Beyond COVID-19: A Whole of Health Look at Impacts During the Pandemic Response

Y-Ling Chi, Lydia Regan, Cassie Nemzoff, Carleigh Krubiner, Yasmine Anwar, and Damian Walker

Abstract

Substantial evidence has emerged relating to the potential magnitude of the indirect health effects of the coronavirus pandemic. We know, from previous crises and outbreaks (e.g., the Ebola outbreak), that indirect health effects are significant and could outweigh the direct toll from the disease itself. This paper provides an overview of the lessons learned from previous outbreaks and economic crises in relation to indirect health effects as well as a framework for adopting a whole of health approach to the COVID response. This framework articulates indirect health impacts around four distinct but interrelated sets of impacts: economic, environmental, health systems, and social/behavioural. We apply this framework to discuss what is known already on the indirect health impacts of COVID-19. Given the rapidly changing nature of the outbreak and the constant publication of new evidence, this paper summarizes our current best knowledge and understanding, adopting a horizontal view to contextualise COVID-19 within the health system, and the whole economy.

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CGD Policy Paper 177
July 2020

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The Center for Global Development is grateful for contributions from Open Philanthropy in support of this work.

Y-Ling Chi, Lydia Regan, Cassie Nemzoff, Carleigh Krubiner, Yasmine Anwar, and Damian Walker. 2020. "Beyond COVID-19: A Whole of Health Look at Impacts During the Pandemic Response." CGD Policy Paper 177. Washington, DC: Center for Global Development. https://www.cgdev.org/publication/beyond-covid-19-whole-health-look-impacts-during-pandemic-response

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Introduction

Since the beginning of the COVID-19 outbreak, decision-makers around the world have undoubtedly been forced to make some very tough decisions. Early models found that, in the absence of a suitable policy response, COVID-19 could claim an unprecedented number of lives in all parts of the world. For instance, Imperial College London published a report estimating 40 million deaths across 202 countries if the outbreak was not managed. This and other similar modelling report influenced many governments' decisions to implement stringent policies to halt the spread of the disease. By April 2020, over 100 countries had instituted either a full or partial lockdown affecting billions of people, and many others restricted movement for some of their citizens, although at the time of the writing, some countries were now lifting lockdowns (Kaplan, Frias, & McFall-Johnsen, 2020; Ritchie, Roser, Ortiz-Ospina, & Hasell, 2020).

It is evident that governments across the globe are (increasingly) relying on models to assess the potential risks of the pandemic and take decisive actions to save lives in the face of this novel threat. The unique contribution of models is to provide estimates/forecasts of cases and deaths in particular policy scenarios *ex-ante* – in time for governments and citizens to evaluate the proper course of action. However, to date, models have had a near singular focus on COVID-19 cases and deaths and have not accounted for the vastly different contexts of countries, including the trade-offs and economic shocks that greatly affect how mitigation strategies translate to lives saved, especially in low- and middle-income countries (LMICs). To give one example, the report published by Imperial College London states in its limitations: *"we do not consider the wider social and economic costs of suppression, which will be high and may be disproportionately so in lower income settings"* (Walker et al., 2020). In particular, models fail (or never were never designed to) to contextualise impacts on the wider health care system and so do not capture indirect health effects of policies; the knock-on or collateral health effects. This omission is not without consequences. We know, from previous crises and outbreaks, that secondary mortality is significant and could outweigh the direct toll from the disease itself. During the 2014–2015 Ebola crisis in West Africa, it was estimated that a 50 percent reduction in access to services led to an additional 10,600 deaths just from malaria, HIV/AIDS and TB—almost equal to the 11,300 deaths directly caused by Ebola (Parpia et al. 2016).

Already in the first two months of the outbreak, substantial evidence (although often anecdotal and piecemeal) has emerged pointing to the potential magnitude of indirect health effects[1]. Chibuzo Otonka, president of Doctors Without Borders in West and Central Africa, stated his worry about a measle epidemic "in a few months' time that will kill more children than Covid" (Hoffman & Maclean, 2020). The causes are often multifactorial, and include demand and supply causes, as well as macro-meso-micro ones. Avoidance of care, restrictions on movement (such as lockdowns), transportation restrictions, stigma, impoverishment and the resulting inability to pay for health services have been widely referenced as barriers to accessing essential care. At the same time, disruptions to medical

[1] See our inventory on resources here

supply chains and diversion of the health workforce and diagnostic capacities toward COVID-specific services are affecting provision of other essential health services. A recent CGD note examined how these disruptions and diversions create vulnerabilities across the continuum of care for key health programmes—such as HIV, TB, and malaria; routine immunization; reproductive, maternal, newborn, child, and adolescent health (RMNCAH); and non-communicable diseases—jeopardising hard-won global health gains.

When secondary impacts are modelled, the results are alarming. Initial estimates of indirect effects on maternal and child mortality in LMICs project an additional 253,500 child deaths and 12,200 maternal deaths over 6 months under the least severe scenario of reduced service coverage and undernutrition (coverage reductions of 9.8–18.5% and wasting increase of 10%) (Roberton et al., 2020). With more severe disruptions to RMNCAH care and food supply, those figures rise to 1,157,000 additional child deaths and 56,700 additional maternal deaths (Roberton et al., 2020). An Imperial College model has estimated HIV, TB, and malaria related deaths may increase by up to 10%, 20% and 36% respectively, over the next 5 years compared to if there were no COVID-19 epidemic (Hogan et al. 2020). However, those modelling exercises seem to happen in a policy vacuum, and it is not clear how they relate to the actions that governments and citizens have taken or could be taking in this outbreak (Walker, Chi, Glassman, & Chalkidou, 2020).

With so many other health outcomes at stake, estimates of how strategies impact the trajectory of COVID-19 must not be the sole metric informing a 'successful' COVID-19 policy response. Different policy responses to COVID-19 will also trigger different levels of disruptions of the economy, social interactions and health system, which will lead to different indirect health effects. Contextual factors, including redesign of health or economic policies, will also influence the nature and magnitude of those indirect health effects. An appropriate strategy to address COVID-19 requires a holistic approach to health, assessing how the pandemic and various response measures will impact the wider range of health needs across the population, with attention to net health impacts of policy options and explicit consideration of trade-offs across health objectives.

The Center for Global Development is developing a set of resources and tools that will support governments and public health agencies around the world to quantify and actively consider non-COVID health impacts when making policy choices, with pragmatic and responsive strategies to mitigate inevitable secondary mortality effects. This scoping report was composed as an early examination into this topic (using literature on previous outbreaks and emerging evidence from the COVID-19 outbreak). It builds on recent commentary to provide a conceptual framework for analysing the ways in which the pandemic could affect other health conditions and services, quantifying net health impacts across services and populations, and evaluating optimal policy options with wider consideration of inherent trade-offs, as well as an inventory of resources on the topic which we have set up in early April.

