

Calibrating the impacts of COVID-19 with the impacts of its control measures: informing decision-making on Non-Pharmaceutical Interventions (NPIs)

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To: Covid-19 Scottish Government Advisory Group

Date: 9th April 2020

Summary

This paper seeks to inform decision-making on the Non-Pharmaceutical Interventions (NPIs) being used to control the spread of COVID-19. It details that:

1. COVID-19 represents a substantial mortality challenge. The scale of this challenge is particularly high when considered only in terms of crude death counts. When considered in terms of age-standardised mortality and impact on life expectancy, the impact is more comparable to other mortality risks Scotland faces, most of which are risks that impact on the population every year. We need to ensure that we are consistent in responding to mortality risks of similar magnitude and that we calibrate our response to the size of the risk.
2. There are numerous unintended consequences of COVID-19 which have very substantial impacts on the economy, education, social relations, and through these pathways, on population health and inequalities in the short, medium and long-term. Almost all of these impacts are likely to be negative although there are some positive impacts, as well as new opportunities to 'build back better'. Ensuring the unintended negative impacts of the Non-Pharmaceutical Interventions (NPIs) are sufficiently mitigated is vital.
3. There are difficult decisions to be made on when and how to reduce the NPIs. These will need to balance the potential impacts on COVID-19 mortality and morbidity, pressures on health and social care services, and the unintended consequences across society (including on population health and health inequalities). Further work can and should be done to estimate the intended impacts of NPIs on COVID-19 and the unintended impacts on health and other outcomes urgently to inform this decision-making. There is a risk that, on many measures, the impact of the NPIs for COVID-19 could be more deleterious than the impact of a less mitigated approach to COVID-19. This balance requires careful ongoing monitoring and consideration.

Scaling COVID-19 mortality risk against other mortality risks

The Ferguson model published by Imperial College is the evidential basis for the implementation of Non-Pharmaceutical Interventions (NPIs) across the UK estimates the number of crude deaths that will arise due to COVID-19 under several scenarios.¹ In the unmitigated scenario, wherein there are no NPIs implemented, it was estimated that between 410,000 and 540,000 COVID-19 deaths would occur. This was estimated to be reduced to between 5,600 and 48,000 deaths in a fully mitigated scenario (full 'lockdown'), depending on the prevalence of COVID-19 at the time of NPI reduction and the transmissibility of the virus. The reduction in deaths due to introducing NPIs is largely modelled to be due to lower pressures on healthcare services, and in particular, intensive care facilities.² The logic of the NPIs is therefore that by spreading the progress of COVID-19 across a longer period of time, fewer people in need of intensive care facilities would have those needs unmet, and as a result mortality would be lower.

The mortality benefit of the full 'lockdown' is therefore estimated as a reduction in crude deaths of between 362,000 and 534,400 across Great Britain (GB) compared to no NPIs being introduced. The Ferguson modelling assumes this reduction is due to more people receiving Intensive Care Unit support (particularly ventilation), and that treatment being highly effective at reducing mortality.¹ However, crude mortality counts are a problematic means of measuring mortality risk because they do not account for the age structure of the population and the co-morbidities within the population. This means that the estimated impacts included in the Ferguson modelling do not consider how likely they would have been to die due to other causes.

The estimated distribution of deaths in the Ferguson Imperial model are provided by age but not by sex or comorbidity.¹ These can be used to make estimates of the loss of life expectancy that were modelled to be averted through the use of NPIs. Our preliminary estimates of this are provided in Table 1, alongside estimates of the loss of life expectancy from other causes for context. It shows that in a fully unmitigated scenario, the estimated 510,000 crude deaths across Great Britain (GB), and the estimated 43,000 deaths in Scotland, would have resulted in a decline in life expectancy of 1.57 and 1.36 years respectively if those deaths all occurred within the space of a single year. By mitigating COVID-19 through full implementation of NPIs ('lockdown') the declines in life expectancy are estimated to be reduced to 0.07 and 0.06 years for GB and Scotland respectively, a net gain of 1.50 and 1.30 years of life expectancy.

This is clearly a substantial saving of life expectancy for the population and justifies radical policy action. This compares to the loss of life expectancy attributable to socioeconomic inequalities, every year, of 0.65 and 0.86 years for GB and Scotland; 0.25 and 0.34 years due to suicide in GB and Scotland; and 0.20 and 0.45 due to drug-related deaths in GB and Scotland. Given that these other mortality risks occur every year and their impact accumulates, these are comparable in scale to the mortality risks of COVID-19. The core

reason why inequality, drugs and suicide are on a similar scale to COVID-19 in terms of their life expectancy impact is because they occur more frequently amongst younger populations and drive substantial premature mortality. This is in contrast to COVID-19 which is impacting most on the older age groups.

