# Direct and Indirect Impacts of COVID-19 on Excess Deaths and Morbidity: November 2020 Update

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## Background

In July, we submitted a paper to SAGE discussing the possible morbidity and mortality impacts of the COVID-19 pandemic. This paper provides an update. As previously stated, health impacts of the pandemic are both direct from COVID-19 and indirect from changes to the healthcare system or for the wider population as a result of the pandemic and the economic strains that it may bring. We retain the following categories of harm to structure the paper:

A. Health impacts from contracting COVID-19
B. Health outcomes from COVID-19 worsened in the event of lack of NHS critical care capacity
C. Health impacts from changes to health and social care made in order to respond to COVID-19, including changes to emergency care (C1), adult social care (C2), elective care (C3) and primary and community care (C4).
D. Health impacts from factors affecting the wider population, due to the pandemic (D1) and from economic impacts, such as increased deprivation (D2).

The results are discussed in the section below, with further discussion of the methodologies provided in the respective annexes where necessary.

## Methodology and scope

### Definitions

Throughout the paper, we use specific metrics to illustrate the potential mortality and morbidity impacts from different categories of harm:

- **Excess deaths:** Any death due to the COVID-19 pandemic which would not have occurred otherwise within one year.
- **QALYs:** Quality adjusted life years; QALYs are used to measure changes, either in state of health of a person or group or in terms of length of life. One lost QALY is equal to losing 1 year of life in perfect health; one gained QALY is equal to gaining 1 year of life in perfect health. As such, lost QALYs are higher for a death if a younger person or a person in better health dies; in this way, the measure is weighted towards effects on healthier and younger people.

### Scope & timescales

In this paper, we consider health impacts to date (March to September 2020) and possible additional health impacts, using a range of scenarios.

Throughout this paper, it is important to note that the analysis does not explicitly account for the new variant 'VUI – 202012/01' which was identified in December 2020 to have increased transmissibility compared to other variants of COVID-19. [1] This paper was written prior to evidence of increased transmissibility provided to NERVTAG on 18th December 2020 and uses scenarios which do not explicitly account for this. In reality, the health impacts estimated in this paper could be worse, both in terms of direct and indirect health impacts if the new variant leads to increased infections, hospitalisations and deaths, and as a result greater levels disruption to health and social care and tighter restrictions.

As before, estimates refer to England only. Previously we also briefly discussed potential inequalities in the four categories of harm; we have not expanded on this in this paper, but it is likely to be a feature of future iterations.

## Scenarios & assumptions

Unless otherwise stated, we have retained the methods used in the previous paper and for the sake of brevity, we only note in this paper where assumptions have changed. Readers should refer to the previous version of the paper for a fuller discussion of the methodology.

Our previous paper used a COVID-19 Static Scenario, which assumed a constant level of deaths over time, as the basis of the direct impacts of COVID-19; other scenarios (such as a two-month lockdown period) were used to estimate other indirect impacts. In this update, we use an epidemiologically-derived "Winter Scenario" as the basis for direct health impacts and try to align scenarios for indirect health impacts with this as far as possible. The "Winter Scenario" runs from 30 September 2020 to 30 March 2021 (26 weeks). It assumes rising levels of infections through October and November to a peak in early December 2020, with a slow decline thereafter. It does not attempt to reflect government policy or recent government interventions. The main parameters are summarised below. For our main analysis, we produce estimates using part of the Winter Scenario until the end of February 2021 (see Table 2).

Again, it is important to note that the Winter Scenario, nor any other scenario used in the paper, does not explicitly account for the new variant, as discussed above; increased transmissibility could mean greater levels of direct and indirect harm than those estimated here. These scenarios represent one possible example of the potential impact of the pandemic; the pandemic could look very different to the scenarios presented in this paper and the impact of the new variant could mean worse health impacts than estimated under our scenarios.

*Table 1. Winter scenario compared to observed data*

| | Winter Scenario (30 September 2020 to 30 March 2021) | | | Observed data |
|---|---|---|---|---|
| | Total over 26 weeks | Average per week | Peak week's value | Week ending 6th November 2020 |
| Infections | 13,000,000 | 510,000 | 650,000 | 360,000[2] |
| Hospitalisations | 380,000 | 15,000 | 19,000 | 9,294[3] |
| ICU beds occupied | n/a | 3,700 | 4,900 | 975[i4] |
| Deaths | 100,000 | 3,900 | 5,200 | 1,771[ii5] |

## Counterfactual comparison

Our previous paper included a comparison with an unmitigated scenario; this is now deemed out of date. Instead we include a comparison with a three-month counterfactual which considers what the impact of little or no government intervention might look like. We compare health impacts for the three-month period between the end of December 2020 and the end of March 2021. This counterfactual has been deliberately and explicitly designed for this purpose alone. It is just one

[i] Average mechanical ventilation beds occupied over w/c 2nd November.
[ii] Number of deaths registered in w/e 6th November.

possible counterfactual that could be used for this purpose; others could be worse or could be better depending on unknown behavioural responses. While epidemiologically possible, this counterfactual does not represent a plausible scenario for the future as no intervention is not Government policy. Again, it is important to note that the counterfactual does not explicitly account for the increased transmissibility of the new variant; health impacts could be worse than estimated under both the Winter and counterfactual scenarios used in this paper.

A comparison of quantified estimates and further explanation of the counterfactual can be found in Annex E: Comparison with counterfactual. Considering the three-month period between December 2020 and March 2021, under the assumed counterfactual described above:

- There could be an additional 97,000 excess direct COVID-19 deaths (Category A), and up to an additional 76,000 excess deaths for COVID-19 patients as a result of worsened outcomes due to lack of NHS capacity.
- There are also likely to be additional harms from impacts on non-COVID care under a counterfactual, including an additional 12,000 deaths from changes to emergency care (Category C1) and 43,000 excess deaths from adult social care (Category C2).

We are unable to quantify all indirect impacts including changes to elective and primary and community care under a counterfactual because of uncertainty about impacts on these aspects of care.

We are also unable to quantify the impacts from Category D harms under a counterfactual, for the wider population living in a pandemic and from the recession. This is because it is difficult to determine the degree of voluntary social distancing in the absence of government intervention and the impact of this on the economy, though we do expect the degree of voluntary social distancing to related to the pandemic dynamics – that is, when cases are high, individuals are more likely to voluntarily social distance or self-regulate their behaviour, relative to when cases are low. Further discussion of this can be found in Annex E: Comparison with counterfactual.

### Limitations & uncertainty

The previous paper highlighted a number of limitations to the analysis; these still apply. It is important to note that the estimates are **not projections or forecasts**, rather estimates of harm that could occur under specific scenarios. The analysis is not exhaustive and does not attempt to represent the totality of impact. Scenarios used are only **illustrative** and the course of the epidemic could be very different to the scenarios assumed. Therefore, estimates in this paper should be treated with caution, as only illustrative of one potential turn of events; they are **not predictions**. As previously noted, the scenarios also do not explicitly account for the increased transmissibility of the new variant and this should be borne in mind when reading the paper.

## Summary of ABCD categories of harm

### Category A

**Mortality:** There were up to 50,000 deaths registered involving COVID-19 by the end of September 2020, all of which were excess deaths by the standard definition (i.e. above five-year average death totals for the same period). Under the Winter Scenario assumed in this paper, we estimate there will be 65,000 to 72,000 more COVID-19 excess deaths in October 2020 to end of February 2021, which represent between 305,000 and 602,000 lost QALYs.

**Morbidity:** For people who contract COVID-19, some may have recovered but are experiencing long-term effects of the virus or are experiencing symptoms for longer than originally expected –

increasingly referred to as 'long COVID'.[6] Based on COVID-19 infections to September 2020, we estimate 53,000 lost QALYs; there may be a further 121,000 lost QALYs under the Winter Scenario between October 2020 and March 2021. There may also be additional health impacts for non-hospitalised patients, but it has not been possible to estimate this at this stage.

### Category B

**Mortality:** It has not been possible to quantify the excess deaths that might occur under this category due to the dynamic and unpredictable nature of the NHS capacity (see Annex B for further discussion). However, any capacity breaches would lead to a sharp rise in COVID-19 deaths; these are discussed more fully in Annex B: Category B – Health outcomes for COVID-19 patients, worsened because of lack of NHS critical care capacity  Modelling suggests if COVID-19 patients requiring ICU ward care do not receive it, their mortality rate could increase by 55 percentage points (from 60% to 94% mortality rate).

### Category C1

**Mortality:** An estimated 4,000 excess deaths may have occurred early in the pandemic due to changes to emergency care: either people delaying attending emergency care, or insufficient resource available due to pressures of the COVID-19 response. Under the Winter Scenario assumed in this paper, a further 10,000 excess deaths are possible, representing 37,000 total lost QALYs between March 2020 and the end of February 2021.

**Morbidity:** Between March and September 2020, there may have been a morbidity impact from changes to elective care of 170,000 lost QALYs.  If emergency care continued to operate below its pre-COVID-19 capacity, there may be an additional 120,000 lost QALYs between October 2020 and March 2021. There may also be mental health impacts for health care staff; previous estimates suggested this could amount to 17,000 lost QALYs although it has not been possible to update these estimates on this occasion.

### Category C2

**Mortality:** Changes to adult social care could have led to 10,000 non-COVID-19 excess deaths early in the pandemic (March to May 2020). Depending on whether this relationship between non-COVID-19 deaths in care homes and COVID-19 total deaths is observed for a second spike in COVID-19 deaths, around 22,000 further excess deaths could be expected between October 2020 and March 2021. Over the full 12-month period, these would represent 88,000 lost QALYs.

**Morbidity:** There may also be morbidity impacts, although these have not been quantified. There may be mental health impacts for social care staff; previous estimates suggested this could amount to 21,000 lost QALYs although it has not been possible to update these estimates on this occasion.

### Category C3

**Mortality:** Considering the observed disruption to elective care up to October 2020, we estimate this may result in 8,600 deaths, (equivalent to 30,000 lost QALYs), as a result of the reduced NHS elective care during the first wave. Although these are likely to occur in the longer term. Considering potential disruption to elective care due to the first and second wave of the pandemic as well as from infection control measures between March 2020 and March 2021, this may equate to a total of 18,200 deaths occurring in the longer term, equivalent to 64,000 lost QALYs.

**Morbidity:** There may also be morbidity impacts as a result of longer waiting times; we estimate these equate to between 112,000 and 403,000 lost QALYs.

### Category C4

**Mortality and morbidity:** In our previous paper, in terms of disruption to cancer diagnoses and treatments, including GP referrals and emergency care, we estimated that there would be 1,400 excess deaths equivalent to 3,500 lost QALYs over a five-year period, based on a scenario of a six-month reduction in cancer diagnoses. For this paper, it has not been possible to include an update to these estimates. Further detailed analysis will be required; unfortunately, it was not possible to complete this analysis in time for this current update, but we are investigating how our estimates could be updated for a future version of this paper.

### Category D1

**Mortality:** There may have been an estimated 3,000 fewer deaths, equivalent to nearly 35,000 gained QALYs, for the wider population from March 2020 to end of November 2020 as a result of the pandemic. The main impacts may be due to better air quality, lower prevalence of other infectious diseases, and reduced road injuries, although there has been an increase in some negative impacts such as lower physical activity, increased alcohol use and higher prevalence of musculoskeletal conditions.