In this paper, we provide:

- An overview of the lessons learned from previous outbreaks and economic crises in relation to indirect health effects
- A framework for mapping out and articulating indirect health impacts of COVID-19 around four distinct but interrelated sets of impacts: economic, environmental, health systems, and social/behavioural
- An application of the framework to the COVID-19 outbreak, using reports and evidence published so far on its indirect health effects

This paper adopts a horizontal view, contextualising COVID-19 within the health system, and the whole economy. Given the rapidly changing nature of the outbreak and the constant publication of new evidence, this paper summarizes our current best knowledge and understanding of the indirect health effects; we aim to make updates twice a year. However, we believe it provides sufficient grounding to shape how national and international policies and guidelines can account for a wider range of health impacts, and course correct where needed, in ongoing efforts to address the dynamic threat of COVID-19, with insights for how to refine methodological approaches and enhance the evidence base for future pandemic threats.

1. What we have learned from previous outbreaks and crises

There has been no crisis, in recent history, similar to the COVID-19 outbreak we are currently facing – both in terms of scale and nature. However, indirect health effects have been reported in previous crises and outbreaks, and can offer some learnings for this current outbreak. We reviewed the evidence on indirect health effects for the following events[2] to draw lessons learned and build our conceptual framework:

- 2013–2016 West Africa Ebola outbreak (articles identified published between 2014–2019)
- 2002–2004 Severe Acute Respiratory Syndrome (SARS) outbreak (articles identified published between 2004– 2012)
- 2009 H1N1 pandemic (articles identified published between 2010–2017)
- 2007–2009 Global Financial crisis (or Great Recession) (articles identified published between 2014–2019)

[2] We identified evidence and lessons learned from published literature identified on the following search engines: PubMed and Google Scholar. The following search words were used to identify published work on PubMed and Google Scholars: "Ebola," "SARS outbreak," "SARS 2003," "2008 recession," "H1N1 pandemic," "health effects," "indirect health effects," "mortality effects," "indirect mortality," "mortality impact," "indirect health impact," "literature review," "systematic review." This section also draws from two this lists 3 systematic literature reviews were published on this topic for the 2014–2016 Ebola outbreak (Elston et al., 2017; Shoman et al., 2017 and Wilhelm and Helleringer, 2019).

Impacts are felt for all of health

The outbreaks and crises and their associated policy response create deep, complex and multi-faceted changes that seem to affect all of health. However, the existing literature documenting indirect health impacts was often conducted from the perspective of a specific disease or service. Some of the most widely documented and researched indirect health impacts include nutrition, infectious diseases (especially HIV, TB and Malaria), and RMNACH (Kamara et al. 2017; Rajmil et al. 2018; Elston et al. 2017; Gamanga et al., 2017).

Fewer studies have also found impact on non-communicable diseases. For instance, during the global financial crisis, a significant increase in suicide among men, specifically those of working age and unemployed, was recorded(Parmar, Stavropoulou, and Ioannidis 2016). During the SARS outbreak in Taiwan in 2003, Wang et al. (2012) found that mortality caused by diabetes mellitus and cerebrovascular diseases increased significantly, by 8.4% and 6.2% between May to August 2003 (Wang et al. 2012).

The magnitude of the indirect health impacts can be large

We have found no attempts to model indirect health effects using on a whole systems approach. Where available, models look at services from the perspective of a disease programme, and differences in methods or scope will hinder direct comparisons between studies.

However, several estimates suggest the indirect health effects perhaps surpassed the direct death tolls during the Ebola outbreak. Parpia et al. (2016) found that deaths from malaria, HIV/AIDS and TB almost equalled the total direct death toll from Ebola. Nelson (2020) found that disruption to childhood immunisation campaigns during the outbreak was severe and may explain that twice as many children died of measles than of Ebola during that period (Nelson 2020).

Not all indirect health impacts are negative

While the term 'indirect health effect' is often equated to 'secondary mortality', it is worth pointing out that not all effects are negative. For instance, as a result of the 2008 global financial crisis, road traffic injuries declined. In Spain, road traffic accidents decreased until 2013, from 15.5 per 100,000 in 2007 pre-crisis to 6.6 per 100,000 in 2013 among men aged 15–64.

Public health crises can also be opportunities to foster positive health behaviours, as documented during the 2003 SARS epidemic outbreak or the H1N1 pandemic. In Hong Kong, a study Lau et al. (2005) found that public health mandated measures to prevent the spread of SARS caused long-term positive health behaviours among city residents, who self-reported adopting a healthier lifestyle, better personal hygiene, wearing masks and avoidance of risky health behaviours post-SARS period (Lau et al. 2005). Similarly, in Mexico, a study by Agüero et al. (2017) found that hand washing behaviours adopted during the 2009 H1N1

pandemic led to a decline in diarrheal diseases among children under the age of 5, with reductions continuing 3 years after the pandemic ended (Agüero and Beleche 2017).

Individual behavourial responses (including care seeking behaviour) are significant in the context of outbreaks

While the impact of stringent policies (such as lockdown) will inevitably have a very large impact of health, we should not overlook individual behavourial responses documented in previous outbreak and crises. Again, adjustments in individual response can be positive (as shown in the case of SARS) or have negative impacts on health through changes in health seeking behaviour or adoption of risky behaviour. Parpia et al. (2016) and Elton et al. (2015) found that reductions in access to healthcare services were partly explained by a loss of trust in the healthcare system during the Ebola outbreak. In addition, avoidance of care was also reported given fear of contracting the disease and stigma (i.e. fear of being seen at health facilities) that led to social exclusion (Rohwerder, 2020). An analysis of a survey carried out in 29 eastern and central European countries and central Asian countries also found that the probability of postponing or foregoing healthcare services or drugs increased post Global Financial crisis in 2008 (Habibov et al., 2018).

The 2003 SARS epidemic outbreak in Taiwan also offers an interesting example of the importance of those changes in care seeking behaviour. A 10-day compulsory quarantine was mandated by the government to all visitors from SARS-affected regions. Although the public was not restrained from accessing health services and those measures were relatively short lived, public fear and panic deterred people from seeking and accessing health care, a 20% decline in health care utilization during the epidemic period was observed (Chang et al. 2004; Wang et al. 2012).

Impacts are felt across the entire population, but disadvantaged populations suffer the most

Because social determinants of health critically shape how disease burdens affect different segments of the population, it is no surprise that emerging infectious disease threats disproportionately affect those who are worse off before an epidemic. Previous pandemic responses have shown that as resources are diverted towards the crisis, existing disparities in resource distribution become exacerbated, for example between urban and rural areas and, even more starkly, away from informal settlements in humanitarian situations (Lau et al. 2020). Lau et al. (2020) find that most marginalised individuals are less likely to seek healthcare during outbreaks, because of fears of contagion, restrictions on movements, along with concerns over legal and citizenship status and lack of trust in public authorities.

The evidence on the Ebola outbreak (see Box 2) also highlights some of the ways in which women and girls have been differentially impacted in the crisis. Further analyses of gendered impacts, both direct and indirect, during the West African Ebola crisis and Zika epidemic illustrate how women and girls suffered compounding effects related to disproportionate economic shocks, social roles as caregivers, gender composition of the health workforce, lack of access to essential reproductive and sexual health services, indirect effects of school

closures on rates of unplanned pregnancy, and increased exposures to gender-based violence (Davies and Bennett 2016).

