

**What are the impacts of past
infectious disease outbreaks
on non-communicable
health outcomes?**

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Introduction

The purpose of this rapid review is to identify the health and social impacts and learning from past infectious disease outbreaks which may be applicable to the current COVID-19 pandemic. Identifying these could help mitigate the short- and long-term impacts of COVID-19 on the general population as well as specific population groups.

Summary of findings

- This rapid review focuses on the non-communicable health and social impacts emerging from previous infectious disease epidemics and pandemics. It does not include macroeconomic, clinical, health protection and surveillance impacts.
- The majority of reports examining the health and social impacts of past infectious disease outbreaks report some degree of adverse outcomes. However, quantification of these is often poor, longer-term follow-up is rare and formal analysis of risk/protective factors is sparse.
- Most of the identified reports focus on mental health impacts such as psychological distress, anxiety, depression, stress and fear. The 2003 severe acute respiratory syndrome (SARS) outbreak in particular was found to cause substantial levels of fear and anxiety because of its status as a new and unknown virus.
- Mental health impacts, especially those related to increased workload and stressful working conditions, were most commonly reported among healthcare workers on the front line and tended to be more acute than among the general population.
- The impact of quarantine episodes on non-communicable health outcomes (particularly mental health) was found to be substantial.

- Observed social impacts included absenteeism from work, school closures, loss of wages, and lack of communication and trust. However, these tended to be transient and often localised to where major outbreaks occurred.
- The impact on health-seeking behaviours included both the avoidance of healthcare services (due to fear of infection risk) but also health-seeking behaviours among those with existing health conditions. Few reports looked at how previous outbreaks affected health behaviours, such as changes in healthy behaviours (for example physical activity or diet) or unhealthy behaviours (for example alcohol or tobacco consumption).
- The majority of the reports were of low quality due to cross-sectional designs, poor survey response rates, few baseline studies or control/comparison groups, and recall bias due to the length of time between an outbreak and research into its effects. Therefore, any firm conclusions from the studies on impact requires caution.
- The longer-term impacts of previous outbreaks is unclear as there is a lack of longer-term follow-up studies. A small number of reports found that impacts tended to be short lived and recovery occurred soon after outbreaks subsided. The one exception to longer-term follow-up is a collection of papers on 'generational follow-up'. These individuals were exposed to the Spanish flu virus in utero and their health and social outcomes were studied as adults. Although these studies predominantly examined the direct effects of in utero exposure, they are also consistent with there being longer-term negative consequences of infectious disease outbreaks, beyond the immediate impact of the disease itself.
- Past outbreaks have not had the same nature and duration of lockdown, isolation or travel restrictions as the current COVID-19

pandemic. Previous outbreak impacts on mental health, individual/family economics, job and income loss, and child education may be less severe than what emerges as a result of COVID-19. It may therefore be difficult to draw any true comparisons between previous outbreaks and the COVID-19 pandemic.

- Very little impact was identified on specific population groups such as children and young people or ethnic minorities, and formal socioeconomic, gender and rural/urban comparisons are rare.
- Interventions to mitigate against the impact of previous outbreaks on non-communicable diseases were generally non-specific, with formal evaluation being extremely sparse. Where interventions were reported, identification of at-risk groups, health protection measures and infection control guidance for frontline staff were most commonly mentioned.
- As a matter of priority, the public health community should focus on new long-term research on the health and social impacts. It should also focus on evaluating the social and economic interventions put in place (such as the employee furlough scheme, public-facing health communications and mental health resources specific to COVID-19 and its social consequences). This is vital as the scale and intensity of the lockdown stands to be larger and qualitatively different from that seen following any previous outbreak. This would provide essential learning in case of future COVID-19 waves or another new viral outbreak in the future.

Background

The world is currently experiencing an outbreak of a novel virus (SARS-coV-2, responsible for COVID-19), the nature and extent of which have not been seen since the 1918 outbreak of the Spanish flu. This pandemic is different in that its direct effects are mainly, but not exclusively, among the elderly and those with underlying health conditions.