For health impacts from December onwards, we use an illustrative scenario with health impacts sustained until the end of February 2021; the scenario is designed to mirror the restrictions in place in the Office for Budget Responsibility's (OBR) central forecast scenario. The scenario is purely illustrative and is not predictive. We estimate this could equate to another 1,100 fewer deaths, equivalent to 13,000 gained QALYs. Depending on the severity of harm experienced and the restrictions in place, the estimates could range from 1,100 to 1,200 fewer deaths and 12,000 to 14,000 gained QALYs.

**Morbidity:** Overall, the morbidity impacts to date from living under pandemic restrictions equate to over 805,000 lost QALYs from March to December, due to an estimated increase in mental health problems, domestic abuse and musculoskeletal disorders. In line with the scenario above, health impacts from December onwards may equate to almost 280,000 lost QALYs; depending on the severity of harm experienced and the restrictions in place, the estimates could range from almost 250,000 to 310,000 lost QALYs.

### Category D2

**Mortality:** Evidence suggests that the recession resulting from COVID-19 and restrictions on activities could have large effects on lives through unemployment, mental health, decreases in income and wealth and increased financial and employment uncertainty. Using external forecasts, we can estimate the fall in economic activity and increase in unemployment as a result of the pandemic and can use this to estimate the resulting medium- and long-term health impacts from the economic downturn. This analysis presents an increase in the impact of the recession on medium and long-term health compared to our previous update, because more recent economic forecasts suggest the bounce-back and recovery are likely to be at a slower pace than previously predicted, and therefore the health impacts from the economic downturn accumulate over a longer period of time than previously considered. We estimate the impact on chronic illnesses divided into five main categories: Mental health, musculoskeletal disorders, cardiovascular disease, disease and 'other'. The mortality effects largely fall in the long-term.

We estimate there will be an additional 41,000 deaths, equivalent to almost 400,000 lost QALYs, in the medium- and long-term.

**Morbidity:** The morbidity effects largely fall in the medium-term (with resulting mortality impacts falling in the longer-term). We estimate over 903,000 lost QALYs through increased morbidity as a result of the economic downturn.

Overall, we estimate that there will be a 1.3m QALY loss as a consequence of the pandemic induced recession. Depending on the severity of the recession, these estimates range from 160,000 to almost 1,875,000 lost QALYs.

## Summary graphs

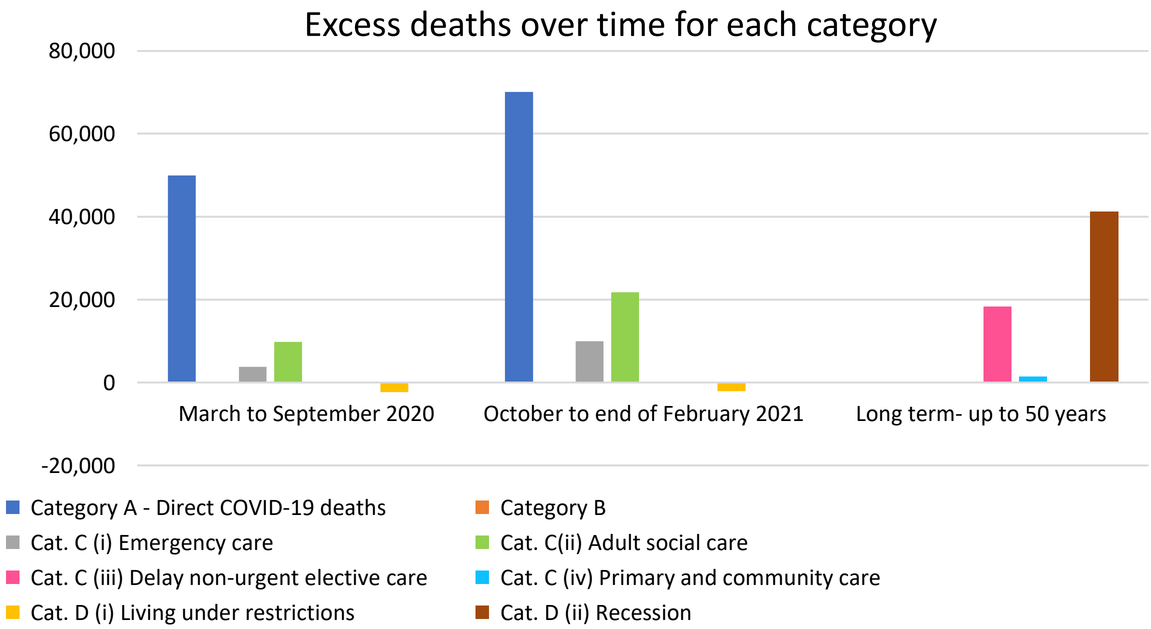



*Figure 1. Summary of excess deaths over short and longer-term timescales*

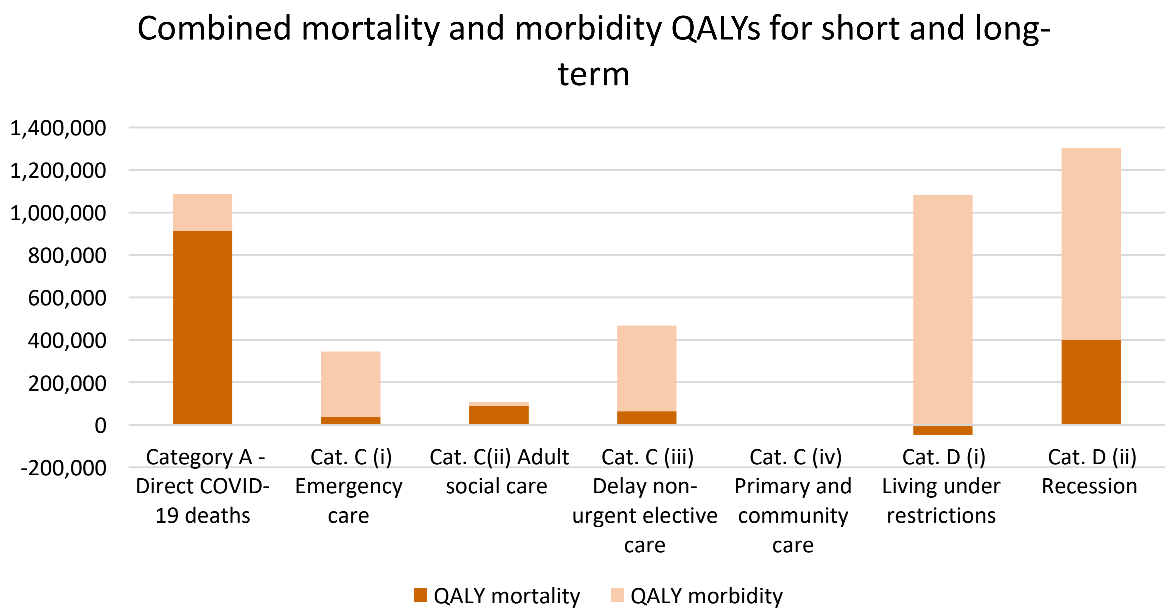



*Figure 2. Summary of QALYs for mortality and morbidity, timescales combined*

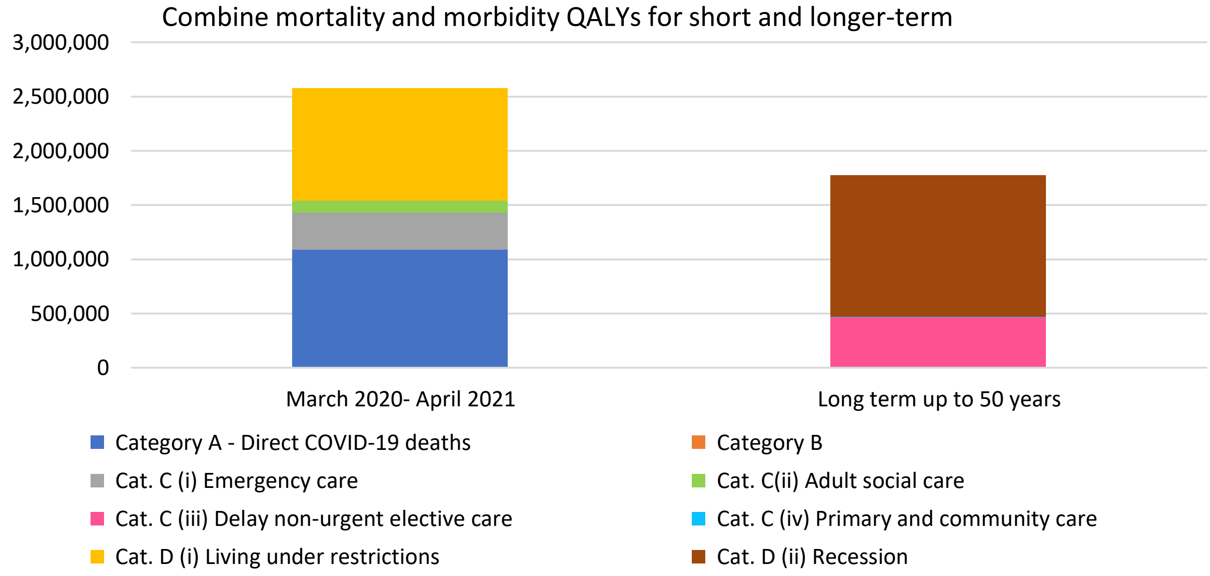



*Figure 3. Summary of mortality and morbidity QALYs combined, short term and long term*