Understanding the cause of indirect health impacts will help develop effective mitigation strategies

Outbreaks create disruptions that are felt across all parts of society. As we have seen with the SARS outbreak, even when less stringent policies are adopted (as was the case in Taiwan in 2003), individual behavourial response will create indirect health effects. From this initial review, we have found multifaceted root causes of indirect health impacts at all macro-meso-micro levels: disruption in funding (e.g. cuts in health budgets as a result of austerity, repurposing funding from vertical programmes to address the Ebola outbreak); disruption in community trade and nutritional patterns (e.g. consumption of bushmeat); avoidance of care and stigma (very commonly documented in all crises and outbreaks we have reviewed).

Developing and implementing mitigating strategies during preparedness, outbreak or recovery can be effective in reducing indirect health impacts to avoid adding loss of health to the direct toll from the outbreak. However, because what causes indirect health effects is complex, mapping out sources and causes is crucial to devising appropriate mitigation strategies.

2. Mapping out the potential indirect health effects of COVID-19 in a comprehensive framework

a. Net health benefits

A "whole of health" approach to COVID-19 requires looking at net health benefits of policy options for the response, accounting for all associated health gains and losses. Net health benefit is a summary measure of the health impacts on the population of introducing a new policy/intervention: in other words, it adds up all positive health impacts and subtracts the negative ones across the entire population.

Please note that in this report, we often discuss loss of health or health impacts in terms of lives saved or deaths averted. This is because our framework and the net health benefits concept are slightly easier to articulate and to operationalize when discussing the number of lives and deaths only. However, this is a limitation that will need to be addressed in our work going forward as this focus will not capture the considerable disability and non-fatal loss of health (especially for indirect health impacts). See Box 1 for further information.

As discussed earlier, indirect health impacts of COVID-19 mitigation strategies can feature on both sides of the equation. Essentially, net health benefit can inform health decision-makers about whether a particular strategy will do more harm than good, and whether one strategy saves more lives across the population than an alternative.

For instance, in the context of COVID-19, a policymaker may want to know how many deaths can be averted through a lockdown. Looking only at mortality directly attributable to the virus, one would calculate this by taking the number of projected COVID-19 deaths without a lockdown minus estimated COVID-19 deaths with a lockdown in place. A calculation of net impacts of a lockdown on mortality across all causes, including indirect losses and gains, would subtract the number of deaths inadvertently caused by the lockdown from the total number of COVID-19 deaths averted and add any additional lives indirectly saved as a result of lockdown (e.g., reduced traffic-related deaths).

If net health impact is positive, then the number of COVID-19 deaths prevented will be greater than the number of indirect deaths caused by the response measure. If it is negative, then the harms of the response measure will outweigh the mortality impact from COVID-19, with the policy response resulting in more people dying from secondary effects than it saved from COVID-19.

Assessing net health benefits is a critical step in evaluating the merit of a response strategy. However, net impacts do not provide the full picture of how the benefits and harms of a given policy are distributed across members of the population, nor the costs associated with realising different kinds of health gains. Box 1 provides some additional considerations on the health trade-offs of different policy options, although they are not exhaustive and require more in-depth discussion than what fell under the scope of this report.

Box 1. Considerations when looking at COVID response trade-offs

Distribution of health impacts across generations/age groups. As of May 2020, the evidence points to a strong correlation between older age and risk of death, with data from HIC showing increasingly higher case fatality among those over 60, 70, and 80 years of age (Roser, Ritchie, Ortiz-Ospina, & Hasell, 2020; Mahase, 2020). There is not yet good evidence on how interactions between COVID and co-morbidities prevalent in LMICs (e.g., HIV, TB, malaria, malnutrition) will affect age-related COVID mortality. Based on what we know now, the benefits of mitigation strategies like lockdowns largely favour protecting the health of the elderly. Yet, the indirect effects of these measures extend to the entire population, with many impacts on access to routine services in LMIC for conditions associated with premature deaths in younger segments of the population (e.g., cardiovascular diseases, maternal and neonatal care, and respiratory diseases like TB). Wide variation in the age structures of populations (Evans & Werker, 2020) (in Nigeria, less than 2% of the population is aged 65+, compared to 23.3% in Italy) and different lead causes of premature death across settings have serious implications for the net and distributional effects of response measures on health (Dowd et al., 2020). One means of formally assessing those trade-offs in future analyses would be to consider both the absolute number of deaths and the years of life loss (a summary measure of premature mortality).

(continued)

Box 1. Continued

Saving immediately identifiable lives versus statistical lives at risk. Many decision-makers and clinicians may be inclined to prioritize the urgent and identifiable mortality risk from COVID-19 over other health services that may prevent more deaths in the near and long term. This reflects a common human disposition often referred to as 'the rule of rescue', in which people feel obligated to help identifiable individuals facing imminent peril when they are in a position to intervene (Brock & Wikler, 2009). While there is a general obligation to save someone at known risk of death, particularly when this can be done without significant inconvenience or expense, the moral force of the duty of rescue is often exaggerated or applied inappropriately if it ignores opportunity costs. If all lives have equal moral worth, then the ability to save lives from COVID-19 should be considered on equal footing as the ability to save lives from vaccine-preventable diseases or childbirth complications that may occur in the future. There will be cases when the severity and urgency of COVID-19 justify redirection of resources and service disruptions, particularly when lost ground can be made up after the pandemic wanes, but this requires careful assessment of trade-offs and net impacts, as a matter of equity and for maximizing health.

Health versus mortality. By narrowly focusing on deaths, net health benefits are easier to estimate. However, such focus will not capture the considerable loss of health from a wide range of diseases. For instance, failure to vaccinate children against Polio would not only result in additional deaths, but also in irreversible paralysis and substantial lifelong disability (Bagcchi, 2019). Polio eradication is on the global health agenda but resurgence due to lower immunisation could lead to millions being disabled in the decades to come (Groce, Banks, & Stein, 2014). An assessment using Quality Adjusted Life Years (QALYs) gained would provide a fuller picture of how different response measures affect different sources of disease-related disability alongside attributable deaths.

Cost-effectiveness. Not all interventions produce the same health results nor cost the same to the healthcare system. A review showed that the most cost-effective intervention could produce as much as 15,000 times the health benefits of the least cost-effective intervention (Ord, 2013). Currently, very little is known about cost-effectiveness of COVID-19 interventions – and about pandemic response more broadly (Ollendorf, Do, Kim, Cohen, & Neumann, 2020), which makes direct comparison with other health interventions difficult. However, to give one example, measles immunization (which has experienced disruptions) is a highly cost-effective intervention that averts one disability adjusted life year with less than $5 in Benin (Kaucley & Levy, 2015).

b. Framework description

We developed a framework based on our review work (drawing upon the framework from Elston et al., 2017) to (1) illustrate the complexity of these 'indirect' impacts and (2) provide a simple structure to analysts who are interested in calculating the overall 'net health impact' of the pandemic, accounting for indirect lives lost and saved as a result of the four impacts. In this framework, sources of indirect losses of health are articulated around four distinct but interrelated sets of considerations: economic, environmental, health systems, and social/behavioural, which we discuss in this section.