While the current focus of public health action is to contain the COVID-19 outbreak, the nature and duration of the outbreak period and the health protection measures implemented are likely to have a direct and indirect impact on non-communicable health outcomes and their wider socioecological determinants.¹

Although not on the same scale as COVID-19 (at least since the Spanish flu) there have been a number of past infectious disease outbreaks with potentially similar direct and indirect health, social and economic impacts including severe acute respiratory syndrome (SARS), Middle East respiratory syndrome (MERS) and pandemic flu (H1N1). This overview highlights the key health and social findings from these outbreaks and their implications for the current COVID-19 pandemic.

Research aim

This review aims to summarise the indirect health and social impacts arising from past disease outbreaks and the measures used to control their spread on the general population and specific population groups.

This includes epidemics and pandemics at a national and international level, but does not include persistent endemic diseases, with the exception of Ebola due to recent outbreaks.

Research questions

- What are the non-communicable health and social impacts observed during previous infectious disease outbreaks?
- What are the impacts of quarantine episodes including enforced lockdown and self-isolation on non-communicable health outcomes?
- What health and social interventions have been put in place following past infectious disease outbreaks to mitigate the impacts on non-communicable diseases and how effective were they?

Methods

Systematic methods were used to identify literature relating to past outbreaks of infectious diseases and/or quarantine/isolation. Database searches yielded 1,678 studies (of which 478 were duplicates). After an initial single screen for broad relevance, the title and abstract of the remaining 1,200 articles were double-screened for relevance.

In addition, 65 articles were identified from grey literature via Google/Google Scholar, using similar search terms to the bibliographic database searches. These articles were also subjected to a double-reviewer title and abstract screen for relevance, after which 34 articles were identified as potentially relevant to the above research questions. A total of 72 articles were included in this rapid review.

Inclusion/exclusion criteria

Inclusion

- Any study design/article type.
- Focus on an infectious disease outbreak event at a national or international level.
- Quarantine or lockdown focus.

- Reports impact on the social, behavioural or structural determinants of health.
- All low-, medium- and high-income countries.
- No restriction on the basis of date.

Exclusion

- Focus on health protection or disease control (surveillance).
- Modelling study.
- Does not examine the impact of an infectious disease outbreak.
- No examination of impact on the social, behavioural or structural determinants of health.
- Has a COVID-19 focus.

Quality appraisal

We included both peer reviewed and grey literature in this rapid review to utilise the maximum extent of the existing evidence base and decrease the risk of publication bias. Although the included studies were not formally appraised due to time constraints, any included methods were examined for likelihood of bias or other methodological shortcomings. Limitations of the retrieved literature are outlined below (see Limitations section).

Main outbreaks included in report

The past outbreaks identified were as follows (See **Appendix 1** for further details): SARS (19 papers); H1N1/pandemic flu (12 papers); avian flu (2 papers); MERS (2 papers); Spanish flu (8 papers); multiple outbreaks (narrative overviews mostly) (7 papers), quarantine (6 papers); Ebola (16 papers).

Results

A total of 72 papers were included in this review with the majority focusing on the 2003 SARS and 2009 H1N1 pandemic flu outbreaks which mainly

occurred in Southeast Asia. However, also included are 16 articles focusing on outbreaks of Ebola (predominantly from Western Africa). These reported similar health and social impacts, although were potentially more acute due to the severity of the disease and because the most affected countries were low income, had a poor health infrastructure and often experienced concurrent conflicts and famines.

The results presented below are grouped thematically as there was a tendency to observe qualitatively similar impacts across outbreaks (with the exception of Ebola which tended to be more severe). The key themes from the literature included: mental health outcomes, health behaviour and lifestyle changes, impact of school closure, and individual and family economic impact.

