Coronavirus (2019-nCoV) plausible worst-case scenarios for the education system

Disclaimer: this note has been compiled at pace. It reflects a quick review of the existing literature on the impacts and possible responses to a possible pandemic. However, given the nature of 2019-nCoV, and the uncertainties around its virility and severity, evidence based on analysis of previous pandemics may not serve as a useful guide in this case.

Most of the evidence on 2019-nCoV examines epidemiology, there is general evidence on the efficacy of specific school-based responses to pandemics, and evidence on the possible general trends of the diseases. This means assessing the specific impacts on the education system from the existing literature is very challenging.

Section 1: plausible worst-case scenarios

WHAT COULD HAPPEN?

The impact of the disease depends on two factors, over which there is considerable uncertainty at this stage:

1. **Transmissibility** – the reproductive rate (R_0) of coronavirus is estimated to be between 1.5 and 3.5 – meaning each case will create between 1.5 and 3.5 new cases. This is higher than the common flu (1.3) and SARS (2.0) (https://www.worldometers.info/coronavirus/)
2. **Impact** – how severe each infection is. This can be measured by the fatality rate (see below) but other more pertinent factors for the education system might be hospitalisation rates, and the rates of infection for younger people.

The virus seems to be affecting older, more vulnerable people (median age outside China is 45 years), but people of all ages can be infected – WHO myth-busting pages:

- People of all ages can be infected by the new coronavirus (2019-nCoV). Older people, and people with pre-existing medical conditions (such as asthma, diabetes, heart disease) appear to be more vulnerable to becoming severely ill with the virus.
- WHO advises people of all ages to take steps to protect themselves from the virus, for example by following good hand hygiene and good respiratory hygiene.

Impact on school may be more limited because of this. However, there is some evidence that children are contracting a milder virus (https://www.nytimes.com/2020/02/05/health/coronavirus-children.html) so number may well rise

The impact for the UK and the EU/EEA is predicted to be low as at 7 Feb 2020:

> ## What is the risk of 2019-nCoV infection for the EU/EEA and UK population?
>
> The risk of 2019-nCoV infection for the EU/EEA and UK population in Europe is currently **low**.
>
> This assessment is based on the following factors:
>
> - Probability of infection for the EU/EEA and UK population is considered **very low**. While there have been imported cases reported from seven EU/EEA countries and from the UK, the overall number of cases reported in the area remains low and containment measures are in place. There are, however, uncertainties regarding transmissibility and under-detection particularly among mild or asymptomatic cases.
> - If an infection is acquired, the impact for the infected individuals is considered **high**. For the population, the impact of one or more infections is also considered **high**. Although information on case severity and the effectiveness of control measures remains very limited, data reported as of 7 February accounts for 31 503 confirmed cases, including 638 deaths (2.0%).

What factors will determine what could happen?

Monitoring and detection will be crucial in the absence of a vaccine or other treatment – the education system could play an important role here (see below)

