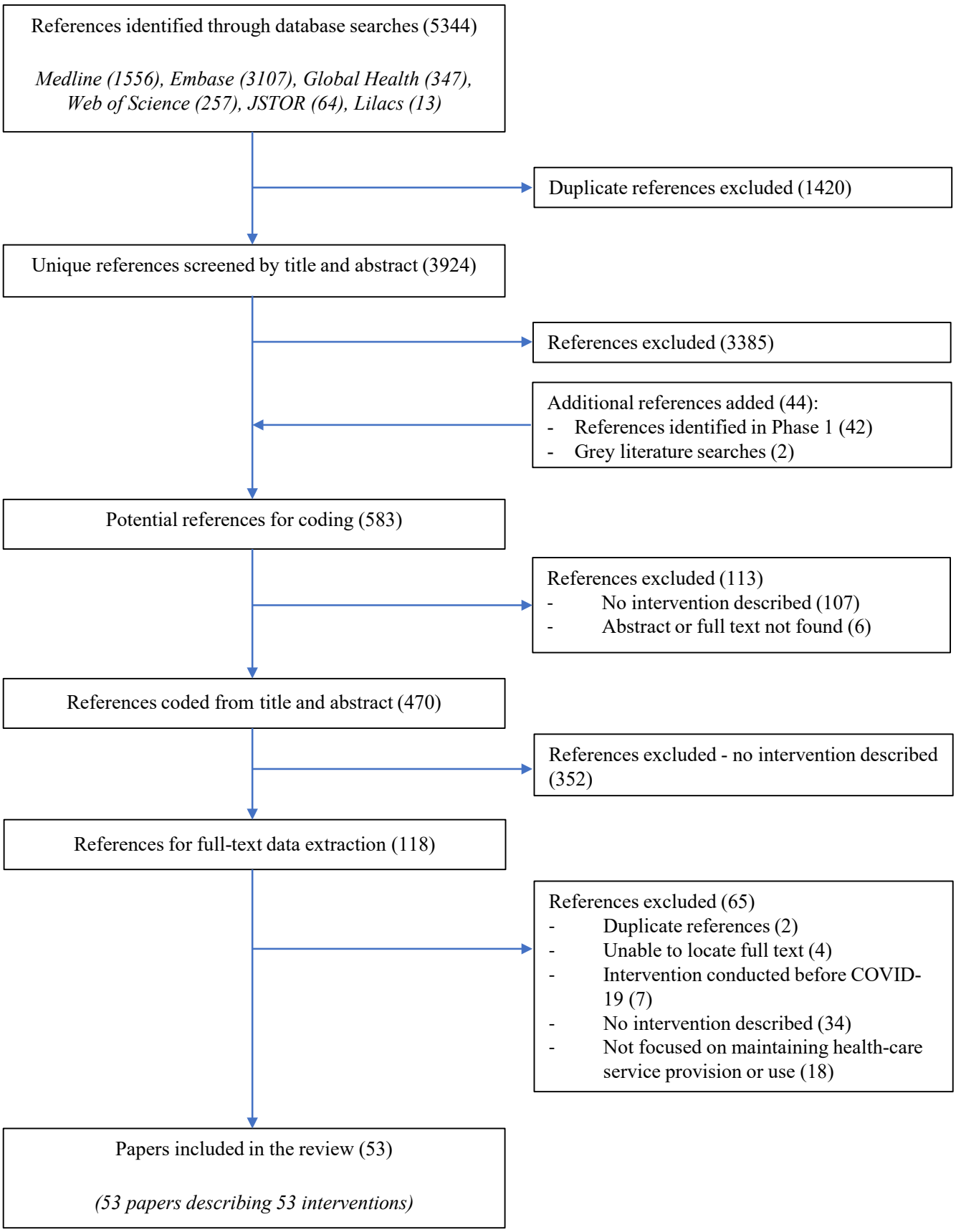
5. PHASE 1 SCOPING REVIEW SEARCH FLOWCHART



6. PHASE 2 SCOPING REVIEW SEARCH FLOWCHART FOR SARS



7. PHASE 2 SCOPING REVIEW SEARCH FLOWCHART FOR COVID-19



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