This framework was initially developed with consideration of lockdowns as we have observed in this initial stage of the outbreak, however, we believe it to be applicable for all types of policies, including less stringent ones such as lower intensity social distancing. This means that not all elements may not be relevant and that the magnitude of the impacts will be lower if less stringent policies are adopted. As a result, this framework should always be applied and contextualised in relation to a specific policy scenario.

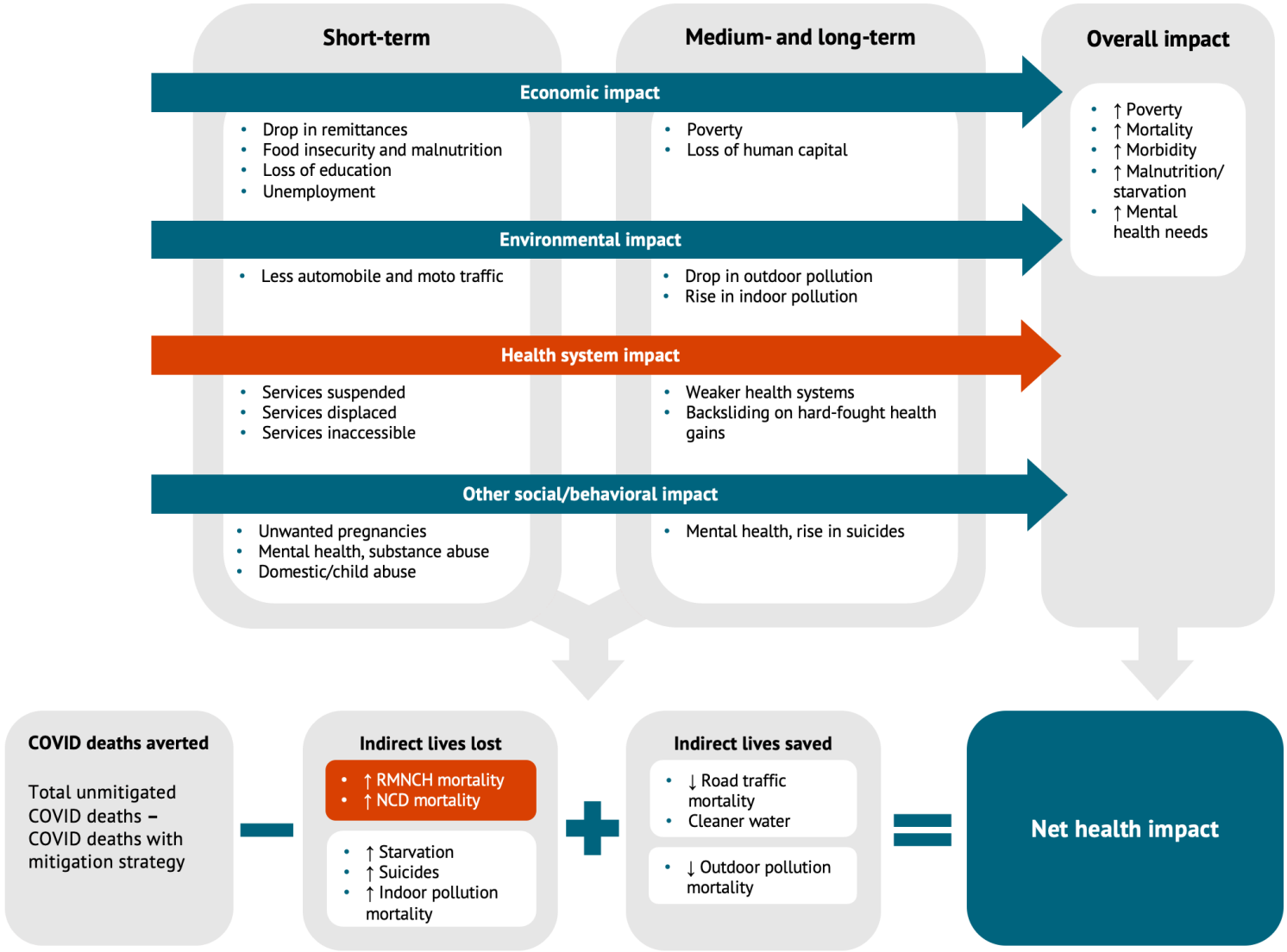
We first discuss this broad framework which intends to map all aspects of indirect health effects, and focus in section 2d on indirect health effects channelled through the healthcare system.

c. Four interrelated sources of indirect health effects

Economic impact

At the macro level, restrictions on movement, trade and social distancing can lead to a collapse in economic activity which will affect population's livelihoods, access to basics (including food) and to education (IGC, 2020). It is likely that COVID-19 will threaten the wages and income of millions in LMICs, where the capacity to borrow funds or run a deficit is constrained and as a result, the creation of appropriate social safety nets will be significantly impaired (Ahmed, 2020). In addition, remittances, which have become a lifeline for millions of vulnerable households in LMICs, have been adversely affected by the falls in wages and employment of migrants in high income countries.

Figure 1. Indirect impacts of COVID-19 mitigation strategies using a whole of health perspective



NB. The boxes in red are discussed in more details in section d "a deep dive into health system impact."

Previous research has shown that economic recessions lead to greater morbidity and mortality in itself, and that the burden will disproportionately fall on more vulnerable strands of the population. Ferreira and Schady (2009) investigate the link between income shocks (looking at macro-economic crises and droughts) and child nutrition and health. They find that in low-income countries (Asia and Africa), income shocks lead to increases in infant mortality and poorer nutrition (relationship is less clear in middle income countries). Those conclusions are also echoed by Maruthappu and colleagues who looked at trends in economic growth and child mortality between 1981–2010 and find similar results in lower income countries. They also find low school enrolment during crises. This may be further compounded by school closures during the outbreak, which may have negative consequences for children's economic prospects in the future, and in turn have impacts on health (Evans & Over, 2020). In the United-Kingdom, Janke et al. (2020) found that recessions (and in particular rise in unemployment) significantly increase the rate of chronic conditions in the working-age population: they find that a 5% fall in the employment rate leads to 7%-10% of increase in chronic conditions. Again, the authors find that those hit the hardest are more deprived, older workers.

Poverty is, in itself, a major cause of ill-health because of food insecurity, housing insecurity and access to hygiene and sanitation (which are expected to play an important role during the COVID-19 outbreak). Increased poverty is likely to reduce access of health services (as we will discuss under 'health systems impacts'), especially in countries where user fees or costs of drugs are borne by households or where informal payments are common (The World Bank, 2014).

Finally, there is growing evidence that economic recessions lead to shifts in health spending. For instance, Brazil, after a deterioration of macroeconomic conditions in 2015–2016, public health expenditure growth flattened except in more well-off states (Andrietta et al., 2020). Of particular importance to LMICs, Stuckler et al. (2010) found no evidence that recessions leads to drops in global health aid (although looking at a time series for 15 high-income countries between 1975–2007).