Reports covering previous flu and SARS/MERS outbreaks mainly focused on Southeast Asia (China and Taiwan) with only a very small number from Canada, the US, Japan and a few European countries. Owing to the qualitatively different nature of past Ebola outbreaks, articles focusing on these outbreaks are summarised separately.

Mental health impact from past outbreaks

The majority of primary evidence on the impact of flu and SARS/MERS outbreaks comes from cross-sectional research designs. This literature typically reports high psychological and mental health impacts including psychological distress, anxiety, depression and fear.

Healthcare workers

The greatest impact tended to be reported among healthcare workers (medical staff, nurses and healthcare assistants) regardless of outbreak type, although most studies came from the SARS and H1N1 pandemic flu outbreaks.^{2,3,4,5,6,7} These included higher levels of psychological distress, post-traumatic stress and burnout from working in high-risk wards; an increased perception of risk to health from a new outbreak of unknown

epidemiology (SARS); and an increase in fear and feelings of isolation and worry about family and friends being infected.⁸ Within the healthcare profession, differential impacts on mental health were reported, with nurses being more affected (often due to higher exposure to day-to-day stressors and increased workload) compared to other healthcare professionals such as medical staff and healthcare assistants.^{9,10,11}

One review article was identified which examined the psychological consequences of infectious disease outbreaks (predominantly SARS) on healthcare workers.¹¹ However, as noted above, and as highlighted elsewhere in this review article, pre-exposure levels of mental health were assessed in only a few studies, and therefore a causal impact of the outbreak cannot be inferred. Further, the observed response rates were relatively low, which potentially represents a source of non-response bias. However, the key findings from this systematic review were:

- Thirteen studies collectively found that around 40% of healthcare workers experienced psychological 'distress' (range from 11% to 75%).
- Four studies found that an average of 39% of healthcare workers experienced insomnia (range from 30% to 52%).
- Five studies examined the impact of previous outbreaks on healthcare workers' use of alcohol and drug misuse. A total of 13% of healthcare workers were observed to use alcohol as a coping mechanism across the retrieved articles (range from 6% to 21%).
- Post-traumatic stress disorder (PTSD) symptoms were examined in 19 of the retrieved articles, which collectively indicate that around 20% of healthcare workers have experienced PTSD symptoms (range between 10% and 33%).
- Depression was assessed in eight articles, with an average of 46% (range from 23% to 74%) of healthcare workers experiencing depressive symptoms.

- Anxiety was assessed in 13 studies with around 45% of healthcare workers experiencing this psychological impact (a range from 19% to 77%).

General population

The impact of past outbreaks on mental health among the wider population has also received considerable interest. This literature includes reports which focus on particular groups such as recovering patients, victims' families, vulnerable groups, communities and the population in general. The mental health impacts observed among healthcare workers are also seen among the wider population, including fear of the unknown, higher stress levels, broad negative psychological effects and depression.^{12,13,14} There is some evidence that symptoms of increased anxiety, fear and perception of risk are exacerbated through poor communication, the nature of communication technology used and its source (from country of origin or country of residence) to inform the general public.^{15,16,17} While the evidence on these effects is sparse, what does exist indicates that consistency of messaging, concise and practical advice, and propagation of public perception that 'something is being done' may, in part, mitigate the mental health consequences of infectious disease outbreak events.

Higher levels of depression and poorer family and community relationships have been observed among the general population. Other social consequences related to mental health include community tension, lack of trust, poorer self-perceived health and household economic impacts.^{13,18,19} Concerns about contracting the virus and problems faced due to quarantine included emotional difficulty of confinement, potential job loss, difficulty communicating with friends/families and access to essential supplies.^{20,21}

Risk factors associated with worse mental health outcomes

Specific risks for mental health were seen among some foreign nationals (Chinese students) living in another country (Japan) where they reported elevated levels of fear, worry, depression and social discrimination attributed

to an association with their nationality and disease transmission.²² Additional factors that increased the risk for poor mental health included being single, being quarantined, exposure to other traumatic events (such as sustaining severe injury in violent circumstances, witnessing a death or serious injury of a close friend or family member) and perceived susceptibility to the virus.²³