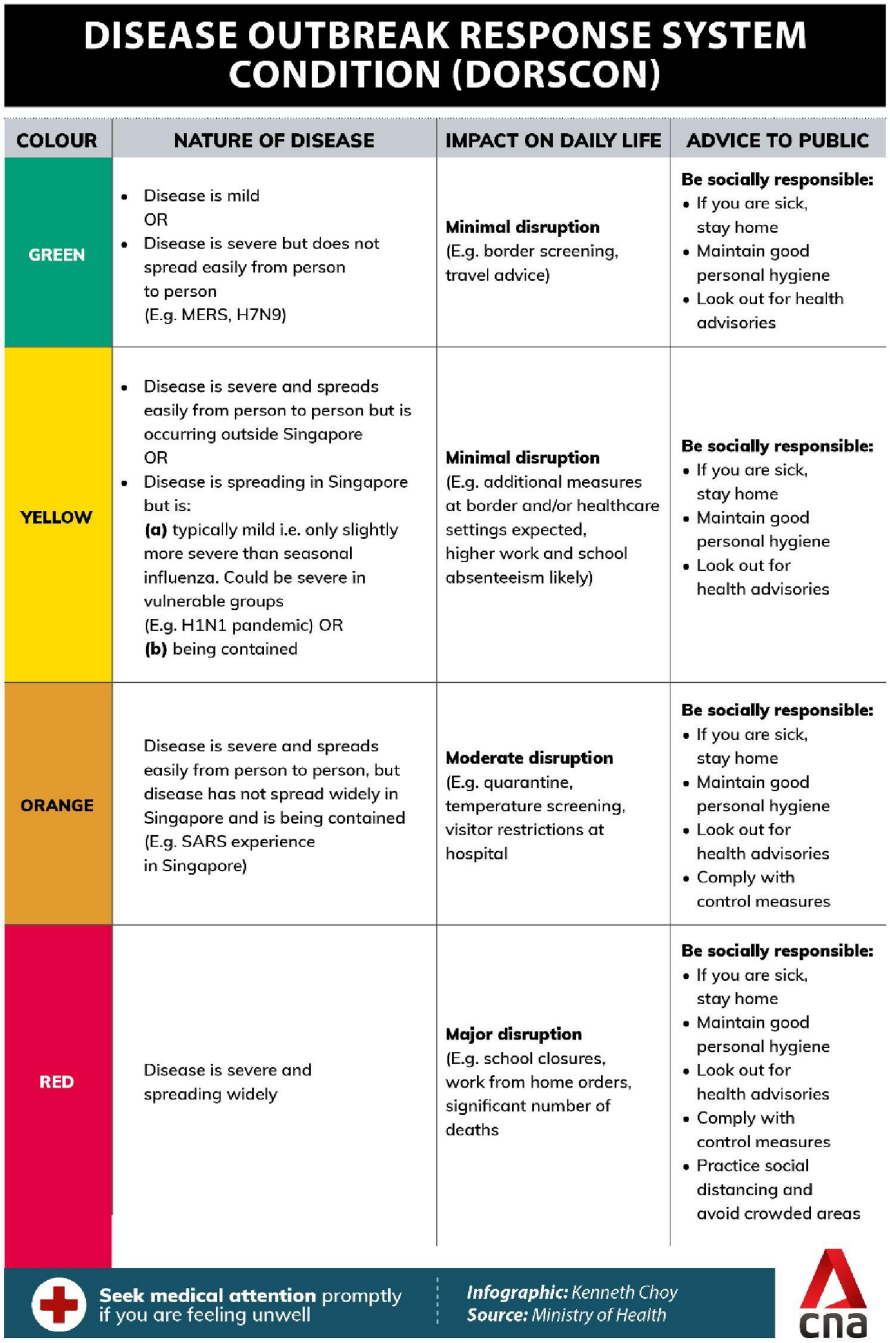
- https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-2019-nCoV-transmissibility.pdf
- "While more severe cases will always need to be prioritised, control may depend upon successful detection, testing and isolation of suspect cases with the broadest possible range of symptom severity."
    - Potential implication: systematic screening (e.g. of students at universities and colleges?)
    - "an accurate test already exists, but the number of labs capable of conducting it is limited, creating delays that will only get longer as the case count rises." (https://www.foreignaffairs.com/articles/china/2020-01-31/how-prepare-coronavirus-pandemic)
    - Monitor development of rapid diagnostic kits

How many people might die?

It's too early to tell, although signs suggest few young/healthy people are dying Nature (2020)

- The fatality rate for a virus — the proportion of infected people who die — is difficult to calculate in the middle of an outbreak because records on new cases and deaths are constantly being updated. The new coronavirus has a death rate of 2–3%: significantly lower than SARS (10%).
- However, this is still quite high for an infectious disease. The 1918 influenza outbreak, known as the Spanish flu, infected around half a billion people, one-third of the world's population at the time, and killed more than 2.5% of those infected (approx. 50m).
- However, the virus is typically not killing younger, healthier people.

Singapore's pandemic response system is currently at yellow – only at red do school closures typically happen – in response to a rapidly spreading outbreak with severe health implications.