Table 1 – Estimated crude mortality and life expectancy due to COVID-19, suicide, drug-related deaths and attributable to inequality, Great Britain and Scotland

	Annualised crude mortality (number of people)	Annualised life expectancy contribution (years)
Great Britain		
COVID-19 unmitigated scenario	510,000	-1.57
COVID-19 fully mitigated scenario (full lockdown)	20,000	-0.07
Suicide (annual mean 2013-7)	5,739	-0.25
Drug-related deaths (annual mean 2013-7)	4,334	-0.20
Inequality (annual mean 2013-7)	144,164	-0.65
Scotland		
COVID-19 unmitigated scenario	42,591	-1.36
COVID-19 fully mitigated scenario (full lockdown)	1,670	-0.06
Suicide (annual mean 2013-7)	701	-0.34
Drug-related deaths (annual mean 2013-7)	850	-0.45
Inequality (annual mean 2013-7)	17,150	-0.86

These estimates represent the upper bound of the life expectancy loss averted through NPIs because of COVID-19 given that the population dying from this would have had a lower remaining life expectancy due to higher prevalence of co-morbidities and other risks than the simple age-matched population risks we have estimated here. Work is underway by Hanlon et al to estimate what the remaining life expectancy of the group of people who have died from COVID-19 in the UK through data linkage which will provide a better estimate because it will match to populations with the same co-morbidity prevalence and age/sex structure.

The value attached to each death averted, and the extent to which this is dependent or independent on the remaining life expectancy at which any death occurs, raises many ethical issues. The Scottish Government's realistic medicine work recognises that there are many end of life scenarios in which prolonging life is not necessarily the best course of action nor the most ethical choice. It is also the case that most healthcare intervention decisions are informed by health economics calculations whereby the gain in life expectancy (and quality of life gain) is an intrinsic component of the decision-making process. However, there is an alternative position which values each life equally and independent of the remaining life expectancy of the individuals who die. This is relevant to whether crude death counts or life expectancy is used as the core metric by which to compare the size of the mortality challenge.

The unintended consequences of the NPIs for COVID-19

In contrast to the beneficial impacts of the NPIs on COVID-19 deaths, there are likely to be many unintended consequences with impacts across society, population health and health inequalities. A rapid Health Impact Assessment (HIA) has been undertaken to identify these unintended consequences, the mechanisms through which they might occur, and the potential mitigation measures that could be put in place to reduce their negative impacts (Table 2).³ Work is now underway to quantify the scale of these impacts through the 'social mitigation cell' led by Public Health Scotland, but this will necessarily be imprecise at this stage because of the uncertainties around the future scale and duration of the 'lockdown' measures, and the effectiveness of the mitigation in place.

What is clear is that the size of the shock to the Scottish economy is very large, estimated at a reduction of between 20 and 25% of GDP if the 'lockdown' continues for 3 months.⁴ Traditional government responses to recession (such as fiscal stimuli) may also be ineffective during the 'lockdown' given that the economic recession has arisen through forced unemployment rather than a decline in demand. Although the impacts of recession on health are mixed,⁵ the evidence of impact of unemployment⁶ and loss of income⁷ is much clearer, both of which are highly likely to have marked negative impacts on mortality, health and health inequality.⁵

The unintended consequences however go far beyond the economic pathways. The social distancing measures have reduced the workforce availability to provide health and social care services with many routine aspects of care having been postponed (e.g. screening programmes). This may have direct negative health consequences as healthcare needs go unmet. There are also likely to be substantial impacts through social isolation, mental health problems and changed physical activity patterns. These could all have short, medium and long-term impacts on population health and inequalities. There are some potential positive impacts of the NPIs however. Air pollution and carbon emissions are likely to decline and these will have positive impacts on health.

A key determinant of whether the balance of health effects of the NPIs will be positive or negative will depend on the economic policy pursued after the pandemic. If there is a similar approach to that after the 2008 recession, whereby public service funding and social security benefits were reduced, this could have very substantial long-run negative impacts. If however the opportunity to 'build back better' is taken, there is the potential for improved population health in the longer-run.^{5,8,9}

Table 2 - Summary of the unintended health impacts of the NPIs

Mechanism	Description	Impact
Economic	Impacting through decreased incomes, employment and the long-term economic policies resulting from the accumulation of government debts and loss of businesses.	Although the impact of recession on mortality and health is mixed, the impacts of lost employment, reduced incomes and the potential impacts of more austere economic policy could all be very large and negative for population health. The longer-term impacts relating to how the current mitigation measures are funded are also likely to have a profound impact on future population health.
Disruption of health and social care services	Routine services are reduced or are underused as a result of the NPIs.	This could increase mortality from other non-COVID-19 causes although the extent of this is very uncertain.
Isolation, mental health and physical activity	People being restricted at home through the 'lockdown' may lead to greater isolation, mental health problems and lower physical activity.	The impacts through these effects could be substantial and long-lasting. There is also the potential for greater gender-based violence and child maltreatment in this context. The mental health impacts may be compounded by the lack of entertainment (e.g. sport), anxiety for friends and relatives, and the rolling news relating to the pandemic.
Food access	There is a risk that groups self-isolating cannot access sufficient healthy food.	The impacts of this are being mitigated but could have substantial impacts if this mitigation is not comprehensive.
Education loss	The suspension of much of the teaching for nursery, school, college and university students may have short, medium and long-run impacts on health, life challenges, the attainment gap, etc.	The impacts of this are very uncertain but could be very substantial in the longer-run.
Substance use	There is potential for greater substance use whilst people are at home, although the impacts may be mixed given the changes in incomes, city centre substance use patterns, and service provision.	The impacts of this are very uncertain but could be substantial.
Sustainability and air pollution	Reduced traffic is likely to improve air pollution and reduce carbon emissions.	This is likely to have positive impacts on road-traffic injuries and pollution-related illness such as asthma.
Community effects	There is potential for greater community bonding as part of the response to the pandemic, but there is also potential for stigmatisation of particular groups (e.g. Chinese) associated with the pandemic or increased crime.	The impacts of these effects are uncertain.