Vulnerable groups that were identified as particularly susceptible to poor mental health outcomes include those with pre-existing mental health or other health conditions, pregnant women, people with a disability, those with a low income and those who are elderly. Additionally, those experiencing uncertainty around the (actual or perceived) risk of infection were associated with worse mental health outcomes and adverse coping behaviours including tobacco and alcohol consumption.²⁴ Longer-term physical and emotional impacts and their effect on quality of life were also reported among survivors of avian flu and MERS up to 2 years post infection.^{25,26} Few studies were found that looked at differences in suicide rates during any outbreak. However, two studies on the Chinese population during the SARS outbreak found an increase in suicide rates but only in the elderly (over 65 years) female population.^{27,28}

In summary, although the quality and methodological robustness of many of the retrieved studies is poor, taken overall, there is consistent evidence that broad, negative mental health impacts have been seen during and after (up to 3 years) past major infectious disease outbreaks with some evidence that there is greatest impact among healthcare workers. What remains unclear from the retrieved literature is the long-term impact of these mental health issues, the recovery time and what short- and long-term interventions or support could help reduce or mitigate the impacts.

Impact of quarantine on mental health

The COVID-19 pandemic resulted in the majority of countries going into lockdown which lasted many months. This is something that has not been documented on the same scale from any previous outbreaks. The closest

evidence to this situation are instances of individual quarantine due to infection, which typically lasted a much shorter period of around 5 to 10 days.

A major gap identified in the included studies is the health and social impact of long-term quarantine on vulnerable populations such as the elderly or those with a serious underlying health condition (i.e. those who are being 'shielded' from an infectious outbreak as seen with the current COVID-19 outbreak).

Previous outbreaks have not reported on long-term quarantine health outcomes, as shielding vulnerable groups has not been widely implemented as a public health measure. This is because previous outbreaks were less specific in who they infected than is seen with COVID-19.

These long-term stricter isolation measures imposed on vulnerable groups may have even greater short- and long-term physical and mental health issues than is seen in the general population.

Mental health impact of quarantine

A recent rapid review of the literature²⁹ included findings of studies which compared people who had been quarantined with those who had not, as well as studies that only looked at those who had been quarantined but had no controls. This review identified a wide range of negative psychological effects similar to those outlined above. These impacts included post-traumatic stress symptoms, confusion and anger. Risk factors for worse outcomes included longer quarantine duration, infection fears, frustration, boredom, inadequate supplies, inadequate information, financial loss and stigma. There is also some indication that these effects may be worse the longer the quarantine is and that they may persist even after containment of the outbreak.^{29,30} Individuals may also be impacted from taking time off work and wage loss especially if they are unable to take any employment leave.³¹

As noted above, healthcare workers may be more affected from working on the front line than the general population. In one study³² it was reported that healthcare workers who had been quarantined had more severe symptoms of

post-traumatic stress than members of the general public who had also been quarantined.

A study focusing on the psychosocial responses of children and their parents who were quarantined compared to those who were not found that levels of post-traumatic stress symptoms were four times higher among children who had been quarantined than in those who were not. The same study found that among quarantined parents, around one quarter (28%) reported sufficient symptoms consistent with a diagnosis of a trauma-related mental health disorder, compared with 6% of parents who were not quarantined.³³

Mitigating the impact of quarantine

Individuals and families undergoing quarantine need to be supported to understand why they need to self-isolate, what they can and cannot do, as well as where to seek help for essential goods and services, and everyday duties. A particular need is transparent and timely communication around the continuation of employment, wages and other forms of income while individuals are not working, and about the means by which they would be supplied with essential items and other services necessary for daily living.³⁴