DISEASE OUTBREAK RESPONSE SYSTEM CONDITION (DORSCON)

COLOUR	NATURE OF DISEASE	IMPACT ON DAILY LIFE	ADVICE TO PUBLIC
GREEN	• Disease is mild OR • Disease is severe but does not spread easily from person to person (E.g. MERS, H7N9)	**Minimal disruption** (E.g. border screening, travel advice)	**Be socially responsible:** • If you are sick, stay home • Maintain good personal hygiene • Look out for health advisories
YELLOW	• Disease is severe and spreads easily from person to person but is occurring outside Singapore OR • Disease is spreading in Singapore but is: **(a)** typically mild i.e. only slightly more severe than seasonal influenza. Could be severe in vulnerable groups (E.g. H1N1 pandemic) OR **(b)** being contained	**Minimal disruption** (E.g. additional measures at border and/or healthcare settings expected, higher work and school absenteeism likely)	**Be socially responsible:** • If you are sick, stay home • Maintain good personal hygiene • Look out for health advisories
ORANGE	Disease is severe and spreads easily from person to person, but disease has not spread widely in Singapore and is being contained (E.g. SARS experience in Singapore)	**Moderate disruption** (E.g. quarantine, temperature screening, visitor restrictions at hospital	**Be socially responsible:** • If you are sick, stay home • Maintain good personal hygiene • Look out for health advisories • Comply with control measures
RED	Disease is severe and spreading widely	**Major disruption** (E.g. school closures, work from home orders, significant number of deaths	**Be socially responsible:** • If you are sick, stay home • Maintain good personal hygiene • Look out for health advisories • Comply with control measures • Practice social distancing and avoid crowded areas

What are the significant uncertainties?

- We don't yet know the total number of cases (it's likely that China may be under-reporting the true scale of the infection).
- We don't fully understand the incubation period, but infected cases can transmit the virus during this period.
- The disease seems to last around 2 weeks, but it could be longer.
- The rate of reproduction is uncertain
- We don't understand the impacts on children
- We don't know how prepared individual schools are to deal with a possible outbreak

Section 2: immediate impacts

EARLY YEARS AND YOUNGER CHILDREN

Very little here (although note evidence above)

SCHOOLS

What will schools need to do in the event of an infection?

Schools and colleges will need to respond to any outbreaks – the Hong Kong government has a checklist responses for schools which may serve as a useful guide. Although it's difficult to know whether 2019-nCoV will be as severe in the UK as SARS in HK.

Comprehensive list of school responses to SARS epidemic in Hong Kong, summarised:

- Day to day measures
    - Schools act as a point of information for communities/home-school cooperation is important (eg instructions to parents on what to do if their child is ill, and how to record their temperature accurately etc)
    - Information on personal hygiene to staff and students
- In schools where SARS was reported
    - Staff members in close contact with SARS should stay at home for 10 days (although likely to be different for 2019-nCoV?)
    - Response and information to parents through letters
- In schools with suspected infections:
    - Health department involved in follow up with school
    - Communication mechanisms set up
    - Schooling could continue through emails and the school website
    - Holidays rearranged to account for the loss of timetable
    - Examinations suspended – relying on formative assessment feedback for high-stakes exams
    - Staff on duty to provide support to children who aren't able to be at home
- Other administrative arrangements:
    - Adequate stocks of liquid soap, paper towels, disinfectants, thermometers etc needed to control and monitor outbreaks.
    - Timetables in place for cleaning and disinfecting the school
    - Additional time in the day for hand-washing – and mandatory enforcement for school children

Further details on how HK schools managed SARS here. Main precautions are around maintaining good hygiene, but also advice for preventing direct transmission:

- Early detection and encouraging parents and school staff to be vigilant
- Investigate absentees and report cases of infection
- Exclude students from school who are infectious
- Only readmit students on recommendation from a doctor
- Thoroughly disinfect the school after any outbreak

However, because we don't know enough about how widespread the infection could be, it's unclear how many schools would need to take these precautions, or whether they are appropriate for 2019-nCoV

OLDER STUDENTS – FE AND HE

Behind paywall – a study on preparedness of the University of Washington to a pandemic (https://www.liebertpub.com/doi/pdf/10.1089/bsp.2007.0029)

Some guidance for universities has already been published: https://www.universitiesuk.ac.uk/policy-and-analysis/Pages/coronavirus.aspx

CHILDREN'S SOCIAL CARE

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Section 3: possible responses in the education system