Environmental impact

Environmental impact will be greater in countries where restrictions on movement and other policies aiming at introducing social distancing are in place. The secondary health impacts of environmental changes are likely to impact both sides of the equation: with reduction in mortality stemming from road traffic and outdoor pollution, and increase in mortality from indoor pollution.

Evidence is emerging that outdoor pollution is declining due to self-confinement, social distancing or lockdown policies, with estimates that global carbon emissions could be reduced by an unprecedented 8% in 2020 (Hook & Raval, 2020). Air pollution is a major environmental risk to health; ambient (outdoor air pollution) in both cities and rural areas was estimated to cause 4.2 million premature deaths worldwide in 2016. Indeed, some 91% of those premature deaths occurred in LMICs, and the greatest number in the WHO South-East Asia and Western Pacific regions (WHO, 2018). Air pollution is also associated with

non-communicable diseases (NCDs) including stroke, heart disease, lung cancer, and both chronic and acute respiratory diseases such as asthma (WHO, 2019)

At the same time, if more people are ordered to 'shelter in place', there may be a rise in deaths from indoor pollution. Around three billion people cook using open fires or simple stoves fuelled by kerosene, biomass (wood, animal dung and crop waste) and coal. Each year, close to four million people die prematurely from illness attributable to household air pollution (WHO, 2018). Similar to outdoor air pollution, indoor air pollution causes NCDs. Further, close to half of deaths due to pneumonia among children under 5 years of age are caused by particulate matter (soot) inhaled from household air pollution (WHO, 2018).

Finally, road traffic accidents will be impacted by social distancing policies, including lockdown, which will save lives in the short run. The 2018 Global Status Report on Road Safety highlighted that global annual deaths from road traffic accidents had reached 1.4 million, with road traffic injuries now the leading killer of people aged 15–29 years (WHO, 2018b). It is worth noting that LMICs are home to 93% of global road traffic deaths.

Other social/behavioural impaact (excluding care seeking behaviour which is discussed within health systems impact)

At the micro level, it is likely that individuals will modify behaviour in response to COVID-19 and its policies. We single out changes in health seeking behaviour, which we discuss together with health system impact below. It is possible that more time spent at home could lead to unwanted pregnancies and unsafe abortions, with resulting deaths in maternal and child mortality, especially if access to family planning commodities are reduced.[3] Furthermore, isolation or increasing economic vulnerability could lead to a rise in mental health needs (Milano, 2020) and as a result, substance abuse and addiction. This could lead to an increase in deaths from suicide, a leading cause of death in younger populations. Some experts have also raised concerns about the increase in domestic abuse, including child abuse (Batha & Wulfhorst, 2020). However, some positive behavioural changes could occur, such as increase in sanitation and personal hygiene practices, especially in the context of an outbreak.

Health system impact

The health system impacts will be wide-ranging. For this reason, we choose to further discuss health system impacts in an extension to this framework in Section 2.d. below.

[3] UNFPA recently reported that it can only get about 50–60% of its usual condom supplies due to virus-related disruptions, e.g. border closings and other restrictive measures that are affecting transportation and production in a number of countries and regions.

d. Indirect impacts of COVID mitigation strategies: A deep dive into health system impact

To better understand what is causing the health systems impact denoted in orange in Figure 1, we leveraged our review work to develop Figure 2 as a subset of the overall framework to focus on mapping out the causes and effects of the health systems impacts. The purpose of this subset of the framework is to help identify broad areas where gains/losses in mortality might be expected from disruptions in provision and access to healthcare services, and to provide a useful tool in supporting the design of strategies to mitigate indirect health impacts from health system disruptions.

Box 2. Indirect health impacts of the Ebola Outbreak on maternal and child health

Disruptions and drops in essential healthcare utilization caused by health emergencies or economic downturns can have devastating impacts in LMICs countries with chronically underfunded and weak health systems. The 2014–2016 Ebola outbreak in West Africa offers important lessons on the nature and magnitude of the indirect health effects. Prior to the Ebola outbreak in 2014, Sierra Leone, Guinea and Liberia were amongst the highest rates of maternal and child mortality worldwide, and experienced high rates of malnutrition, endemic diseases, and low life expectancy among their populations.

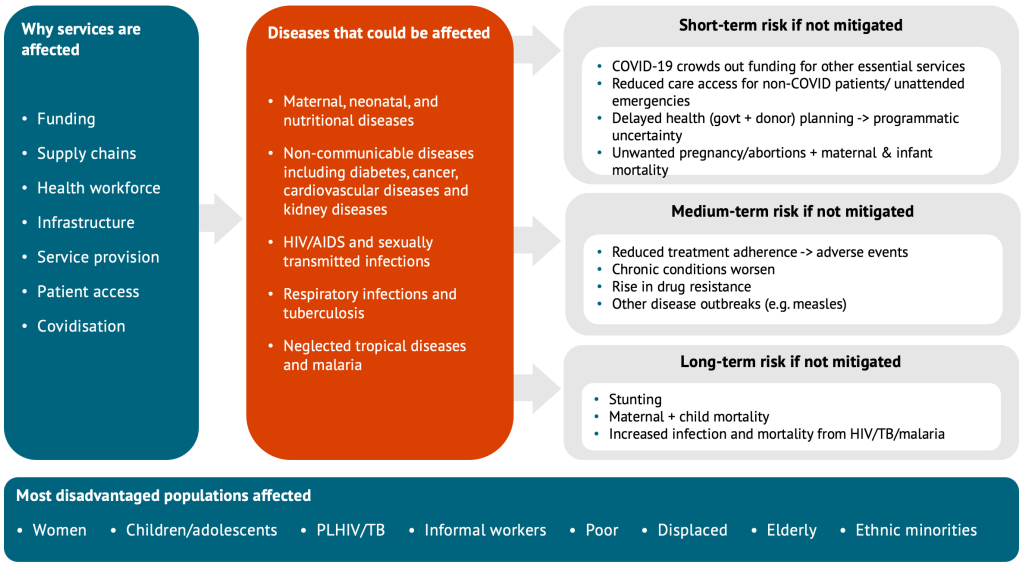
During the Ebola outbreak, the reduction in utilization and coverage of healthcare services severely impacted the health of women and children who were the primary users of the healthcare services. In all three countries affected, the number of assisted deliveries and caesarean sections dramatically dropped. Declines as high as 40–50% were reported in the most Ebola-affected provinces of Sierra Leone, and in two Ebola-affected prefectures of Guinea, the number of assisted deliveries dropped by 87% between July-September 2014 and the Caesarean sections dropped by 90% between October and December 2013. In Sierra Leone, this decrease in routine healthcare utilization and access was reported to have resulted in an 22% increase of maternal deaths and a 25% increase in newborn death.

Source: (Elston et al. 2017)

We found that sources of health system impact could be categorized in the following way: funding; supply chain; health workforce; infrastructure; service provision; patient access, and covidisation[4].

[4] We use the term 'covidisation' to define the following phenomenon 'Focusing economic, environmental, health, and social policies and research funding on the impact on COVID-19 (global level), and/or changing social and behavioral constructs in response to experiencing the COVID-19 pandemic (individual level)'.