Difficulties in adhering to quarantine and the psychological impact of the quarantine experience has also been observed among patients and healthcare workers.³² Isolation resulting from quarantine can lead to loneliness, boredom and distress. Being able to communicate and keep in touch with family and friends (for example via telephone and social media channels) is also essential. It is important that clear lines of communication about what to do if experiencing any symptoms are readily available to people who are quarantined.²⁹

In summary, overall, the evidence around the psychological impact of quarantine episodes is substantial, even when considering that evidence on such restrictions pertains to substantially shorter periods of time than the measures to control COVID-19. The impact of three or more months of

lockdown during the current outbreak has the potential to be considerably greater and longer lasting, and may have differential impacts on specific groups including those who have been 'shielded'.

Other key findings

Health-seeking and lifestyle behaviour

Few studies were identified that focused on changes in health-related behaviour, whether positive or negative. However, in the few studies that were found in relation to health service use, two studies found a reduction in the number of visits to and use of health services (for example outpatient visits) due to the perceived risk of infection.^{35,36}

Compared to respondents who sought health care, those who did not were more likely to be current smokers and/or moderate or heavy drinkers.

People without health insurance and those with financial barriers to health care were also less likely to seek help from the healthcare system,³⁷ which are less of a barrier in the Scottish context. Two further studies reported on lifestyle changes during the SARS outbreak in China, including improvements in physical activity, diet, sleep, hygiene, money spent on 'health' leading to a healthier lifestyle, and avoidance of risk and greater prioritisation of their health.³⁸ In a separate paper by the same authors, individuals were also observed to place a greater emphasis on social relationships (family and friends), lifestyle factors and attention to their own mental health.³⁹ However, no follow-up was conducted, meaning the duration of these positive impacts is unknown.

Impact of school closure

A few studies report on the impact of school closure on outcomes such as work absenteeism and wage loss. Past instances of school closure tended to occur when a major outbreak was observed within a specific school or cluster of schools rather than a blanket closure across a wider area, as is the case

during the COVID-19 pandemic. Closure tended to be for around 1 to 2 weeks until the infection had subsided which, again, is different from the present situation. While a number of impacts were observed in connection to school closures, they tended to be relatively minor; however, there is some evidence that the impact was more pronounced on individuals and families with low income or socioeconomic status.

Issues such as childcare and childcare expenses, transportation, food provision and lost income were proportionately greater among low socioeconomic groups in a 2-week school closure during the H1N1 pandemic flu in Argentina.⁴⁰ Minimal impacts on work absenteeism and wage loss from school closure were seen in other countries.^{41,42,43} There is some evidence that the social impact of school closures can be minimised by virtue of children still going out to others' homes, thus minimising childcare costs and wage loss. However, this may serve to compromise disease control measures which may ultimately increase the severity and duration of any outbreak event. Formal evaluation of the risks and benefits of such recommendations is required at individual, family, community and wider population levels.^{44,45}

Individual/family economic impact

There is a lack of evidence of economic hardship experienced by individuals and families in general, other than the short-term impact of school closure and work absenteeism affecting individuals' wages. However, where an outbreak and the public health measures such as quarantine have lasted for prolonged periods, there can be greater social and economic impacts especially among specific groups such as those in low socioeconomic positions or from minority ethnic groups. During a flu (H1N1) pandemic outbreak in the US, adverse effects were more prominent among ethnic minority groups. This may be due to having less capacity to implement infectious disease control interventions and to tolerate the social consequences of a pandemic because of systemic inequality in underlying health status and social factors, and lack of access to and use of health care.⁴⁶ In other outbreaks, older workers are also reported

at risk from economic downturns. They may experience higher involuntary unemployment and underemployment in the form of decreased working hours.⁴⁷

In utero exposure and long-term impacts

An influenza outbreak (Spanish flu) in the 1910s is known for the large numbers of lives lost, particularly among young men (in part, a consequence of military movement during and following the First World War). However, a number of retrospective studies, all from the US, have reported on long-term effects among those that were in utero at the height of this outbreak event (fetal origins hypothesis).