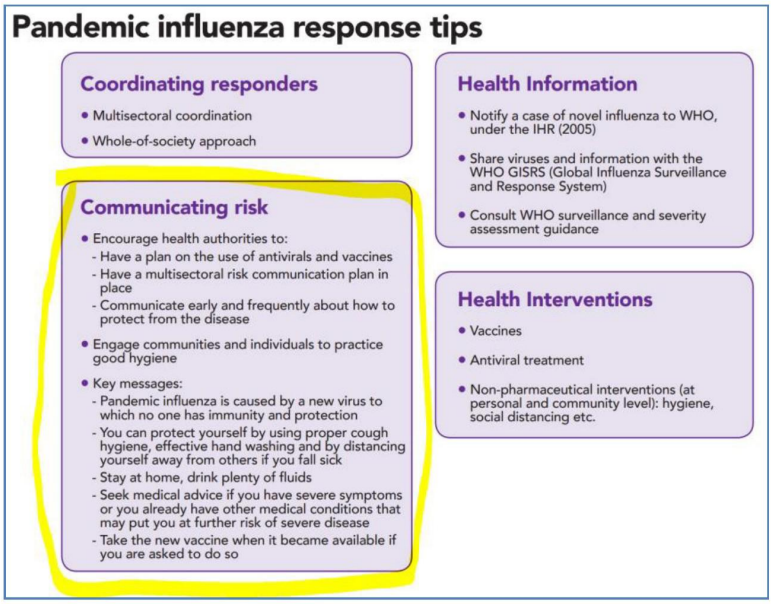
COMMUNICATION

WHO government responses

WHO: managing epidemics recommends 4 ways to control diseases – with implications for the education system

- **Coordinating responders (C)**
- **Health Information (HI)** – Schools/colleges/universities could play a role in disease surveillance given they bring together lots of families in one place. For Coronavirus, this might be temperature monitoring.
- **Communicating risk (C)** – Communicating about the risks during outbreaks leads to specific outcomes. First, early, transparent and understandable communication on the event establishes lines of dialogue with affected populations and stakeholders, and builds trust in the response. This type of communication must have facts and information (that cater to the head); and include messages that acknowledge and respond to people's concerns and fears (catering to the heart). Schools/colleges/children centres are a key site for providing information for traditionally harder to reach populations. Building trust is important – information coming from trusted school leaders could be impactful in certain communities.
- **Health Interventions (HI)**

Chart below shows specific recommendations for pandemic influenza (ie probably the closest analogue to 2019 n-CoV) – engagement with communities may be the key consideration for the education system.



Role of schools/colleges in communication

Communicating risk is a major component of the response – school can play a role here. So when we do know what people can and should be doing, **schools might be one effective avenue for communicating this**

- WHO: national capacity checklist (more about health infrastructure, but some details on communicating risk – which could be important for schools)
- WHO: communicating risk for 2019-nCoV (importance of community engagement – and possible role for teachers/schools)

- "Well run education & health systems are the best protection against epidemics" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4517126/)
- In many cases, parents and pupils may not follow advice given by schools, either in the event of becoming infected themselves, or if schools are closed (source). This underlines the importance of communicating the risks effectively to all.

PREVENTION MEASURES

Vaccinations

Developing a vaccine is likely to take at least a year (https://www.cnbc.com/2020/01/28/us-fast-tracks-coronavirus-vaccine-hopes-to-start-trial-in-three-months.html). We obviously can't wait that long.

- Who to vaccinate is also a difficult question. This study found that very high-resolution data (ie. which we don't have) would be needed to develop immunisation strategies that are any better than random chance: https://www.pnas.org/content/pnas/107/51/22020.full.pdf

Treatment and care for children in schools

Case study of H1N1 outbreak in France: Control measures were implemented as soon as a new case was confirmed in a school, which included active case finding among the pupils in the same class as the index case, setting up a dedicated influenza outpatient clinic that families were recommended to consult if necessary, prophylactic treatment of contacts and school closure

- Rapid response appeared effective: *"In this context, good communication and cooperation among the different people involved (healthcare authorities, the city council, clinicians, staff from schools, parents and children) were of major importance. This epidemic shows the transmission of the pandemic virus in a school setting and in households. The measures established appeared to have stopped the transmission. The absence of transmission in the community at that time in France justified the measures taken."*

School closures

BMJ meta analysis: school closures can be effective in controlling influenza, but significant heterogeneity in results, and lack of clarity over the optimal duration and timing of closures – this will also depend on the disease type) see also here.