## Table 2. Summary of mortality impacts

| Category of harm | | Brief description | **Short term** (March 2020 to end of February 2021) | | | | **Long term** (up to 50 years) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **Excess deaths** (Mar to Sep 20) | **Excess deaths** (Oct 20 to end of Feb 21) | **QALYs** (Mar 20 to end of Feb 21) | **YLL** (Mar 20 to end of Feb 21) | **Excess deaths** | **QALYs** | **YLL** |
| **A** | Directly from COVID-19 | Mortality as a result of contracting COVID-19 | Up to 50,000 | 70,000<br><br>(65,000 to 72,000) | 910,000<br><br>(520,000 Oct 20 to end of Feb 21) | 1,220,000<br><br>(690,000 Oct 20 to end of Feb 21) | Not quantified | Not quantified | Not quantified |
| **B** | From COVID-19 as a result of lack of NHS critical care capacity | Mortality as a results of NHS critical care capacity being breached. | Unquantified[iii] but modelling suggests if COVID-19 patients requiring ICU ward care do not receive it, their mortality rate will increase by 55 percentage points (from 60% to 94% mortality rate). | | | | | | |
| **C1** | From changes to emergency care, to respond to COVID-19 | Reduction in emergency attendance and admission partially due to unmet need from reluctance to attend or changes in protocols. | 4,000 | 10,000 | 37,000<br><br>(23,000 Oct 20 to end of Feb 21) | 44,000<br><br>(32,000 Oct 20 to end of Feb 21) | Not quantified | Not quantified | Not quantified |
| **C2** | From changes to adult social care, to respond to COVID-19 | Patients may have died earlier due to early hospital discharge, from non-COVID-19 medical emergencies, impacts of quality of primary care in care homes, patient safety impacts or patients not wanting to transfer to hospitals. | 10,000 | 22,000<br><br>(2,000 to 24,000) | 88,000<br><br>(4,000 to 71,000 Oct 20 to end of Feb 21) | 130,000<br><br>(7,000 to 98,000 Oct 20 to end of Feb 21) | Not quantified | Not quantified | Not quantified |
| **C3** | From changes to elective care, to respond to COVID-19 | Patients waiting longer for non-urgent elective care; impacts are expected to occur in the longer term. | 0 | 0 | 0 | 0 | 18,200 | ~ 64,000 | Not quantified |
| **C4** | From changes to primary & community care, to respond to COVID-19 * | Only delays to cancer diagnosis have been estimated and have not been updated for this paper. | 0 | Not quantified | Not quantified | Not quantified | 1,400 (Cancer only) * | 3,500 (Cancer only) * | 4,900 (Cancer only) * |
| **D1** | For the wider population due to the pandemic** | Overall estimated net reduction in some non-COVID-19 causes of death to date (better air quality, lower levels of infectious diseases, road injuries, STIs and occupational injuries); counterbalanced by increased deaths from lower physical activity, increased alcohol use, increased self-harm and increased musculoskeletal conditions. | -2,300 | -2,100 | - 48,000 | -70,000 | Not quantified | Not quantified | Not quantified |
| **D2** | Impacts from recession** | Mortality impacts from the pandemic induced recession through increased unemployment, reduced income and wealth and increased uncertainty | Not quantified | Not quantified | Not quantified | Not quantified | 40,000 | 400,000 | 590,000 |
| **Total** | | | 61,000 | 100,000 | 991,000 | 1,322,000 | 61,000 | 467,000 | 594,000 |

[iii] Some excess deaths may be expected but have not been quantified due to the dynamic, unpredictable and uncertain nature of the dynamics as the NHS nears full capacity. See Annex B for further discussion.

* It has not been possible to update these estimates on this occasion.
** Based on an illustrative scenario where health impacts after 2nd December mirror impacts estimated under tighter restrictions experienced prior to national restrictions being imposed in November 2020; these levels are assumed to remain until March 2021.

## Table 3. Summary of morbidity impacts

| Category of harm | | Brief description | Time period | QALYs |
|---|---|---|---|---|
| A | Directly from COVID-19 | Health impacts from so-called 'long COVID', where survivors of COVID-19 experience symptoms on a longer-term basis. | March 20 – end of Feb 21 | 174,000 |
| B | From COVID-19 as a result of lack of NHS critical care capacity | A lack of critical care capacity could result in higher morbidity as well as mortality. | Not quantified | |
| C1 | From changes to emergency care, to respond to COVID-19 | Reduction in emergency attendance and admission partially due to unmet need from reluctance to attend or changes in protocols. | March 20 – end of Feb 21 | 290,000 |
| | | Healthcare staff experiencing mental health impacts as a result of additional pressures on the sector. * | Mar 20 – Mar 21 | 17,000* |
| C2 | From changes to adult social care, to respond to COVID-19 | Adult social care service users and people receiving informal care may have coped with reduced levels of support during the pandemic; these impacts remain unquantified and this section has not been updated. | Not quantified | |
| | | Adult social care staff may have experienced mental health impacts as a result of pressures working during the pandemic. * | March 20 – end of Feb 21 | 21,000* |
| C3 | From changes to elective care, to respond to COVID-19 | Morbidity impacts from patients waiting for longer for non-urgent elective care living with symptoms for longer. | Up to 10 years approx. | 403,000 |
| C4 | From changes to primary & community care, to respond to COVID-19 * | Only delays to cancer diagnosis have been estimated and have not been updated for this paper. | 5 years | 300* |
| D1 | For the wider population due to the pandemic** | Restrictions may have resulted in an increase in mental health problems, domestic abuse, musculoskeletal disorders and alcohol use. | By April 2021 | <1,100,000** |
| D2 | Impacts from recession** | Morbidity impacts from the pandemic induced recession through increased unemployment, mental health impacts and reduced income and wealth and increased uncertainty | Medium: 2-5 years<br>Long-term: >5 years | 900,000 |
| | | | **Total** | 2,900,000 |

* It has not been possible to update these estimates on this occasion.
** Based on an illustrative scenario where restrictions after 2nd December are equivalent to pre-lockdown tier 3 until end of February 2021 in line with OBR's central forecast.

Table 4. Summary of changes in estimates

| Category of Harm | | Summary of Changes | Mortality (QALYs) | | | Morbidity (QALYs) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Direction of Change | Previous | Updated | Direction of Change | Previous | Updated |
| A | Directly from COVID-19 | New mortality estimates include impacts to date and estimated impacts under a Winter Scenario. Changes to morbidity methods to estimate long COVID impacts. | ↑ | 530,000 | 910,000 | ↑ | 40,000 | 174,000 |
| B | From COVID-19 as a result of lack of NHS critical care capacity | Updated modelling approach to estimate impact on mortality if beds are breached. Definition extended to cover general beds as well as critical care beds. | Unquantified[iv] | | | No estimate has been provided. | | |
| C1 | From changes to emergency care, to respond to COVID-19 | New mortality estimates include impacts to date and estimated impacts under a Winter Scenario. Morbidity impacts increased due to changes in scenario. No changes to estimates of impacts for healthcare staff. | ↓ | 41,000 | 37,000 | ↑ | 157,000 | 309,000 |
| C2 | From changes to adult social care, to respond to COVID-19 | New mortality estimates include impacts to date and estimated impacts until February 2021. No changes to estimates of morbidity impacts for social care staff. | ↑ | 73,000 | 88,000 | → | 21,000 | 21,000 |
| C3 | From changes to elective care, to respond to COVID-19 | Updated assumptions on disruption to elective care to date; now includes estimates from second wave and impacts of infection control measures. | ↑ | 45,000 | 64,000 | ↑ | 254,000 | 403,000 |
| C4 | From changes to primary & community care, to respond to COVID-19 * | No changes; methodology and estimates have not been updated on this occasion. | → | 3,500 | 3,500 | → | 300 | 300 |
| D1 | For the wider population due to the pandemic | Previous methodology only accounted for 2-month lockdown; new estimates are based on potential harm under varying levels of restrictions until end of February 2021. | ↓ | -30,000 | -48,000 | ↑ | 134,000 | <1,100,000 |
| D2 | Impacts from recession | We have updated the methodology to exclude short-term impacts and introduce longer-term economic forecasts relative to a pre-Covid-19 baseline to identify the impact of Covid-19 on unemployment. | ↓ | 421,000 | 400,000 | ↑ | 421,000 | 900,000 |

* It has not been possible to update these estimates on this occasion.

[iv] Some excess deaths may be expected but have not been quantified due to the dynamic, unpredictable and uncertain nature of the dynamics as the NHS nears full capacity. New modelling suggests if COVID-19 patients requiring ICU ward care do not receive it, their mortality rate will increase by 55 percentage points (from 60% to 94% mortality rate). See Annex B for further discussion.

## Annex A: Category A – Direct health impacts from COVID-19

### Mortality impacts

A critical review of the modelling approach and assumptions therein has identified some potential improvements to this methodology, many of which will not be possible to adjust until GP data are made available to ONS later in the year by the General Practice Extraction Service (GPES) run by NHS Digital. These improvements will be considered for a future version of this analysis.

#### *Estimates to date*

ONS's death registrations data can inform us that up to and including the week ending 2 October 2020, there have been almost 49,900 death registrations involving COVID-19 in England. The number of these which are excess deaths by this paper's definition – would not have otherwise occurred within 12 months – is unclear. Total 2020 deaths between 6 March and 2 October have exceeded the five-year average deaths during that time by more than 50,000, so by the ONS definition of "excess deaths", all of these deaths involving COVID-19 would count as excess deaths.

If all of these 49,900 deaths involving COVID-19 are excess deaths, we estimate these deaths equate to 527,000 YLL (370,000 to 663,000), and 394,000 lost QALYs (244,000 to 447,000).

#### *Additional impacts*

For this paper, the methodology and assumptions used to model COVID-19 excess deaths have not changed. The scenario modelled has changed to the Winter Scenario (outlined above), which is not an official planning scenario for Government, nor is it a forecast, but it does provide a possible outcome for modelling purposes.

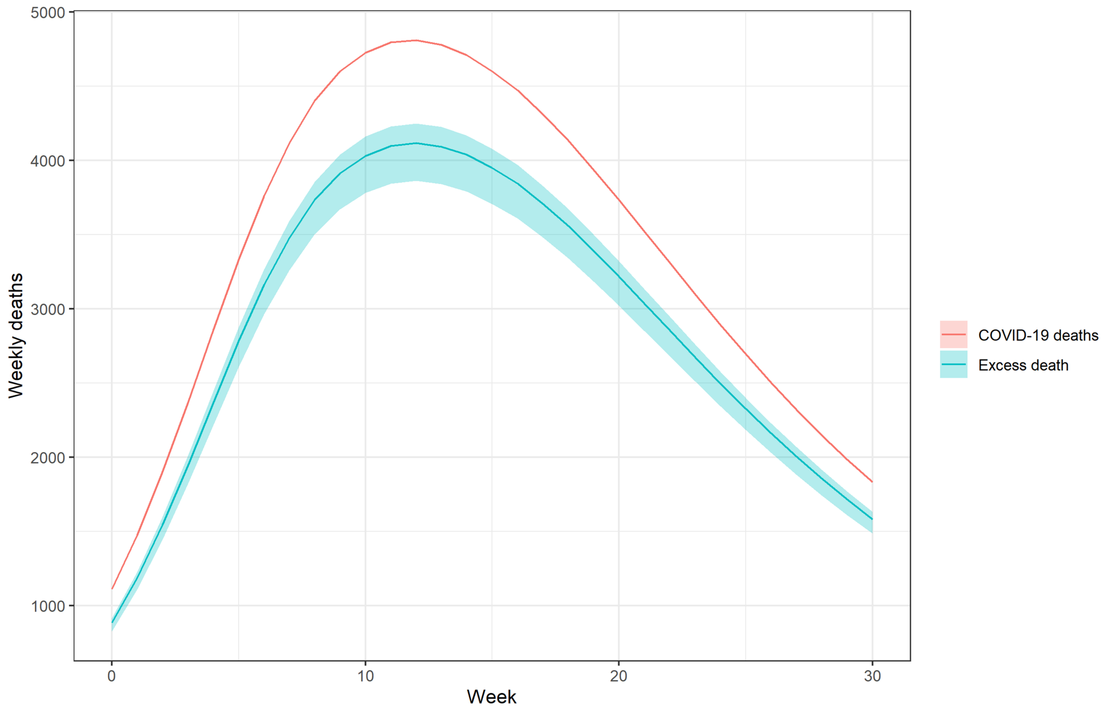



*Figure 4. Modelled COVID-19 deaths and excess COVID-19 deaths, England: 30 September 2020 – 4 May 2021*

The total number of deaths from COVID-19 between September 2020 and the end of February 2021 is assumed to be 82,000. The excess mortality due to COVID-19 is estimated to be 70,000. Using the same methodology for calculating upper and lower bounds in the previous paper (page 27), the number of excess COVID-19 deaths during that period would be between 66,000 and 72,000.