Adverse impacts have been reported on social, economic and health outcomes including lower education and employment attainment, lower socioeconomic status, poorer health outcomes, kidney/circulatory/pulmonary disease and hospitalisation.^{48,49,50,51,52,53} However, one long-term study on mortality rates found no difference between cohorts exposed and unexposed several decades later.⁵⁴

These findings, which tend to be modest in nature, are attributed to the impact of the flu virus on fetal development (direct impact) which may pass down through several generations, with each generation showing less adverse outcomes in health or other social outcomes. The impact may also be compounded by mothers in low socioeconomic positions (indirect impact) with little access to health care, low income and poorer education, or becoming ill and unable to provide the best care for themselves and their children.

In another study looking at childhood health and sibling outcomes, families with a child in utero during the pandemic shifted financial investments to the child's older siblings, leading to significantly higher educational attainments for these older siblings.⁵⁵ The author linked adult health and educational attainment information from military enlistment records to childhood census, to examine how educational investment and health outcomes differed for

individuals that had a sibling exposed to the pandemic while in utero and those individuals who did not. This potentially reflects an evolved psychological mechanism where parents adjust allocation of finite resources in response to perceived environmental risks.

Gender impact

One paper focused on applying learning from a gendered approach to biological weapons and infectious outbreaks including Ebola, SARS and other natural disease outbreaks.⁵⁶ Women comprise the majority of carers and healthcare workers and so, as a group, are more likely to experience negative effects associated with these roles. In lower-income countries, women tend to be less educated, have less access to information and are less likely to attend health meetings. They may be exposed to more adverse psychiatric consequences from flu-like outbreaks as well as Ebola (see below).

One narrative review was identified that examined ways in which pandemics can affect violence towards women and children.⁵⁷ This article addressed a number of pathways through which disease outbreaks may be associated with violence, such as via the stress surrounding economic insecurity and specific challenges around quarantine. This review concluded, however, that research on the links between disease outbreaks and gender-based violence is fairly sparse. More research is needed to better understand the type and extent of issues faced, as well as look at effective interventions to mitigate them.

Children and adolescents

Other than the aforementioned study by Sprang and Silman³³ which reported increased mental health issues among some children, and the potential impact of short-term school closure on children's education, few studies were found that had a focus on children and young people. As such, there is very little learning from past outbreaks on the impact of long-term lockdown and school closure on children's mental health, wellbeing and educational attainment that can be applied to the current COVID-19 outbreak.

Ebola outbreaks

Health and social impacts from Ebola outbreaks are included in this rapid review. While Ebola is endemic in several African countries (mostly Western Africa), there are also new sporadic outbreaks either in these countries or in neighbouring ones. Although mostly affecting low- and medium-income countries, some of the learning from these outbreaks may be useful for long-term impacts from outbreaks that are qualitatively different and more similar to the current COVID-19 pandemic.

Mental health impact from Ebola outbreaks

The mental health impacts seen among individuals and communities of Ebola outbreaks reflect closely those seen with the flu and SARS/MERS outbreaks, but often on a more acute scale. This may be partly due to the conflicts and famine seen in these countries and the poor level of health care and support for dealing with casualties and longer-term impacts. In addition, absence of robust surveillance systems, poor healthcare services, unskilled healthcare workers, and poor access to and knowledge of the use of personal protective equipment compounds the devastating impact the virus can have on communities.⁵⁸

Owing to strict containment and quarantine measures imposed by governing authorities during outbreaks and the public health information provided to communities regarding the deadly nature of the virus, communities can be exposed to an 'epidemic of fear' to ensure compliance with regulations to reduce the spread of the virus.^{59,60,61}

Mental health issues reported among victims and healthcare workers include fear and anxiety, depression and PTSD, which are exacerbated by lack of mental health services.^{62,63,64,65}