Is School Closure an Effective Strategy to Control Influenza? Summary Version

Making decisions on school closures depends on the availability of a variety of evidence, including the:

- dominant influenza strain
- strain severity (mild, moderate, severe)
- age-specific attack rates as an indication of which sub-populations are susceptible
- transmission rate (R_0).

…and information about the local population that may heighten risks for adverse effects of closure and influenza severity, such as:

- demographic make-up (e.g. population under age 5, over age 65)
- inadequate housing (e.g. crowding)
- water and sanitation conditions
- prevalence of predisposing health conditions and risk factors (e.g. diabetes, smoking)
- social factors influencing contact patterns (e.g. mass gatherings, multi-generational households, caregiving)

There is some evidence of effectiveness

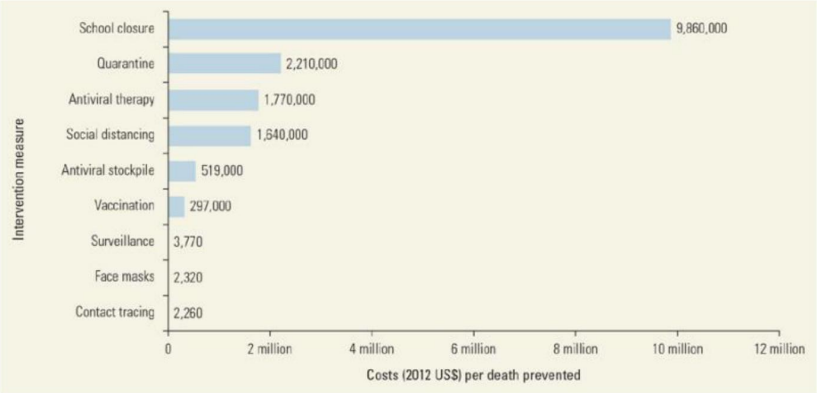
- School closure can considerably slow down influenza epidemics and mitigate their impact on the population De Luca et al (2018), different strategies based on pupil absenteeism can all be effective,

but costly (Fumanelli et al 2016 – based on computer modelling). Influenza spreads more slowly during the holidays (source)

- WHO says that school closures 'early in the outbreak' can be effective at slowing the spread (and that the 'benefit needs to be weighed against the cost': https://www.who.int/emergencies/diseases/managing-epidemics-interactive.pdf; https://www.sciencedirect.com/science/article/pii/S1755436518301749

But there are significant costs of school closures, and they may only be effective in certain situations

- Scale of closures matters to control epidemics (eg 2016). School closures may not have a huge impact on hospital bed space – when ICU space is severely limited, only widespread school closures are likely to be beneficial. There is a strong need for local coordination (House et al 2011) but this comes with substantial economic costs. Ineffectual school closures can have significant wider implications for other public services and the eco nomy.



- School closures are expensive ways to prevent deaths (chart based on influenza, so harder to control diseases may have higher costs per death prevented.
    - Measures that decreased person-to-person contact, including social distancing, quarantine, and school closures, had the greatest cost per death prevented, most likely because of the amount of economic disruption caused by those measures. Social distancing includes avoidance of large gatherings and public places where economic activities occur. School closures often lead to lost productivity because they cause workplace absenteeism among caretakers of school-age children. Macroeconomic model simulations also have identified school closures as a potential source of GDP loss during a moderately severe pandemic (Smith and others 2009).
    - But this is contested – for the most severe pandemics, school closures may be the most cost effective way to save lives
    - Also see economic costs below
- During the swine flu outbreak in 2009, the UK decided not to close schools. This decision has been supported/validated by research evidence since then. Instead stockpiled anti-viral medication for almost the entire population, distributed informational leaflets to every household, etc. Not much on what schools, universities & childcare providers did though
- Efficacy is unclear, and economic impacts are significant (esp. If caregivers have to stay home from work): https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0029640
- School closure will also have a significant impact on more vulnerable groups (eg those who are FSM eligible, as they may not be able to access free meals, and those with unsalaried parents) https://nccid.ca/publications/is-school-closure-an-effective-strategy-to-control-influenza/

Alternative to school closures

- Simulation studies in the US suggest that total number of contacts between children within schools can be roughly halved by implementing relatively simple interventions like schedule shifts and internal movement restrictions https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0029640
- Supported to some extent by other studies, but generally from very limited samples (like one day of data from one school in the US). The studies openly say that public health decisions shouldn't be based on those results alone.