Figure 2. Health system impact



Those sources of disruptions occur at the macro-meso-micro levels. For example, governments and donors are repurposing funding towards COVID which may lead to a decline in funds for other/essential services. In the same vein, governments or donors may decide to suspend or deprioritise services in response to the outbreak (e.g. vaccination campaigns (Gavi, 2020)). Furthermore, the overall 'covidisation' of research (Pai, 2020) and donor funding (Cookson, 2020) may lead to suspension of non-COVID-19 research and shrinkage of non-COVID-19 donor funding. Supply chains may be disrupted by travel restrictions (including restrictions on import and exports, or by restrictions in road traffic). Health infrastructure such as hospitals may be repurposed to only care for COVID patients, shifting flow of patients to further, less accessible facilities. At the micro-level, health workforce may become unavailable due to illness, fear, or protests, resulting in a commensurate reduction in the quantity of services that can be delivered or inaccessible (e.g. transport bans or patient fear). Finally, here the effects of changes in demand for services is likely to be significant, as observed across all previous crises and pandemics as noted above. Avoidance of care, fear of stigma, inability to travel and also inability to pay for health services (due to income shocks) is likely to affect the demand for health services significantly as the outbreak progresses.

These reasons affect access to the services for diseases listed in the middle part of the framework. This is not meant to be an exhaustive list, but rather an indicative list of the types of services that patients may not access due to health system constraints. It is worth noting that as discussed above, it is likely that services are disrupted from a combination of factors, rather than a single one. For instance, unwanted pregnancies could be the result of supply chain issues (e.g. impacting the provision of family planning commodities), changes in behaviours (towards more risky ones), lower access of family planning services due to restrictions of movements or avoidance of care, or due to changes in services provision and crowding out of family planning services due to COVID-19. Identifying the causes and

effects of health system disruptions can be a useful tool to support the development of bespoke strategies to maintain access to essential services.

Because disruptions will impact many areas of care, they may only translate into loss of health in the future. At the far right, we identify some short-, medium-, and long-term risks of not protecting access to these services. In the short and medium term, if service access is disrupted this could lead to reduced treatment adherence, unwanted pregnancies/abortions, worsening chronic conditions, rises in drug resistance, and other disease outbreaks. In the longer term, this could result in increased disability and death related to stunting, maternal and child health, and infection/mortality from HIV, TB, and malaria.

3. Applying the framework to COVID-19: What we know so far

To apply the framework to the COVID-19 outbreak, we conducted an extensive review, which combines several methods. Because of the recent nature of the outbreak and rapidly changing literature, we combined searches on PubMed, major news outlets, google and Twitter. The appendix to this paper describes our methods. It is also worth noting that we assembled, as part of this review, an inventory of resources which is updated on a regular basis and freely available here. This inventory already includes evidence ranging across HIV/AIDS and sexually transmitted infections, respiratory infections and TB, maternal and neonatal disorders, neoplasms.

This review builds on the 131 resources referenced in the inventory as of June 19, 2020.

Economic impacts

There is currently little data on the depth and length of the recession to be caused by COVID-19 in LMICs. Experts expect this impact to be large, given the fragility of LMIC economies, limited capacity to borrow, weak health systems, size of the informal sector and the stringent nature of some policies already in place in some low-income countries. Early models/estimates (Evans & Over, 2020) include the Orlik et al. at Bloomberg which hypothesize a global $2.7 trillion in lost output this year; the OECD refers to an impact equivalent to halving global economic growth. The Asian Development Bank also released scenarios which range from $77 billion to $347 billion.

Since the beginning of the outbreak, unemployment rates have increased dramatically in many countries, including the UK (Verity, 2020), USA (Rushe & Holpuch, 2020) and South Africa (Zulu, 2020). The International Labour Organisation estimates that, alarmingly, nearly half of the global workforce may be at risk of losing livelihoods (ILO, 2020). In Malawi, one of the poorest countries in the world, a three-week halt of all 'non-essential business' was declared (although not imposed) on April 18; which led to the closure of central markets, where many sell and buy foods (Nemzoff, Chalkidou, Walker, & Sullivan, 2020). The World Bank estimates that remittances will fall 20% in 2020 (The World Bank, 2020). Recent estimates suggest 22 million people in Sub-Saharan Africa will be pushed into extreme poverty (Gerszon Mahler, Lakner, Castaneda Aguilar, & Wu, 2020). Moreover, as others

have pointed, health itself is also a contributor to poverty (Wagstaff et al., 2018): in this outbreak, individuals may incur high user fees or expenses from falling ill from COVID, lost income from falling ill or caring for a household member who is ill, or experience stigma that may affect their ability to work. Those disruptions could have adverse impacts in the long term. For instance, with school closures, vulnerable students may not return to the education system, which would translate into long-term loss of income generating opportunities (Evans & Over, 2020; Clarke, Chalkidou, & Ruiz, 2020). These negative impacts will be further exacerbated as the pandemic has a direct effect on government spending on health. Nigeria has recently announced plans to to cut healthcare spending by 40% despite cases of coronavirus climbing due to the impact of the pandemic, along with a crash in global oil prices and reduced oil sales (Akinwotu, 2020).

As discussed in the previous section, those negative economic impacts will translate in loss of health through food insecurity, drops in housing standards including water and sanitation, inability to pay for COVID or non-COVID services and the resulting foregone care, mental health. World Vision International have estimated that roughly five million additional children could suffer from malnutrition as a result of collapse of economic activity (Hughes et al., 2020). Other estimates show COVID-19 could increase the number of people in acute hunger from current estimate of 135m, to 265 million (World Food Programme, 2020). How the economic impacts of COVID affect health is yet to be fully documented.

Environmental impact

China, the UK, Turkey, the US have all reported large reductions in road traffic due to COVID-19 lockdowns. In China, non-life insurers have claimed a dramatic drop in claims (Chatterjee & Leng, 2020). Road traffic has plummeted in the UK by 73%, but the impact of this reduction on the decline in road traffic deaths is not yet available (Carrington, 2020). Istanbul has reported a 35% reduction in road traffic accidents, as of the end of March 2020 (Daily News, 2020). In California, the US state with highest number of registered vehicles on the road, has seen a 50% reduction in traffic accidents—as well as crash-related injuries and deaths (Shilling & Waetjen, 2020). Some Indian states have reported a remarkable drop in death rates, leading some to believe this could be due to reduced road traffic; Central Mumbai saw the number of deaths fall by about 21% in March compared 2019. Similarly, in Ahmedabad, Gujarat deaths saw a drop of 67% (Ulmer & Khanna, 2020).