The total years of potential life lost (YLL) lost as a result of these excess deaths is estimated to be 690,000, with lower and upper bounds of 460,000 and 890,000 respectively. These YLL represent 310,000 to 600,000 lost QALYs, with a central estimate of 520,000 lost QALYs.

Over the whole period March 2020 to March 2021, the evidence to date and this Winter Scenario estimate a central estimate of 120,000 excess deaths (equivalent to 1,220,000 YLL, or 910,000 lost QALYs).

Considering the end of December 2020 to the end of March 2021, the Winter Scenario presents 97,000 fewer deaths than the counterfactual (as described above and in Annex E: Comparison with counterfactual), representing 600,000 fewer lost QALYs.

### Morbidity impacts

Our previous paper discussed potential health impacts for people who contract and survive COVID-19. This drew upon early evidence from the pandemic as well as previous epidemics to discuss the range of health impacts that might occur from the virus itself, as well as receiving hospital and critical care. Since then, more evidence has emerged about the health impacts from COVID-19, particularly about a condition or conditions frequently known as 'long COVID'. Here we provide an initial discussion of the existing evidence and provide early estimates of the potential health impacts from so-called 'long COVID'. However, it is important to note that understanding of this condition or group of conditions is continually evolving and therefore this should be seen as an early, illustrative estimate which may be refined over time as more evidence becomes available. Furthermore, the evidence does not represent a comprehensive literature review.

For individuals who contract COVID-19, it seems likely that the cumulative health impacts of COVID-19 are likely to depend on a range of factors:

- Initial disease severity: for some people, they may be asymptomatic and experience no symptoms at all, for others they may experience some mild symptoms and for others, symptoms may be more severe. We discussed symptoms of COVID-19 in our previous paper and these have also been documented elsewhere[vii].
- The possibility that symptoms may continue for some time and evidence is starting to emerge about the longer-term impacts of the virus, both for those who initially self-isolate at home and those who are hospitalised.
- For those individuals who require hospital treatment, particularly those who need critical care, there may be health impacts from the type of treatment received. We previously discussed potential health implications from receiving hospital and critical care, including potential for post-intensive care syndrome (PICS).

Since our previous paper, more evidence has emerged about 'long COVID', which generally refers to a condition where people who contracted COVID-19 have either recovered but are experiencing long-term effects of the virus or are experiencing symptoms for longer than originally expected.[viii] 'Long COVID' may occur both for people who initially had mild symptoms and isolated at home, as well as people who received hospital and critical care (although the latter may also have lasting health impacts from treatments and spending time in hospital).[ix]

The COVID symptom study suggests that 14.5% of people with symptomatic COVID-19 would be ill for at least 4 weeks, 5.1% of people would be ill for 8 weeks and 2.2% of people would be ill for 12 weeks or more.[x] There is also wider evidence which suggests a longer term health impact for people who receive hospital treatment[xi][xii] and those who self-isolated at home[xiii][xiv][xv].

Symptoms of 'long COVID' appear to be varied and affect many different parts of the body, including the respiratory and cardiovascular systems, the brain, kidneys, liver, skin and gut. There may also be impacts on mental health. The COVID Symptom Study has suggested that symptoms could be divided into two main groups, either respiratory symptoms such as shortness of breath, cough, fatigue and headaches; or multi-system symptoms, affecting the brain, heart and gut (which was more likely amongst people needing hospital assessment).[xvi]

The COVID Symptom Study also suggests that older people, those with higher BMI, younger women, and those with asthma may be more likely to get 'long COVID'.[xvii] In addition, experiencing a higher number of symptoms in the first week of the illness may mean the person is more likely to develop 'long COVID'. Researchers also suggest that people who experience a longer duration of COVID-19 symptoms were more likely to attend hospital: 44% of those who had symptoms for 56 days or more, 32% of those who had symptoms for 28 days or more, compared to 7% of those with short term symptoms of up to 10 days. This may suggest an increased propensity for long COVID amongst those who received hospital care; however, it is not possible to isolate the impacts of the virus and hospital care.[xviii]

There are several important challenges when estimating the impact of 'long COVID':

- It is challenging to isolate the long term impacts of the disease itself from the type of healthcare received – for example, if an individual who received critical care experiences ongoing bouts of fatigue, it seems possible that this may be due to the virus *or* from the impacts of receiving very intensive levels of hospital care. Similarly, it is difficult to attribute mental health impacts to the virus, the type of treatment received or even lockdown restrictions (discussed further in Category D).[xix]
- For people who initially had mild symptoms and isolated at home, some have never been tested for COVID-19 because testing was not initially available to everyone with symptoms. As a result, many people may suspect they had COVID-19 and subsequently 'long COVID', but will not know for certain; therefore, there may be a lack of robust data on this group to date.
- There is a lack of consensus of diagnostic criteria for ongoing COVID-19. Researchers have highlighted it is uncertain whether people have the same condition, or that their symptoms can be defined with a single diagnosis.[xx]
- We do not yet know the duration of 'long COVID'. The pandemic is ongoing and whilst much research has been commissioned, it may be quite a while until we truly understand the condition.[xxi][xxii] Research also suggests that symptom severity is not linear, but symptoms may move around a patient's body. [xxiii]

### *Methodology*

In this paper we provide additional health impacts that arise as a result of contracting COVID-19, by estimating morbidity QALY estimates for those who contract long-COVID. We are grateful to the Institute and Faculty of Actuaries (IFoA) for sharing with us their modelling approach (currently unpublished) that, with their consent, we have drawn upon to produce these estimates.

With a lack of data on quality of life estimates for those who are not hospitalised, this scenario primarily considers health impacts for those who are admitted to hospital; our modelling assumes minimal contribution of non-hospitalised cases to the burden of long-COVID, however, the potential scale of impact on this group of patients is discussed further below. As stated above, literature suggests a relationship between the severity of COVID-19 and those with lasting health impacts, therefore the scenario assumes most health impacts will be sustained by those who are hospitalised, including those admitted to critical care[xxiv].In this scenario, data from those who experienced long-COVID symptoms 6 weeks post hospital discharge are considered[xxv]. The most common symptoms were fatigue, breathlessness and psychological distress.

Those hospitalised were split into 2 groups; those who did not need critical care and those who additionally received critical care, using RWC hospitalisation estimates. Using the EQ-5D index measure for quality of life (QoL) before and after discharge, the average lost QoL score for those who are hospitalised with long-COVID is determined.

Using the Quality of Life (QoL) estimate from the sample data and a fitted distribution of symptom duration from Sudre et al, 2020, IFoA estimated lost QoL of 0.169 from long-COVID.

We estimate QALY loss due to long-COVID for a 1-year time horizon for 2 periods:

- QALY loss to 30th September, based on assuming 5.8 million infections have occurred already (estimate taken from MCR Biostatistics Unit)[xxvi]
- QALY loss from 1 October 2020 to March 2021, based on the estimated 13 million infections from the Winter scenario

It is plausible that many individuals have long-COVID symptoms beyond 1 year. However, due to the significant uncertainty in long term impacts, this estimate is limited to only including the QALY loss within 1 year of infection.

It should also be noted that the QALY impacts generated from the model go beyond the definition of long-COVID and represent all changes to symptoms before and after hospitalisation.

*Estimates of health impacts for hospitalised patients*

Based on COVID infections to September 2020, we estimate QALY loss of 53,000.

Based on projected COVID infections until March 2021 in addition, we estimate QALY loss of 121,000.

*Table 5. Long-COVID QALY loss – hospitalised patients only*

| | **Infections** | **Total hospitalisations** | **Long-COVID QALY loss for 1-year time horizon from infection** |
|---|---|---|---|
| Impact from all infections to 30 Sept '20 | 5.8 million | 170,000 | 53,000 |
| 1st Oct-March '21 | 13 million | 320,000 | 121,000 |
| **March '20-March '21** | **19.8 million** | **490,000** | **174,000** |

Under a counterfactual, there may be a higher number of infections and hospitalisations leading to worse health outcomes for COVID-19 patients as a result of a lack of NHS critical care capacity; this is discussed further in Annex E: Comparison with counterfactual.

*Estimates of health impacts for non-hospitalised patients*

As previously noted, due to a lack of data on utility, our modelling assumes the contribution of non-hospitalised cases to our estimates of long COVID is negligible. However, there is emerging evidence that non-hospitalised patients, those who isolated at home and did not initially need hospital treatment, may also experience lasting health impacts as a result of contracting COVID-19. At this stage, it has not been possible to estimate the potential impacts for non-hospitalised patients; this group is likely to have a different loss of utility compared to hospitalised patients because the sources of health impacts differ, as described above.

However, for illustrative purposes, here we have mapped the potential population size of non-hospitalised patients that may be impacted by long-COVID. At present, there may be limited evidence about the impacts for non-hospitalised patients, likely due to some of the challenges around data noted above; however, evidence suggests approximately 10% of non-hospitalised COVID-19 cases experience some symptoms lasting more than 4 weeks[xxvii][xxviii][xxix]. As noted above, we do not yet know how long 'long COVID' lasts and it is possible that not all people who experience symptoms at 4 weeks will continue to experience ongoing symptoms in the long term. However, for illustrative purposes to demonstrate potential patient population size:

- Estimates of total infections to date remain very uncertain. Testing only captures a small proportion of all infections and seroprevalence data can only provide an estimate of how many have antibodies at any one time. As antibodies are now understood to wane over time, the data does not provide a complete picture of infection exposure. Estimates from the MRC Biostatistics Unit, University of Cambridge[xxx] produce nowcasts of the cumulative infections for England and estimate there were 5.8 million infections (95% credible interval is 4.6 to 7.6 million) up to 30 September 2020. Removing those admitted to hospital, if we assume 10% of symptomatic, infected individuals experience 'long COVID', this would equate to 380,000 patients (range: 290,000-490,000). Alternatively, if 5% of symptomatic, non-hospitalised cases experience 'long COVID', this would equate to 190,000 individuals (range: 150,000-240,000).
- Going forwards under the Winter Scenario, there are estimated to be approximately 8 million new symptomatic infections which are not hospitalised between the end of September 2020 and the end of February 2021. Again, applying the 10% assumption of contracting long-COVID, this could suggest a potential population of approximately 850,000 people with ongoing symptoms. Alternatively, if 5% experience 'long COVID', this would equate to 420,000 people.

However, the above figures are purely illustrative, should be treated with caution and considered in the context of the following limitations:

- The assumptions about prevalence are unevidenced and based on symptoms at 4-weeks. It seems likely that the size of the population experiencing ongoing symptoms in the longer-term would be smaller, as symptoms may improve, and patients start to recover. However, there is considerable uncertainty about this.
- We do not have estimates of utility for non-hospitalised patients, and therefore it has not been possible to quantify the health impact for this population. If patients face barriers to accessing care and support as a result of a lack of formal diagnosis or lack of testing in the past, it is possible that their health impacts could be greater and therefore the QALY loss would be greater.
- Experiencing 'long COVID' is likely to depend on specific characteristics and as noted above, it may be more likely to occur for some groups than others; therefore, the above figures should only be treated as explorative and illustrative.