Other outcomes include orphaning of children, feelings of shame or guilt, discrimination and stigma, high mortality (including medical staff dying due to contact with patients' bodily fluids), increased workload among healthcare

workers and inadequate resources such as food and medicines.^{66,67,68} Some cultural practices and beliefs, such as funeral procedures, are prohibited during outbreaks due to contamination risk from the deceased's bodily fluids.⁶⁹

Broad negative social impacts on wellbeing and relationships, not being able to care for children, and loss of family and livelihood are also widespread. Large sections of the population suffered economic hardship, mainly due to unemployment. However, increased community cohesion and supporting others during the outbreaks was also apparent.^{70,71,72}

Not only are indigenous populations at risk, but health workers deployed in response to the outbreaks are also potentially at greater risk of suffering mental health issues depending on individual risk factors such as experience, education levels and previous deployment activity.¹¹

In summary, the impacts seen during Ebola outbreaks tend to reflect the outcomes from other outbreaks, although they are more acute due to the nature of the disease, the effect of conflict and famine, and the lack of quality healthcare provision. These studies also highlight the negative impact of poor health surveillance systems, inadequately trained health staff, overwhelmed health systems and a lack of appropriate protective equipment which individuals are trained to use.

Aid workers, including medical personnel who are not experienced in dealing with high-risk outbreaks, may also be at greater risk of adverse mental and physical health from dealing with the traumatic consequences of the disease. This may have relevance to the current COVID-19 outbreak with non-intensive care medical staff being placed in high-risk wards and intensive care units when they have little or no experience in these surroundings and may require long-term support following their placement.

Limitations/caveats

A broad approach was taken for this literature review, the key purpose being to identify the range and nature of adverse health and social outcomes identified from past global infectious disease outbreaks. We did not include endemic diseases such as malaria and human immunodeficiency virus (HIV), but did include Ebola as this has seen new outbreaks in several countries, which could be relevant and transferable to the current COVID-19 outbreak in the UK. The main drawback of this broad approach is that a wide range of outcomes were observed from countries with vastly different cultural and economic circumstances which may not transfer easily to the UK.

The current COVID-19 pandemic is also unique in the scale of the outbreak, and in the responses and impacts which have arisen from 'lockdown' and physical distancing measures. The scale and duration of these measures have not been previously recorded. The current outbreak has the potential to result in greater social and economic impacts owing to substantive differences in the nature and extent of the outbreak and the outbreak control measures used.

With the exception of a few reviews or overview papers, most of the included studies were cross-sectional, with substantial variation in when data were collected (from during the outbreak to three years post outbreak). This may affect individuals' ability to self-report the outcomes of interest, and presents challenges for understanding how outcomes may change during and after the emergence of an outbreak event. In addition, the recruitment and survey methods used, response rates and measurement tools used tend to be fairly weak, adding to the limitations and robustness of the findings presented here. Many studies were also narrative in nature with general statements made about the impacts observed without supporting these with formal evidence.

A significant additional limitation with the literature identified in this rapid review is that it does not permit contrasts to be made against population

baseline levels or within individuals across time. Thus, no firm conclusions can be made about the extent to which, for example, healthcare workers show increased levels of the identified symptoms because of the circumstances surrounding infectious disease outbreaks.

Conclusion

Relevance to current COVID-19 outbreak

The key findings reported here tend to be similar across most of the flu and SARS/MERS outbreaks, including Ebola, which may have relevance to the current COVID-19 pandemic. Of the recent infectious outbreaks, SARS presented the most severe mental health issues such as fear and anxiety, especially among healthcare workers. These included increased workload and working in high-risk situations, as it was a new and unknown virus which affected people indiscriminately, albeit at a lower infection rate but with higher mortality than the other observed outbreaks.

Few papers examined the longer-term impacts of past outbreaks or mitigation interventions for indirect impacts. In some cases this may reflect a relatively short duration and geographical spread (limited to only a few countries) of past outbreaks, lower infection and mortality rates, and shorter duration of quarantine/social isolation measures.