With reduced road traffic, comes reduced pollution. Evidence has emerged that outdoor pollution is declining due to self-confinement, social distancing or lockdown policies, with estimates that global carbon emissions could be reduced by an unprecedented 8% in 2020 (le Quéré et al., 2020). The Centre for Research on Energy and Clean Air has published a report showing there are likely to be 11,000 fewer air pollution related deaths because of the lockdown. This includes 6,000 fewer new cases of asthma in children, 1,900 avoided emergency room visits due to asthma attacks and 600 fewer preterm births (Myllyvirta, 2020). In China, Chen et al. (2020) found that the COVID-19 response (including restrictions of movements) has led to significant improvements in air pollution, which was modelled to have saved 8,911 lives (lost indirectly through cardiovascular diseases or chronic

pulmonary disorder). However, there is no evidence yet on the impact of COVID-19 on indoor pollution.

Social and behavioural impact

A report by UNFPA models the delay in scaling up efforts for the Sustainable Development Goals for Family Planning, Ending Gender-based Violence, Female Genital Mutilation and Child Marriage (UNFPA 2020). The report's grim forecasting highlights detrimental effects lockdowns on increasing gender-based violence, access to contraceptives (and unwanted pregnancies), and increases in child marriages. Increased reports of domestic violence have been reported in many regions soon after stay-at-home directives were announced (Kofman & Garfin).

Mental health services face disruptions due to COVID-19, similarly to other health services (Nandan Jha 2020), but there is the additional burden due to the increased anxiety and depression exacerbated by a global pandemic and country-wide lockdowns. A paper from China has shown individuals with pre-existing mental disorders are more likely to experience a worsening of their mental health status when exposed to disease epidemics (Wang et al. 2012). Another paper has found that the pandemic has created a global context likely to increase eating disorder (ED) risks and symptoms, while decreasing factors that protect against EDs, and exacerbate barriers to care (Rodgers, et al., 2020).

The lockdown in India has had negative effects on those with substance abuse disorders. The emergency room visits for those with severe alcohol withdrawal symptoms increased from a mean of 4 to 8 per day during the lockdown (Narasimha, et al., 2020).

Health systems impact

The highest volume of articles in the inventory refer to services being suspended, disrupted and inaccessible. The most frequently reported affected disease areas, with the most substantial data on effects, are HIV and TB services, childhood immunisation, RMNACH and surgery.

Early estimates have shown that those disruptions will have an important impact on mortality. The interruption of ARV, and treatment for TB and Malaria have been modelled and shown to be have a huge effect on the secondary mortality of COVID-19 pandemic in the short to medium term. Imperial college have shown that in high burden settings, HIV, TB, and malaria related deaths may increase by up to 10%, 20% and 36% respectively, over the next 5 years compared to if there were no COVID-19 epidemic (Hogan et al. 2020). World Vision, an international charity, have released a report showing that 26 million children are at risk of infectious diseases due to a projected 30 percent reduction in Diphtheria-tetanus-pertussis (DTP3) immunisation coverage (World Vision 2020). Riley, et al., at the Guttmacher Institute found that a 10% reduction in pregnancy and new-born health care would result in an additional 28,000 maternal deaths and 168,000 new-born deaths (Riley et al. 2020). At the height of the pandemic in Spain the mean number of organ donations has declined from 7.2 to 1.2 per day, and the mean number of transplants from

16.1 to 2.1 per day (Domínguez-Gil et al., 2020). Similar reductions in blood donation has been reported in India (Raturi & Kusum, 2020)

What causes those impacts, again, seems complex and multifaceted. At the macro-level, disruptions of funding occurred from redirecting funds, otherwise spent on other diseases, to COVID-19. Some International donors have refocused some of their resources on COVID-19, most recently the Bill and Melinda Gates Foundation (Cookson 2020). The Global Fund announced that up to $1 billion programming funding could be used for COVID-19 planning (The Global Fund, 2020). Stringent policies, such as lockdowns, also present important challenges when it comes to accessing health care facilities (both for patients and staff), organising supply chains or public health interventions at the community level. Fourteen major Gavi-supported vaccination campaigns against polio, measles, cholera, HPV, yellow fever and meningitis have been postponed (The Vaccine Alliance 2020). This has been linked to measles and diphteria is flaring or appearing in many LMICs: of 29 countries that have suspended measles campaigns, 18 have already reported new outbreaks (Hoffman & Maclean, 2020).

Source: New York Times, June 14, 2020.

Similarly, Stop TB completed a rapid assessment showing in India there was approximately an 80 percent decline in the reporting diagnosed TB cases during the lockdown period compared to the average, in part due to the inability to conduct community level screening (StopTB, 2020). India's lockdown has also resulted in many kidney patients struggling to access care as dialysis units have been shut down after patients had tested positive for COVID-19 (Dore, 2020). Even in open facilities, there is growing concerns over the shortages in equipment and materials for dialysis patients (Dore, 2020). In Uganda, seven women have died due to not being able to access the hospital during labour (Biryabarema 2020).

Disrupted supply chains has been reported through various sources: increased checks and regulation of imported goods (Naftulin 2020) reduced or slowed international transport (Purdy 2020) or decisions to reduce the of exports of medicines, as has occurred in India (Porecha 2020; Ellis 2020). Other product transportation, such as donor stem cells, which rely heavily on speedy transport are a risk of being severely impacted (Szer et al. 2020).

Demand-side responses, affecting the demand for healthcare, have already been widely reported. Such demand side responses have been associated with travel bans (inability to travel to facilities due to restrictions on travels) (Biryabarema, 2020), or fear of catching the virus and avoidance of care. A study from France suggests patients may have been avoiding accessing health services; the authors show a decrease of 26% of all emergency department visits, comprising of a decrease of 34% of strokes, 32% of transitory ischemic attacks, 64% of unstable angina, 42% of appendicitis, and 36% of seizures (Feral-Pierssens, Claret, and Chouihed 2020). These events are unlikely to have reduced within the population, which leaves the conclusion that these events are occurring with no emergency medical intervention. In Wuhan during the strict lockdown, people with HIV resisted contacting local officials to receive HIV medication delivered due to fear of revealing HIV status in their community (Lee and Westcott 2020).

Not only have patients care seeking behaviour changed, but healthcare workers have also adjusted their behaviour in some cases. There has been reports of health workers reluctancy to handle samples for tuberculosis testing because of the similarities in the symptoms of tuberculosis and COVID-19—coughing, fever, and difficulty in breathing (Adepoju 2020). In the UK doctors have had to readjust how cancer care has been delivered, with patients having to go through difficult procedures with less human contact, with potentially detrimental health outcomes (Gossage 2020). Various reports of disruptions due to health workers falling ill (Sawlani, 2020) or not coming to work due to fear or protest over protective equipment (such those in Malawi) (Pensulo, 2020) have been reported too.

For further information organized by programmatic area, a related piece by CGD colleagues examines how these various types of disruptions at different points along the care continuum will affect near- and longer-term health outcomes across priority disease areas for global health.

Conclusion

CGD will continue to work on indirect health effects during this COVID-19 outbreak. The objective of this scoping review was to summarise the lessons from past outbreaks, present a framework to map out and articulate indirect health impacts of COVID-19 around four set of impacts, and use this framework to discuss evidence we found, through a systematic review, about indirect health effects in this outbreak. On this topic, CGD has already published a previous note on the topic and set up an open access inventory of resources on indirect health impacts we are constantly updating.