- At a pupil level, the variation in propensity to transmit an infection is substantial, and based on social networks and contact groups – although some methodological questions over this study given it is survey-based (source). The results may suggest some students are 'super-spreaders' with a much higher propensity to infect others.

MONITORING AND DIAGNOSIS IN THE EDUCATION SYSTEM

Mandatory temperature checks

Impact of mandatory temperature monitoring may be minimal, but psychological effects on teachers and parents may be important to influence behaviours and attitudes.

- During the SARS outbreak, temperature monitoring was mandatory for all Singapore schoolchildren. None of the Singapore children with SARS were detected through school temperature screening. However, temperature monitoring procedures have a powerful psychological effect of reassuring parents and the public that schools are safe during a SARS outbreak. ou BMJ 2004

Absence data could predict outbreaks – but this would need to be almost transmitted in real time (source):

- "Certain influenza outbreaks, including the 2009 influenza A(H1N1) pandemic, can predominantly affect school-age children. Therefore the use of school absenteeism data has been considered as a potential tool for providing early warning of increasing influenza activity in the community …Weekly school absenteeism surveillance would not have detected pandemic influenza A(H1N1) earlier but **daily absenteeism data and the development of baselines could improve the timeliness of the system**."

WIDER IMPLICATIONS OF RESPONSES TO A PANDEMIC

Impact on healthcare system in the event of widespread school closures could be substantial:

- Even if health care workers do not die, their ability to provide care may be reduced. At the peak of a severe influenza pandemic, up to 40 percent of health care workers might be unable to report for duty because they are ill themselves, need to care for ill family members, need to care for children because of school closures, or are afraid (Falcone and Detty 2015; U.S. Homeland Security Council 2006). https://www.ncbi.nlm.nih.gov/books/NBK525302/

In any pandemic response, priorities need to be drawn. It is unclear whether targeting children through vaccinations would be most cost-effective

- Allocation of limited resources (by creating priority groups for vaccines and antivirals) is an important consideration during a pandemic. Modeling studies from the 2009 influenza pandemic investigated the most cost-effective strategies for allocating vaccines. Those studies found that vaccinating high-risk individuals was more cost-effective than prioritizing children. Favoring children decreased the overall infection rate, but high-risk individuals were the predominant drivers of direct costs during the pandemic, because they were more likely to be hospitalized (Lee and others 2010). However, these studies did not account for the indirect costs of school closures and absenteeism. Consideration of these factors could reveal increased cost savings from vaccinating children.

Section 4: longer term impacts

TRAJECTORY OF THE DISEASE

The long-term prospects for the disease are unknown Nature (2020)

- When a virus circulates continuously in a community, it is said to be endemic. The viruses that cause chicken pox and influenza are endemic in many countries, but outbreaks can be controlled through vaccination and keeping people at home when they are ill.
- Whether the virus becomes endemic is contingent on responses in other countries to control the virus. However, if the virus can be controlled such that each infected person transmits to less than one other person, the virus will have a finite life span and will not become endemic.
- In a worst case scenario, this could mean a much greater strain on educational infrastructure in future years.

ECONOMIC IMPACTS

There are serious long-term and short-term impacts of epidemics:

- IMF article
- BMJ economic modelling of pandemic influenza in the UK: The costs related to illness alone ranged between 0.5% and 1.0% of gross domestic product (£8.4bn to £16.8bn) for low fatality scenarios, 3.3% and 4.3% (£55.5bn to £72.3bn) for high fatality scenarios, and larger still for an extreme pandemic. School closure increases the economic impact, particularly for mild pandemics. **If widespread behavioural change takes place and there is large scale prophylactic absence from work, the economic impact would be notably increased with few health benefits.**
    - Balancing school closure against "business as usual" and obtaining sufficient stocks of effective vaccine are more important factors in determining the economic impact of an influenza pandemic than is the disease itself. Prophylactic absence from work in response to fear of infection can add considerably to the economic impact.