Impact of quarantine

Perhaps surprising is the impact of even short-duration quarantine episodes (average of 5–10 days) on individuals and families, particularly on mental health, and social and economic outcomes such as work absenteeism, wage loss and reduced employment. However, one caveat with this literature is that none of the included studies looked at longer-term lockdown as is currently seen with COVID-19. Therefore, it is difficult to extrapolate findings to the current outbreak and whether any psychological adjustment occurs during this period to reduce its impact

Interventions

One of the main areas not covered in the retrieved literature is about the interventions put in place to reduce or mitigate against short- and long-term impacts on non-communicable disease outcomes. The section below details some emergent research questions that would need to be addressed to understand the impact of the current outbreak and to guard against potential negative consequences of future outbreak events.

Research questions

Emergent research questions

The unprecedented nature, extent and duration of the COVID-19 pandemic (and the associated disease control measures) means that much of the existing evidence on the impact and mitigation of previous outbreaks lacks relevance and specificity to the current context.

In addition, much of the identified literature is of poor quality, with small sample sizes and unclear representativeness (typically convenience samples rather than probabilistic stratified samples). Furthermore, the research designs do not lend themselves to making causal inferences or robust statements about differences in impacts over time or between groups of people.

As such, a series of knowledge gaps have been highlighted by this review which include but also go beyond the original research aims. These emergent questions are briefly summarised below. Addressing these questions with robust data collection and evaluation will help mitigate the impact of the ongoing COVID-19 outbreak (particularly if multiple lockdown periods should be necessary). Their consideration will also contribute to improved preparedness for future infectious disease outbreaks.

For all of the questions below it is vital to document and understand potential differences in impacts and mitigation efficacy across population groups,

particularly in terms of age, sex, socioeconomic status (including measures of employment), ethnicity and pre-existing morbidity.

1. What are the long-term impacts of infectious disease outbreaks on non-communicable disease outcomes?
 - a) What are the long-term impacts of COVID-19 and associated control measures on a range of non-communicable disease mental, physical and social health outcomes (for example incidence and/or prevalence of anxiety, PTSD, suicide, unemployment rates and relative poverty).
 - b) What risk and protective factors are causally associated with non-communicable disease outcomes following infectious disease outbreak events? What is their population prevalence, what is the strength of association and how modifiable are they?
2. What is the long-term effectiveness of specific measures taken to mitigate the consequences of infectious disease control (for example access to job retention schemes) on non-communicable disease outcomes and their determinants?

Other potential questions

1. Is there any evidence that known socioecological determinants of health are more or less associated with non-communicable disease outcomes in the context of an infectious disease outbreak?
2. What existing non-communicable disease interventions may represent particularly cost-effective uses of public funds in recovering from the COVID-19 pandemic?
3. What evidence is there of widening in income inequalities following outbreak events such as COVID-19?
4. What evidence is there of widening of socioeconomic inequalities in health outcomes following outbreak events such as COVID-19?

5. Is there a lasting impact on non-communicable health outcomes of being in utero/neonate during an infectious disease outbreak? Can we untangle the potential biological/epigenetic effects from those that are due to socioecological factors (such as parents' employment sector/status, family structure)?

Appendix 1: Key outbreaks covered in this review

1918 influenza pandemic ('Spanish flu'). Influenza A virus subtype H1N1: 17–100 million deaths worldwide.

2002–04 Severe acute respiratory syndrome (SARS) outbreak. SARSr-CoV-1: 774 deaths worldwide.

2009 swine flu pandemic. Influenza A virus subtype H1N1: 151,700– 575,400 deaths worldwide.

2012 Middle East respiratory syndrome outbreak. MERS-CoV: 862 deaths worldwide.

2004 – present. Five major outbreaks of Ebola in African countries (mainly Western Africa): Over 11,000 deaths from all outbreaks.

2019 – present. COVID-19. SARS-CoV-2: Over 900,000 deaths (data from 10 September 2020).

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