## Annex B: Category B – Health outcomes for COVID-19 patients, worsened because of lack of NHS critical care capacity

This annex relates to the extent to which the NHS has sufficient critical care capacity to treat COVID-19 patients in the winter of 2020/21. In the event that there is insufficient capacity, it is likely that deaths rates would climb sharply at the margins and disproportionately raise the total societal costs of COVID-19; this is discussed and quantified further in Annex E: Comparison with counterfactual.

The NHS has built significant surge capacity including reconfiguring hospitals and building Nightingale hospitals. The NHS also has the capacity to postpone elective care and re-purpose existing provision to treat a surge of COVID-19 patients, where necessary. Postponing non-urgent care would lead to indirect harms to non-COVID-19 patients. In Annex C3 of this paper, we discuss and estimate the extent of harm from changes to elective care; however, these estimates do not account for the levels of harm that might occur if there is a lack of NHS critical care capacity to treat COVID-19 patients, rather the analysis assumes the second wave leads to the NHS delivering 20% below its 19/20 elective activity levels. If a lack of critical care capacity leads to a greater level of disruption to elective care, it is possible that indirect harms could be worse.

It is difficult to estimate actual capacity in the NHS for COVID-19 patients, and this relates to varying levels of differing resources. NHS capacity is likely to depend on the number of beds available, as a function of staffing as well as physical capacity; all of these resources are subject to change depending on a range of factors. For instance, there is not a fixed number of beds that the NHS can utilise for COVID-19 patients; rather, there is varying demand from non-COVID-19 admissions which is often not possible to predict. There are also beds occupied for elective care, some of which will be postponed based on varying circumstances. Surge capacity, such as Nightingale hospitals, is available if required, but staffing and quality may be impacted, and it may not be possible to open all the surge capacity simultaneously. Furthermore, NHS capacity is also affected by the availability of staff, which in turn is a function of several factors including but not limited to: the return of retired staff or introduction of student staff members; the expertise of staff to treat critical care patients; the health and wellbeing of staff including COVID-19 infection; and staff members' caring responsibilities. It is also likely that the timing of the peak of the epidemic will vary across the country and therefore there may be demands on capacity in some areas before others; there may be the facility to move patients from one region to another in order to access critical care.

Overall, it is clear that NHS capacity does not rely on a single factor or metric and estimating a sufficient level of capacity is very challenging. However, for the purposes of this paper and in the absence of a single figure, we have used the assumption that there is a capacity limit of 25,000 beds for COVID-19 patients in England. This is illustrative, relies on a simplistic assumption related to one of many factors affecting capacity, and should be considered with caution given the caveats discussed above; capacity could be higher or lower depending on a range of other factors. For the purposes of this paper we work on this assumption and this is consistent with the assumptions in the counterfactual. We split this into 5,000 critical care unit (CCU) beds and 20,000 general beds. The assumption that 5,000 CCU beds are available for COVID-19 patients is based on the availability in the first peak [xxxi], acknowledging that this is variable given what other demands there are on CCU beds at the time and the possibility to utilise Nightingale hospital capacity. It is important to note that these thresholds are illustrative, to demonstrate potential consequences of a lack of NHS critical care capacity (discussed further in Annex E: Comparison with counterfactual); it is possible that actual NHS capacity could vary considerably depending on a range of moving factors.

## Does the winter scenario breach NHS capacity?

The Winter Scenario does breach NHS capacity for approximately 8 weeks at its peak; requiring an additional 1,400 more general beds in its peak week, in addition to the 20,000 general beds assumed to be available for COVID-19 patients. In this scenario critical care beds are not breached.

The Institute and Faculty of Actuaries (IFoA) provided a model (available as a pre-print[xxxii]) which suggests that for COVID-19 patients requiring general ward care for whom a bed cannot be found, their mortality rate will increase by 29 percentage points (from 22% to 51% mortality rate). In other words, for every 100 patients who require care on a general ward and are not admitted due to beds being full, this would result in an additional 29 deaths (based on 29% absolute additional mortality). By comparison, for those requiring ICU beds and not receiving any hospital care (which does not occur in this modelled scenario), the absolute increase in mortality is 55%. See Annex E for more details on this model.

However, the number of additional beds needed at the peak of the Winter Scenario, out of the 95,000 general and acute NHS beds available in England[xxxiii], is less than 2% of all beds. Given the nature of NHS capacity being dynamic and unpredictable over time, as discussed above, and hence the estimates of NHS capacity being uncertain, this level of mismatch between demand and capacity is well within the uncertainty of the modelling. Therefore, due to this uncertainty it is left unquantified, while indicating it is plausible that there will be additional excess deaths from capacity being breached in the Winter Scenario.

## Discussion

It is a very significant concern that in the winter scenario, the NHS will be pushed to what appears to be at or beyond its maximum capacity for a prolonged period of time.

Modelling what might happen so close to the threshold of NHS capacity is problematic due to the high level of uncertainty in the parameters and the decisions that would be made. On the one hand, it is plausible that the NHS can fill more than the 25,000 beds modelled as maximum capacity for COVID-19 patients. On the other hand, it is plausible that other factors come into play close to this threshold, as occupancy rates go beyond usual levels and other factors such as staff sickness rates could result in lower quality care. The model also does not factor in the likely geographical variation meaning some areas will be overwhelmed while there might be spare capacity elsewhere in England. For these reasons we do not provide a single quantified estimate, but we do indicate that for the Winter Scenario it is plausible that there could be some excess deaths in the peak period from hospital beds being breached.

## Annex C: Category C – Health impacts from changes to health and social care made in order to respond to COVID-19

### C1: Changes to emergency care

#### *Mortality*

Excess deaths in Categories C1 and C2 were previously calculated by categorising the non-COVID-19 excess deaths observed in ONS's death registrations data. Deaths for care home residents were assigned to C2, and all other excess deaths assigned to C1. Category D's impact is estimated to reduce mortality in the short term, so this impact is applied to the excess deaths total to increase it.

We have reviewed this method for apportioning non-COVID-19 excess deaths into categories and feel no alternative approach for estimating the impact to date improves on this simple split without introducing additional uncertainty. As such the same methodology has been applied from the previous paper but using updated estimates of short-term socioeconomic impacts (D1).

#### Estimates to date

Observing death registrations up to Week 43 of 2020 (ending 23 October), non-COVID-19 excess deaths have been broadly stable and consistently negative each week since 2 May up until 7 August (i.e. numbers of deaths have occurred below five-year average levels)[xxxiv]. For the remaining weeks of August, there is not a clear relationship between changes in COVID-19 death totals and the non-COVID-19 excess deaths observed in the same period. As such, the impacts of COVID-19 on deaths due to changes to emergency care and adult social care presented here are based on the same period as in the previous report: 21st March to 1st May 2020. The socioeconomic impacts used in these estimates have been updated to reflect latest evidence, presented in Annex D of this paper.

*Table 6. Apportioning non-COVID-19 excess deaths into categories.*

| | |
|---|---|
| Total Excess Non-COVID-19 deaths for 21st March to 1st May | **13,121** |
| These are apportioned as follows: | |
| Category C1 due to changes in emergency care | 3,810 |
| Category C2 due to changes in adult social care | 9,767 |
| Category D1 reduction in short-term due to recession | -456 |
| Category D2 reduction in short-term due to economic downturn | 0 |
| TOTAL non-COVID-19 excess deaths for Category C | **13,121** |

Using this short period for estimating non-COVID-19 excess deaths may overestimate the total, because the lower than average non-COVID-19 deaths observed following this period may be due to mortality displacement: these 13,000 deaths might include some brought forward only by a few weeks compared to when a person would otherwise have died. There are many reasons to expect deaths in 2020 to be lower than the five-year average, as observed in January and February 2020 prior to the COVID-19 outbreak in England, so we cannot confidently ascertain the lower death totals in following weeks is due to these deaths occurring only a few weeks early.

The lost QALYs from these deaths due to changes in emergency care are estimated as 13,000. This is consistent with the QALY method presented in the previous paper.

### Additional impacts

Since weekly COVID-19 death registrations began to increase again in September, care home non-COVID-19 excess deaths and total non-COVID-19 excess deaths have not yet presented the same pattern. This could suggest fewer excess deaths in categories C1 and C2 will be expected for a second spike of COVID-19 deaths.

Using the same methodology as the previous paper, assuming deaths due to changes in emergency care occur as the same proportion of COVID-19 deaths observed in March and April 2020 (12.0% of the COVID-19 total), the total number of excess deaths due to changes in emergency care over the Winter Scenario period is estimated as 10,000. The lost QALYs from these deaths are estimated as 23,000.

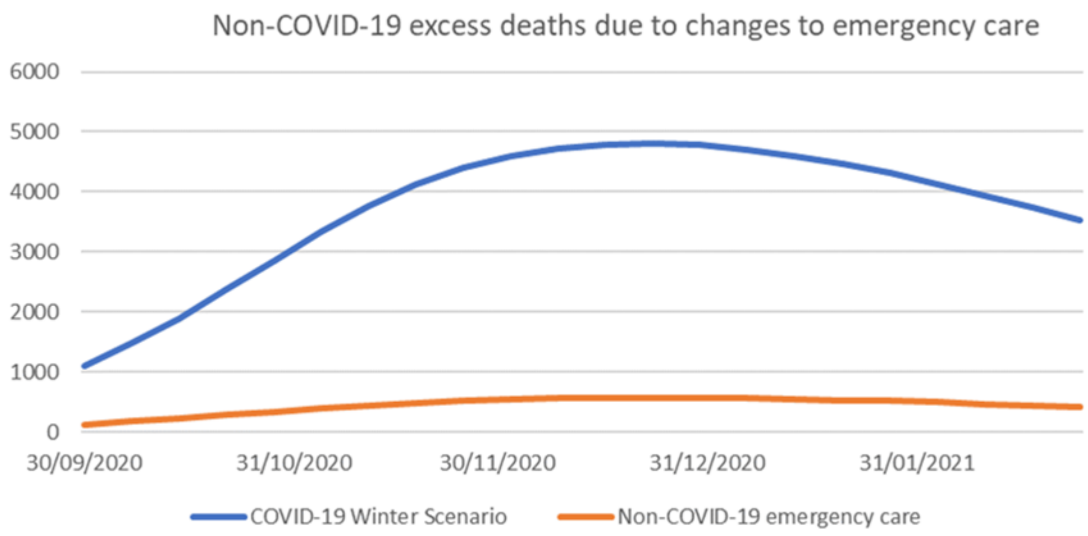



*Figure 5. Non-COVID-19 excess deaths due to changes in emergency care, England: September 2020 – February 2021*

Comparing the Winter Scenario to the counterfactual detailed in Annex E: Comparison with counterfactual, for the period between the end of December 2020 and the end of March 2021, the Winter Scenario presents 12,000 fewer deaths due to changes in emergency care, estimated to represent 28,000 fewer QALYs lost.

### *Morbidity of patients*

In September 2020 A&E attendances were 20% lower compared to the previous year, showing an increase in activity since the outset of the pandemic, where attendances were nearly 60% lower compared to the previous year. With data from the last few months available, we can estimate an average drop in activity of 30% for A&E activity and 20% for non-elective activity for the duration of the scenario. We maintain the same assumptions around proportion of G&A spend on A&E.