Balancing decisions

The mortality impact of COVID-19 is clearly large and sudden and radical policy measures to control its spread are justified. However, the population health and mortality impacts of the control measures, working through economic, social and behavioural pathways are also likely to be very large given their very wide range and severity. It is therefore important that decision-making and when and how to reduce the NPIs takes account of the balance of likely effects of NPIs – both positive and negative – on population health and on society more generally.

Table 3 outlines the main factors that require to be balanced and the assumptions they rest upon. Clearly the benefits of NPIs rest upon the assumption of the effectiveness of Intensive Care support for those most severely afflicted by COVID-19.¹ The relative benefits of more severe NPIs is also enhanced if the unintended positive impacts are larger, if the unintended negative impacts can be adequately mitigated, and if macroeconomic decision-making after the pandemic supports population health for the future. However, if these assumptions are not true, for example if the unintended negative impacts cannot be adequately mitigated, then the case for prolonged NPIs *to protect population health* may be undermined.

Table 3 – Summary of the factors and assumptions to be balanced in decision-making about the timing of the reduction of NPIs

Factors and assumptions in favour of a prolonged period of NPIs	Factors and assumptions against a prolonged period of NPIs
Reduction in COVID-19 mortality as more patients benefit from Intensive Care support and this is an effective treatment with a success rate.	Intensive Care support is less effective than envisaged for COVID-19 and the mortality averted is therefore less than modelled.
Unintended positive impacts of NPIs (e.g. reduced pollution, road traffic accidents, carbon emissions, etc.).	Unintended positive impacts of NPIs are small.
Unintended negative impacts of NPIs (e.g. unemployment, loss of income, social isolation, loss of education, etc.) are able to be fully or largely mitigated.	Unintended negative impacts of NPIs cannot be largely or fully mitigated and this has large impacts on population health through the social determinants of health over the short, medium and long-term.
Macroeconomic decision-making after the pandemic avoids policies known to be damaging for population health (e.g. austerity).	Macroeconomic decision-making after the pandemic repeats mistakes made previously and this exacerbates the existing stalled life expectancy trends and increasing health inequalities.

Despite the large scale of the mortality challenge presented by COVID-19, it is also worth noting that other mortality challenges, not least mortality attributable to inequality, occur year on year and are of a similar scale to COVID-19. It seems likely that the uncertainty surrounding COVID-19, its seemingly indiscriminate nature, and the lack of agency amongst individuals to protect themselves from it, have contributed to the concerted and radical policy action to control it. The mortality challenge presented by other avoidable causes of death due to inequality is equally amenable to change if there is sufficient policy will and priority. It may therefore be time for a serious reconsideration of efforts to address known causes of socioeconomic inequality in society and the very substantial population mortality risks that this also presents.

Next steps

To take this work forward and to inform future decision-making in the area the following will be undertaken through Public Health Scotland and collaborators:

1. Finalising the mortality estimates and rapid Health Impact Assessment contained within this paper.
2. Quantifying and modelling the unintended health impacts of the NPIs in order to balance their intended and unintended consequences.
3. Detailing the mitigation measures that can be put in place to reduce the unintended negative consequences of the NPIs at national and local level, and to work with partners to support their introduction.
4. Evaluation of the unintended consequences of the NPIs and of the mitigation measures.

We will be able to provide an update to the group on the first three of these in one month's time.

Acknowledgements

This is based on the work of a large number of colleagues who have produced relevant material in a short timescale. Margaret Douglas, Vittal Katikireddi, Martin McKee and Martin Taulbut all worked on the rapid Health Impact Assessment (HIA). Ruth Dundas, Alastair Leyland and David Walsh worked on the calibration of the mortality impacts of COVID-19 against other mortality risks. Neil Craig provided sage advice.

Disclaimer

This work has not yet been peer reviewed and could contain errors. The rapid HIA has been submitted for publication and the mortality calibration will be soon. It was also produced at an early point in the pandemic when all the data that you would want for such analyses were not available. The intention is to update this work as further data becomes available.

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