This is only the beginning of our project. We developed a calculator, which allows decision makers to bring together, in a simple and accessible format, COVID deaths estimates for different policy-scenarios and own estimates of indirect health effects to calculate net health benefits. We will use this scoping review and framework to develop case studies in LMICs, not only to map out the nature of indirect health effects, but also to learn from countries how different mitigating strategies have been put in place and what has worked and to pilot the calculator. We will also work on quantitative approaches to monitor and estimate indirect health impacts, in a future report.

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Appendix. Methodology COVID-19 Evidence

W aimed to rapidly build an online open access inventory of accounts of indirect health effects of COVID-19. This inventory is available here. The following section describes the process for collecting and reviewing the initial literature on indirect health effects and secondary mortality of COVID-19 for inclusion in the online inventory, and proceeds to outline a summary of the accounts gathered thus far.

Rapid literature review

Firstly, a rapid review of journal literature was conducted. Due to the wide selection of journals, PubMed was used as the search engine for peer reviewed scientific articles. The PubMed search was performed on May 7, 2020 using the search terms in Figure A1. The search terms were kept broad to capture all a wide base of evidence, as this topic has yet to have commonly used or agreed upon terminology in ScopingFig1.png the literature. The search results were included if in English with full text available in PubMed. The articles were screened by based on the title and abstract to determine inclusion in the inventory. Additional scientific articles were included based on the reference lists of selected journals.

Figure A1. Search terms

Indirect health effects	Secondary mortality	Crowding out
Indirect deaths	Secondary impacts	Interrupted access
Collateral damage	Indirect Effects	Disruptions
Paused services	Unintended consequences	Suspended services

Non-scientific article scoping

Due to fast moving nature of the topic area, and inherent delays in scientific journal reporting, a search based only in peer-reviewed journals proved insufficient. To include the most recent developments, additional searches international and national daily online newspapers were performed. For this purpose, the Financial Times (FT), the New York Times (NYT), the Guardian and the Times of India, Reference News (Xinhuanet.com) were selected to ensure a global perspective. The newspaper articles were limited to those published between November 1, 2019 and May 7, 2020. For the newspapers, the terms "Indirect health effects Covid" using the Google-based search engine on their website. The news articles selected by title only were all read and selectively added until there was a saturation of citations and information.

Twitter has proven to be an effective tool to gather quickly emerging articles quickly evolving topics. In order to facilitate the use of Twitter to gather information, a 'call to action' blog was posted on the CGD's website and repeatedly shared widely on Twitter on April 23 2020 requesting for additional articles to be sent via email to be included in the public inventory. While the blogpost only led to 3 emails from researchers with additional

resources, this enabled inclusion of articles and reports that has not been previously included. In addition, the blog post helped to spark further discussion on Twitter for this topic.

Advanced searches were used on Twitter to track the discussion of COVID-19 indirect health effects and secondary mortality. The search criteria for Twitter was "Covid indirect health effects lang:en until:2020-05-29 since:2019-11-01" and "Covid secondary mortality lang:en until:2020-05-29 since:2019-11-01." The search resulted in 44 tweets, of which 4 additional papers were found to include in the Inventory. Figure A2 shows a truncated PRISMA chart showing the full process for inclusion and exclusion of articles at each stage of scoping for the inventory.
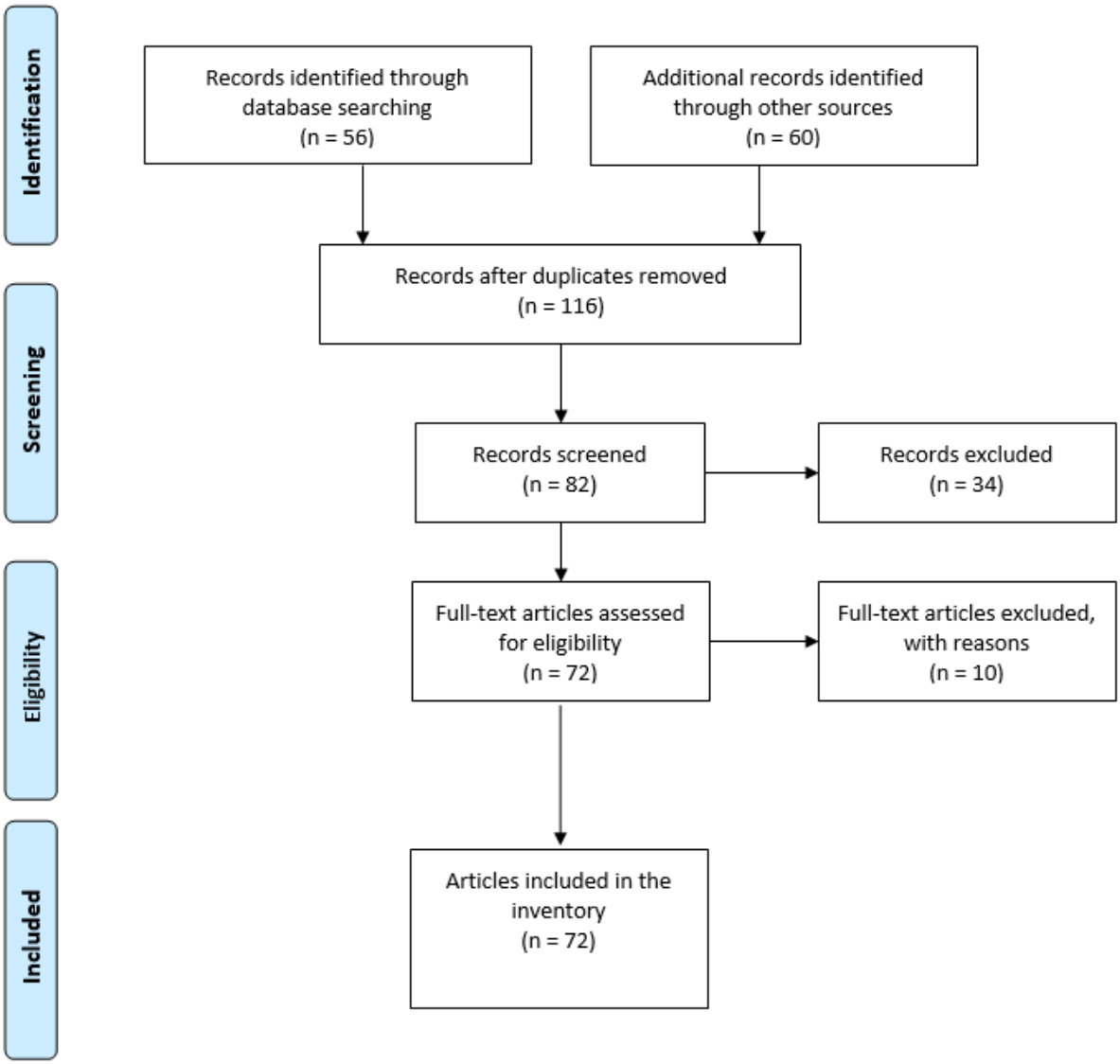
Figure A2. PRISMA Flow Diagram on scoping for inclusion within the inventory.