For the period between March and October 2020, we estimate a QALY loss of 170,000. If emergency care continued to operate below its pre-COVID-19 capacity, there may be 290,000 lost QALYs from March 2020 and end of February 2021. If we continue to see activity in emergency care rise to pre-

COVID-19 levels, the indirect morbidity impact may diminish over the course of the year, and in years to come.

### *Morbidity of staff*

Since our previous publication, a wealth of international evidence has been published about the impact of working during the pandemic on the mental health of healthcare staff, particularly from China. Evidence is varied and usually employs a cross-sectional design[xxxv][xxxvi][xxxvii][xxxviii], which limits our understanding of the *change* in mental health problems as a result of working during the pandemic.

Evidence from the UK is mixed[xxxix] and often groups key workers rather than looking at health care workers specifically; indeed, some sources suggest there is uncertainty about whether health impacts for healthcare workers have been significantly greater than the general population. However, a recent survey by the British Medical Association suggested a greater proportion of doctors said they currently suffered from a mental health condition relating to work which was worse than before the start of the pandemic, compared to during the first peak[xl].

An initial high-level review of the evidence to date suggests that further detailed work is required to consider the impacts on the workforce of a second wave of the pandemic; therefore, it has not been possible to update these estimates on this occasion.

## C2: Changes to adult social care

### *Mortality*

#### Estimates to date

As discussed in Annex C1 above, the number of non-COVID-19 excess death registrations occurring between weeks ending 13 March and 1 May is likely the most meaningful estimate of COVID-19's impact on non-COVID-19 care home mortality. 9,800 non-COVID-19 excess deaths of care home residents were registered during this time, estimated as representing 27,300 lost QALYs (26,900 to 29,000).

#### Additional impacts

Since weekly COVID-19 deaths began to increase again in September, care home non-COVID-19 excess deaths have not yet presented the same pattern. This could suggest fewer excess deaths in categories C1 and C2 will be expected for a second spike of COVID-19 deaths.

There are several reasons for the relationship between COVID-19 deaths and non-COVID-19 deaths in care homes to be different during a second spike of COVID-19:

- If care home population numbers have not yet returned to normal levels after a greater number of deaths earlier in the year, deaths of care home residents would be lower. This could occur if care homes are limiting capacity to enable social distancing, or if potential care users are delaying entering a care home, possibly due to perceived risk of infection.
- Some care home non-COVID-19 deaths may have been deaths due to undiagnosed COVID-19. The nature of the virus is better understood now, so any misclassification of deaths should be less likely now in a second wave.
- Similarly, care homes are likely more prepared to tackle COVID-19 than at the start of the pandemic, meaning measures to limit transmission should be less disruptive to residents' daily life. If non-COVID-19 deaths in care homes occurred due to additional stress or lack of social contact exacerbating other conditions, this effect earlier in the pandemic could be expected to be reduced in a second spike.

As such, three estimates of non-COVID-19 care home excess deaths are presented here, using regression models to estimate the relationship between COVID-19 deaths and non-COVID-19 excess deaths in care homes. The models are based on different weeks in 2020 to capture a range of estimates, as detailed in Table 7 below. All three scenarios are dependent on the Winter Scenario projection, and as such are not forecasts for expected trends, but present possible outcomes under that Winter Scenario.

*Table 7. Estimates on non-COVID-19 excess deaths in care homes*

| **Scenario** | **Weeks used in regression model** |
|---|---|
| Low | From week ending 22 May onwards, so excluding the pattern observed during the first spike in COVID-19 deaths. This assumes the increases observed in the first wave are not observed for the second wave. |
| Central | All weeks including COVID-19 death registrations to date, week ending 13 March to week ending 23 October. |
| High | All weeks during the first spike only, week ending 13 March to week ending 15 May. This assumes the same relationship will occur as observed for the first spike. |

Using the Winter Scenario, this approach produces the following estimates of non-COVID-19 excess deaths due to changes in adult social care presented in Figure 6 and Table 8 below. Lost QALYs are calculated with the same method for high, medium and low estimates as used for QALYs in the previous paper.

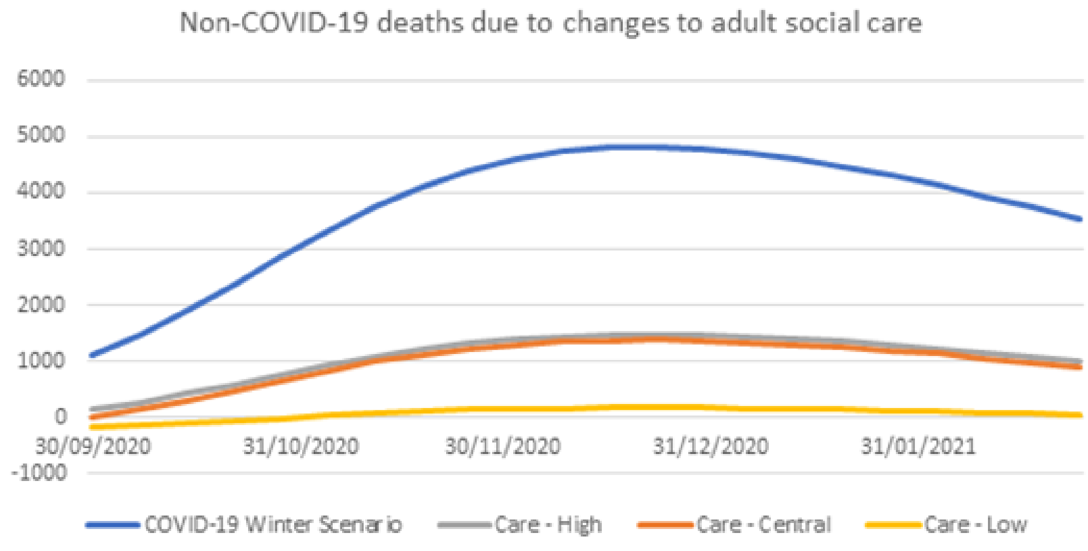



*Figure 6. Non-COVID-19 excess deaths due to changes in adult social care provision*

*Table 8. Total non-COVID-19 excess deaths in care homes over the Winter Scenario period (30 September 2020 – February 2021)*

| Estimate | Number of deaths | QALYs |
|---|---|---|
| Low | 1,600 | 4,000 |
| Central estimate | 21,700 | 61,000 |
| High | 24,000 | 71,000 |

In the low association between COVID-19 deaths and adult social care non-COVID-19 deaths, some weeks' estimates are slightly negative (i.e. there is a small improvement in numbers of deaths in care homes). This may be expected if measures to tackle COVID-19 also reduce risk of other infections.

Compared to the counterfactual, the central estimate of deaths due to changes to adult social care in the Winter Scenario presents 43,000 fewer deaths than the counterfactual scenario, calculated using the same methods as above. Note this method does not factor in the size of the population receiving residential care. These 43,000 fewer deaths represent 119,000 fewer QALYs lost in the Winter Scenario compared to the counterfactual.

### *Morbidity of service users*

Previously we discussed the potential morbidity impacts for service users receiving adult social care and informal care, including possible reduction in support and mental health impacts due to social isolation. Reflecting some of the narrative in our previous paper, research to date has suggested that people accessing care and support during the pandemic faced a range of challenges:

- Social distancing impacting loneliness and isolation, and a reduction in support mechanisms[xli]
- Financial pressures due to additional household costs such as bills and food[xlii]
- Cancellation of day and respite services and the extra responsibilities picked up by unpaid carers[xliii][ix][xliv][xlv]
- Increased feelings of isolation and anxiety experienced by older people and people with disabilities' worry about the impact of the pandemic on their lives[xlvi]
- Some changes to care packages, such as reduce care or cancelled support[xlvii]
- Limited communication with friends and family when care home visits stopped[xlviii]
- Increases in need since the pandemic.[xlix]

As before, it has not been possible to provide quantified estimates of harm given uncertainty and lack of evidence in this area; however, readers should refer to the previous paper for discussion of possible harms that may have and could occur.

### *Morbidity of staff*

Previously we discussed the potential impacts for social care staff as a result of working during the pandemic and presented estimates of the QALY loss from mental health impacts, using a methodology in-line with that for healthcare staff. Since our last paper, research on the COVID-19 pandemic suggests that triggers of mental health problems for frontline workers in care homes and providing domiciliary care largely align with our previous hypotheses, including fear of infection and infecting others, lack of guidance, unsafe discharges from hospital, bereavement for colleagues and residents, testing, staff shortages and disparity between health and social care[l]. As with healthcare staff, it has not been possible to update these estimates on this occasion; further reviews of the evidence would be necessary to estimate the impact on the social care workforce from a second wave of the pandemic.

## C3: Changes to elective care

HES data from M12 19/20 (i.e. March 2020) to M6 20/21 (i.e. September 2020) showed the NHS delivered on average 45.9% less elective activity for these 7 months than the same period 12 months ago.

The reduction per month has decreased as the NHS has moved from:

- Avoiding non-urgent elective procedures in April/May
- To more recently trying to treat as many elective patients as can be done subject to infection prevention and control measures.

*Table 9. Elective admissions compared to 12 months ago*

| | March | April | May | June | July | August | September |
|---|---|---|---|---|---|---|---|
| Reduction in elective admissions over the same month last year | -23.9% | -73.0% | -69.0% | -52.2% | -43.0% | -34.7% | -25.6% |

The COVID-19 pandemic is the likely cause of this reduction. Furthermore, there are likely to be further electivity activity reductions due to the second COVID-19 wave in 2020/21 and the need for continued Infection Prevention and Control measures (IPCs) in 2021/22.

We look at 2 potential impacts of the NHS having not delivered this elective activity:

i. If the activity is cancelled – this is likely to be an overestimate as much of the activity is likely to be postponed (i.e. delivered later). Our best estimate of this is 7,000-11,000 excess deaths and 170,000-270,000 lost QALYs (of which 25,000-39,000 QALYs associated with mortality).
ii. Postponing the activity means the stock of patients waiting for treatment will increase - leading to longer waits for all patients in the future. This leads to a QALY loss as patients will be waiting for longer in an inferior health state. Our best estimate of this is between 112,000 and 403,000 lost QALYs.

### *Mortality and morbidity if all elective activity is cancelled*

#### Effects observed to date

HES data from M12 19/20 (i.e. March 2020) to M6 20/21 (i.e. September 2020) showed the NHS delivered on average 45.9% less elective activity for these 7 months than the same period 12 months ago.

We assume 34% of NHS spend was for elective activity. As the NHS England mandate was £130bn (pre – COVID costs) we assume £45bn would have been spent on elective activity in this year.

As 45.9% of elective activity was undelivered for 7/12 of a year - the overall value of deferred elective activity is £12bn = (7/12 * 45.9% *£129.6bn).

York University research suggests a marginal cost per death averted across all Programme Budget Categories in 20/21 prices is £90k. This suggests 132,000 extra deaths would result if this activity is never delivered.

This assumes the mix of activity deferred in Programme Budget Categories in response to the COVID-19 pandemic is the same as that observed in the original research for small changes in expenditure. As the NHS will probably have prioritised activity with highest mortality impact, we refine our estimate by relating reductions in elective activity at Programme Budget Category (PBC) level to specific estimates of the marginal cost per death averted for each PBC.

When the elective postponements were observed by PBC there was a bias towards categories with higher costs per death averted. The marginal cost per death averted increases to £1.4m when we multiply the reduced activity by the cost per deaths averted for the specific 22 PBC categories. This reduces the number of projected deaths to 8,600.

When we take an average over the 11 PBC categories most closely linked to mortality the marginal cost per death increases further to £2.3m and the number of projected deaths reduces to 5,200.

### Morbidity

York published that for the 22 PBC categories there are on average 14.9 QALYs per death averted meaning the morbidity impact of 130k QALYs (i.e. 14.9 * 8,600).

York published a QALYs per death averted for the 11 PBC most closely associated with mortality. If we take a weighted average over the 11 PBC categories most closely linked to mortality we get there are on average 24.6 QALYs per death averted giving a morbidity impact of 130k QALYs.

The next two tables compare the original estimates with the revised estimates.

*Table 10. Original estimates*

| | Marginal cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 185,000 | 12,500 | 6,000 |
| QALYs lost | | 185,000 | 130,000 |
| Of which, mortality QALYs lost | | 45,000 | 21,000 |

*Table 11. Revised estimates*

| | Marginal cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 132,200 | 8,600 | 5,200 |
| QALYs lost | | 128,000 | 127,000 |
| Of which, mortality QALYs lost | | 30,000 | 18,000 |

The key parameters that have changed are

- The amount of a year's electivity activity deferred reduced from 37.5% (75% for 6 months) to 26.7% (45.9% for 7 months)
- The marginal cost per death averted for the 22 PBCs increased slightly from £1,346 to £1,443.
- The marginal cost per death averted for the 11 PBCs increased from £1,864 to £2,393.

### Second wave

We assume the second wave leads to the NHS delivering 20% below its 19/20 elective activity levels for October 2020 to March 2021. That is, it continues at slightly above the September level of elective activity through the rest of 20/21.

The impact of this lower level of activity on morbidity and mortality is summarised in the tables below:

*Table 12. Further QALYs/ reduced deaths averted from the 2nd wave*

| | Average cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 49,400 | 3,200 | 1,900 |
| QALYs lost | 375,000 | 48,000 | 47,000 |

The next table summarises the effects for adding wave 1 and wave 2

*Table 13. Total morbidity and mortality impact from wave 1 and wave 2 forecasts*

| | Marginal cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 181,600 | 11,800 | 7,100 |
| QALYs lost | 1,377,000 | 175,000 | 174,000 |

### Infection prevention and control

Through 21/22 the NHS is likely to have to continue with infection prevention and control measures (IPCs). If we assume the efficiency impact of these reduce elective activity by 20% it will lead to the following further less deaths averted and QALYs lost.

*Table 14. Total morbidity and mortality impact from continued IPCs in 21/22*

| | Marginal cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 98,800 | 6,400 | 3,900 |
| QALYs lost | 749,000 | 95,000 | 95,000 |

The final table gives the less deaths averted and QALYs lost from the first wave, the second wave and IPCs in 21/22.

*Table 15. Total morbidity and mortality impact from IPCs, wave 1 and wave 2 forecasts*

| | Marginal cost | PBC specific (22 categories) | PBC specific (11 categories) |
|---|---|---|---|
| Less deaths averted | 280,400 | 18,200 | 10,900 |
| QALYs lost | 2,126,000 | 270,000 | 269,000 |

Vaccine availability and providers ability to reduce the efficiency impact of IPCs in 21/22 may mean the impact of IPCs on electives may be below the 20% modelled above. If this is the case the outcome is likely to be somewhere between Table 13 and Table 15.

Furthermore, these are likely to be over-estimates as we assume the activity is all cancelled whereas it is more likely to be postponed. However, when the postponed activity is done in the future it may displace other spend which may have had a health benefit. For example, doctors' time may be spent on clearing the elective backlog rather than pioneering a new technique on new patients.

### *Morbidity due to longer elective waits*

To understand the morbidity impact of longer elective waits we consider two scenarios for the level of elective activity delivered

- Actual levels of activity to October then 20% below 19/20 levels to the end of 2020/21 (to reflect the impact of the second wave).
- Actual levels of activity to October then 20% below 19/20 levels to the end of 2021/22 (to reflect the impact of the second wave and the having IPCs in place in 2021/22)

And two scenarios for the level of demand returning

- 66% of the unmet demand returns (the lowest value/simplest pathways do not return. Around 1/3 of pathways end after a first outpatient appointment and don't involve further interventions in secondary care)
- 33% of the unmet demand returns (only urgent pathways including cancer return. These are estimated to be 1/3 of all new pathways).

Average waiting times for each scenario are calculated using Little's Law (expected wait = waiting list / completed pathways per week), where projections of the future waiting list are a function of demand (RTT clock starts) and activity (completed pathways) assumptions detailed in each of the scenarios. The data used in these calculations is provided by NHS England and is a slightly more accurate version of the published RTT data, in that it contains estimates for non-reporting trusts and 'removals for reasons other than treatment' (an adjustment for data quality).

Treatment tends to improve the quality of life and/or life expectancy chances of a patient. A delay in treatment therefore diminishes the benefit a patient will receive over their lifetime. Evidence from York University suggests a patient's health state will be 80% of its post-treatment state prior to the health intervention. For an average elective patient, receiving treatment at 54 years of age and with a life expectancy of 85 years, a delay of 7 months in treatment could reduce their expected health benefits by around 2%. A delay of 2 months would have a more modest impact of around 0.5%.

As elsewhere in this paper, we have used quality-adjusted life years (QALYs) to estimate health benefits. Based on research conducted by Claxton et al at the University of York, we assume that NHS spending at the margin generates QALYs at a cost of £15,000, and that average NHS spending generates QALYs at a cost of £7,000. The average cost per QALY is a less robust metric than the marginal one, and likely to be an overestimate of the true average QALY cost.

We have taken high-level categories of NHS expenditure and estimated that elective activity represents around a third of overall expenditure; the value of elective activity is around £45bn per year in 2020/21 prices. Dividing the value of elective activity by the estimated cost of a QALY produces an estimate of health benefits (measured in QALYs) that elective activity delivers per year – circa 4m QALYs. It is important to note the cost per QALY used was estimated at £12,000 (between the margin and average for NHS expenditure) as spending equivalent to £45bn is significant and will include activity beyond the margin. To the extent that the NHS will choose to defer the least urgent/valuable activity ahead of more urgent/valuable activity, some of the spending curtailed as a result of the cancellation of elective activity would be more cost-effective than at £12,000 per QALY. This means we would be underestimating the total health benefit associated with elective activity.

There will be a wider effect than just on those patients with elective treatments postponed due to COVID-19. Waiting times will be longer for everyone as the postponed treatments will be added to the stock of elective waiters which increases the average wait. The following Table gives the QALYs lost by 2031 under the 4 scenarios due to longer elective waits.

*Table 16. Cumulative QALYs lost to 2031 due to excess waiting*

| Scenario | 12k per QALY | 15k per QALY |
|---|---|---|
| 20% activity reduction to Mar-21, 66% demand bounceback | 222,000 | 177,000 |
| 20% activity reduction to Mar-21, 33% demand bounceback | 112,000 | 90,000 |
| 20% activity reduction to Mar-22, 66% demand bounceback | 403,000 | 323,000 |
| 20% activity reduction to Mar-22, 33% demand bounceback | 291,000 | 233,000 |

As mentioned above the effect of the elective patients not being treated due to COVID-19 has an impact not just on these patients but will lead to longer waits for all patients until an investment is made to reduce the stock of patients waiting. Our methodology above estimates a one month increase in average wait decreases the QALYs per year gained by ~10,000. Hence, a 6-month extra average wait will decrease the QALYs per year gained by ~60,000.

These QALYs will be lost every year until the waiting list is reduced. Furthermore, it will cost the same every year to maintain a longer average wait as a shorter wait. That is, it costs the same to maintain a one-year average wait as a one-month average wait. This is because the flow of patients through the system will be the same – they will just take longer to flow through due to the increased stock of patients.

## C4: Changes to primary and community care

The previous iteration of our paper included discussion of the health impacts from disruption to primary and community care, as a result of routine services stopping or being reduced. We also included estimates of harm from delayed cancer diagnosis, based on a scenario of a six-month reduction in cancer diagnoses due to disruption to referral pathways through GPs and emergency care; our estimates suggested this could result in 1,400 excess deaths occurring over a five-year period, equivalent to 3,500 lost QALYs.

Since the previous paper, new evidence has been published on the disruption to healthcare, including a reduction in GP referrals[li] and an increase in the number of NHS 111 calls, potentially reflecting a shift in how people access primary care[lii].

Overall, we have concluded more detailed work is required to refine our previous estimates which has not been possible in time for this update. However, we are investigating ways to update our previous estimates for inclusion in a future update. It seems likely that primary and community care services will be coping with greater demand as a result of the pandemic, through supporting patients with long COVID[liii liv] or mental health issues[lv lvi] from living under pandemic restrictions. Health stakeholders have also identified some significant challenges for primary and secondary care going forwards:

- **Worsened health problems:** Non-urgent health care provision was paused during the initial peak of the pandemic which may have led to worsening health conditions; as a result, more complex consultations may be required now. [lvii]
- **Longer hospital waits:** Some stakeholders suggest that patients facing long waits for secondary care may seek ongoing support from primary care services to manage their conditions.[lviii]
- **Productivity:** A challenge for both primary and secondary care services is the necessary increases in infection control measures, including the use of personal protective equipment, which will decrease how quickly patients can be treated and have an impact on waiting times and potential health outcomes.[lix]

Overall, it seems possible that primary and subsequently secondary healthcare services may be supporting a different and more challenging range of health problems as a result of the pandemic, such as potential increases in more complex conditions which existed before the pandemic, increases in specific health problems due to the pandemic (e.g. mental health) and the introduction of completely new and evolving health problems (e.g. long COVID). Taken together, this presents new challenges for health services when allocating scarce and finite resources to continue to support patients with a varied range of health problems.

## Annex D: Category D – Health impacts for (1) the wider population due to the pandemic and (2) the economic downturn

Category D estimates the health impacts on the wider population as a result of the pandemic and subsequent economic downturn. Changes in behaviour as a result of mandatory and voluntary social distancing may have significant health impacts, e.g. as a result of lower road traffic accidents and occupational injuries as mobility falls (D1 harms), and economic impacts as businesses temporarily and permanently close and consumer demand falls. The subsequent economic recession will also likely lead to a worsening in health for the population as a whole (D2 harms).

This annex is structured as follows:

*D1: Health impacts for the wider population due to the pandemic*

- Discussion on the expected wider health impacts as a result of the pandemic
- Impact to-date (up to 2 December 2020)
- Forecasted impacts (December 2020 – end of February 2021)

*D2: Medium to long-term health impacts from the economic downturn*

- Brief summary of the literature
- Discussion of economic impacts due to the pandemic
- Impact of increased unemployment rate on medium and long-term morbidity and mortality

*Table 17 – summary of the QALY impact of D1 and D2 harms*

| | March 2020 – December 2020 | | | Beyond December 2020 | | |
|---|---|---|---|---|---|---|
| | **Pessimistic** *(The impact of the initial lockdown is consistent throughout the period)* | **Central** *(Assuming four distinct time periods)* | **Optimistic** *(The impact during the second lockdown is minimal)* | **Downside** | **Central** | **Upside** |

| | | | | (OBR's downside scenario[5]) | (OBR's central forecast[6]) | (OBR's upside scenario[7]) |
|---|---|---|---|---|---|---|
| **D1** morbidity and mortality QALY loss | 915,000 | 770,000 | 753,000 | 293,000 | 265,000 | 237,000 |
| **D2** morbidity and mortality QALY loss | Not estimated | Not estimated | Not estimated | 2,700,000 | 1,300,000 | 230,000 |

## D1. Health impacts for the wider population due to the pandemic

### *Introduction*

This section sets out the impact of the pandemic, including the impact of living under COVID-19-related restrictions, voluntary behaviour changes, and as a result of the witnessing the impacts of the pandemic (e.g. on mental health), on the morbidity and mortality of the wider population (in the year between March 2020 and February 2021). We present the impacts of these together as the impact of the pandemic and do not distinguish between them. The quantified estimates are based on a range of assumptions, and therefore their reliability and robustness are considered to be low and should be interpreted with caution. We estimate the impacts as a result of the pandemic as a whole; we do not distinguish between the impacts as a result of voluntary social distancing and government intervention. We focus on the impact of the pandemic on specific health conditions that will have seen a significant change, including drug and alcohol use, physical activity, diets, road injuries, conditions associated with working from home, mental health, domestic abuse and interpersonal violence.

### *Expected wider health impacts of the COVID-19 pandemic.*

Here we set out the estimated impact of the COVID-19 pandemic, including social distancing restrictions, on the wider health of the population in England.

1. According to Public Health England[lx], **alcohol** intake across the population remained about the same during the first national lockdown, with almost half reporting that they had neither increased or decreased their drinking, and this pattern continued as restrictions eased. However, there was an increase in the proportion of 'increasing and higher risk drinkers'[lxi]. Total alcohol receipts fell up to May compared to the same period in 2019[lxii], then increased as restrictions were lifted and have remained higher since. The proportion of adults reporting high risk drinking was 53% higher in March 2020 compared to 2019, 58% in April and 34% in May. It has remained over 40% higher than the equivalent month in 2019. On the other hand, the proportion reporting cutting down on their alcohol consumption has remained higher than 2019 throughout the pandemic. Therefore, we overall assume that there has been a small increase (5%) in alcohol consumption throughout the pandemic as

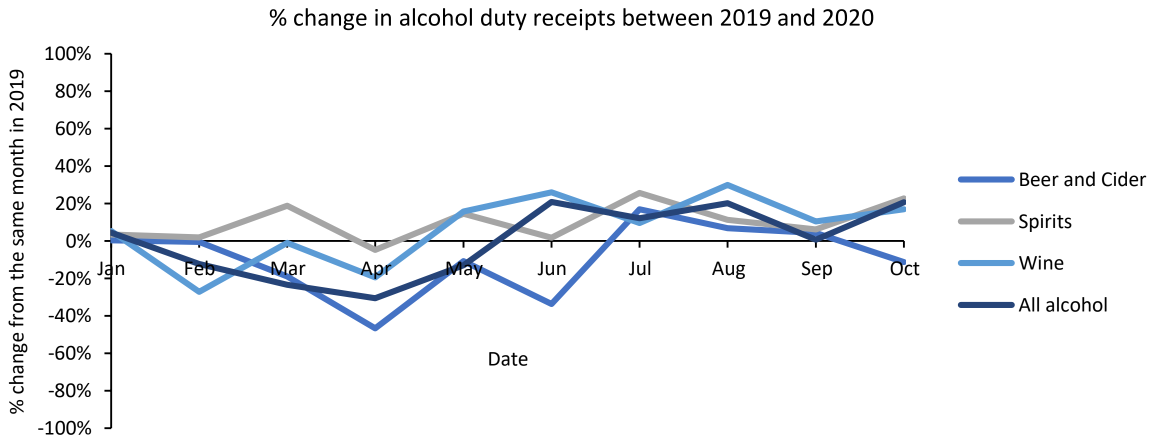
[5]***Downside scenario:*** *More stringent public health measures (varying regionally and over time but "broadly equivalent to somewhere between England's pre-lockdown Tier 3 and the November lockdown") are in place throughout the winter. The arrival of spring again permits some easing of restrictions but, unlike in the central scenario, a sufficiently effective vaccine does not become available. Subsequent waves of infection then require further re-imposition of health restrictions.*

[6] ***Central forecast:*** *A more stringent set of public health restrictions are in place over the winter, which may vary regionally and over time but are "broadly the same as remaining at the equivalent of England's pre-lockdown Tier 3 until the spring. The arrival of warmer weather then allows an easing of the restrictions. An effective vaccine becomes widely available in the latter half of the year".*

[7]***Upside scenario:*** *November restrictions substantially reduce infection rates by 2 December. After that point, the testing system is combined with a return to tiering which would vary in intensity regionally and over time but be "broadly the same as remaining at the equivalent of England's pre-lockdown Tier 2 until the spring". Then "an effective vaccine becomes widely available… permitting a further easing of health restrictions".*

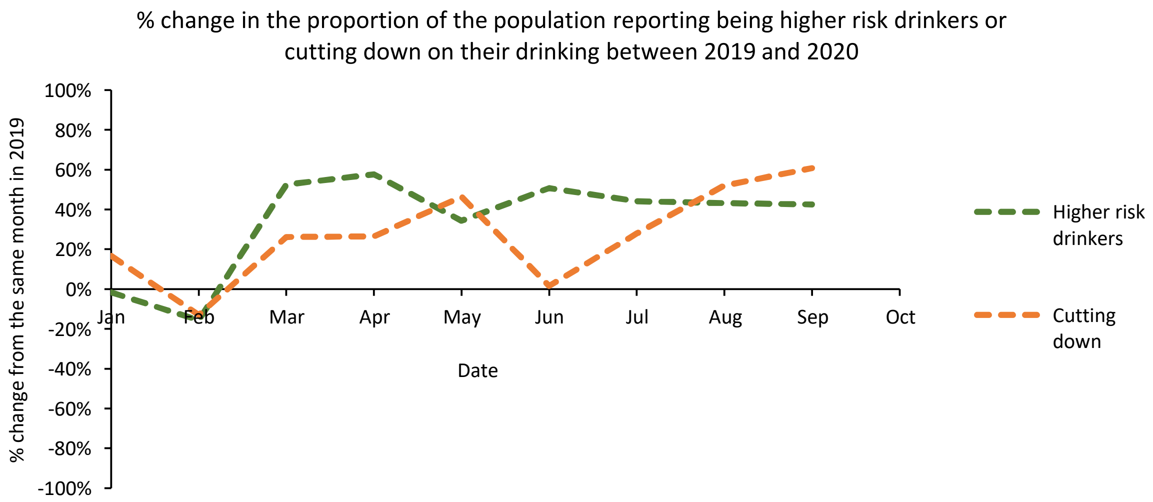
some of the increased at-risk drinking will be offset by the overall fall in consumption across the population.

*Figure 7 - % change in alcohol duty receipts between the same month in 2019 and 2020*




*Source: Alcohol Bulletin, GOV.UK*

*Figure 8 - % change in the proportion of the population reporting being high risk drinkers or cutting down their drinking between the same month in 2019 and 2020*




*Source: Alcohol Toolkit Study, UCL*

2. A lack of robust data means that it is not possible to determine whether **drug misuse** and related harms have increased or decreased since March 2020. The limited data suggests that 'high' restrictions may have impacted drug use and the drug market. Social drug use (and related accidental poisonings) could have decreased during initial restrictions. However, supply issues may have impacted the health of users due to withdrawal and/or some users turning to alternative drugs, or the same drugs now being cut with other, more dangerous, substances, with a further risk to overdose and harm.

   As discussed in the previous version of this paper, survey findings suggest challenges from the pandemic have included taking different drugs than normal as well as product shortages, price increases and drugs of 'poorer quality', which is reflected in anecdotal evidence[lxiii]. 58% of 300 respondents in a study conducted by CREW reported taking drugs more often and

19% reported taking drugs less often than before the pandemic.[lxiv] However, the sample used in this survey is not fully representative of England and the UK, as most respondents were from Scotland. Linked to CREW's findings, the EMCDDA reported that there had been an overall increase in activity related to cannabis on three popular dark net drug markets since the beginning of 2020; however, there had been a decline in demand for party drugs commonly used at social gatherings[lxv], which may bring health benefits. Overall, in the absence of robust evidence, we have slightly reduced our initial assumptions. We present an illustrative scenario considering drugs related morbidity and mortality to decrease by 5% during initial restrictions but this falls to 0% as restrictions are eased.

3. **Smoking** prevalence in the 4-week period ending 5 July was lower than the 2019 baseline. Smoking prevalence for people aged 16 to 24 more than halved in the same 4-week period. There has been an increase in the number of people attempting to quit smoking during the pandemic with two-fifths of smokers attempting to quit in the 3 months up to September 2020.[lxvi] We estimate an initial 2% fall in smoking, followed by a 5% fall throughout the course of the pandemic.

4. The data surrounding **physical activity** levels in the population is mixed. Although some online polls suggested the proportion of adults who did not exercise fell during the initial 'high' restrictions period in March-May[lxvii], the Active Lives Adult survey of 19,000 adults found that there was a 7.4% increase in the proportion of 'inactive' individuals and a 7.1 percentage point decrease in 'active' adults in mid-March to mid-May 2020 compared to the same period in 2019.[lxviii] This had improved as gyms and group exercise was permitted. We therefore assume a 7% increase in levels of low physical activity during periods of high restrictions and a 2% increase otherwise.

5. With fewer people in the workplace, especially with certain industries, such as construction closed at the beginning of the 'high' restrictions, there is likely to have been a reduction in **occupational injuries** and fatalities. Data from the Office for National Statistics has been used to demonstrate the proportion of employees who are no longer attending their usual place of work during each of the periods examined.[lxix] Depending on the restrictions determining levels of people working away from their usual place of work, we estimate a 30% - 60% fall in occupational injuries.

6. According to the Department for Transport vehicle use fell by around 50%[lxx] during the first period of restrictions in March - May, which equated to a 70% reduction in the number of people killed or seriously injured in road collisions up to June.[lxxi] We have used similar data to estimate the impact of lower levels of traffic throughout the pandemic on **road injuries**. It is not plausible to assume a one-to-one proportionate relationship between road traffic levels and road deaths, although it is likely that a fall in road activity leads to fewer road accidents and in turn fewer road fatalities. However, for simplicity, we estimate the reduction using Department for Transport statistics on the number of vehicle use.

7. PHE data suggests there has been a significant environmental change as a result of restrictions reducing mobility. These environmental improvements may have a subsequent health impact. The data suggests there was a reduction in NOx levels by around 40% during the initial lockdown in March[lxxii] and has remained around 20-30% lower than pre-lockdown levels since**Error! Bookmark not defined.**. This is supported by a paper published by DEFRA

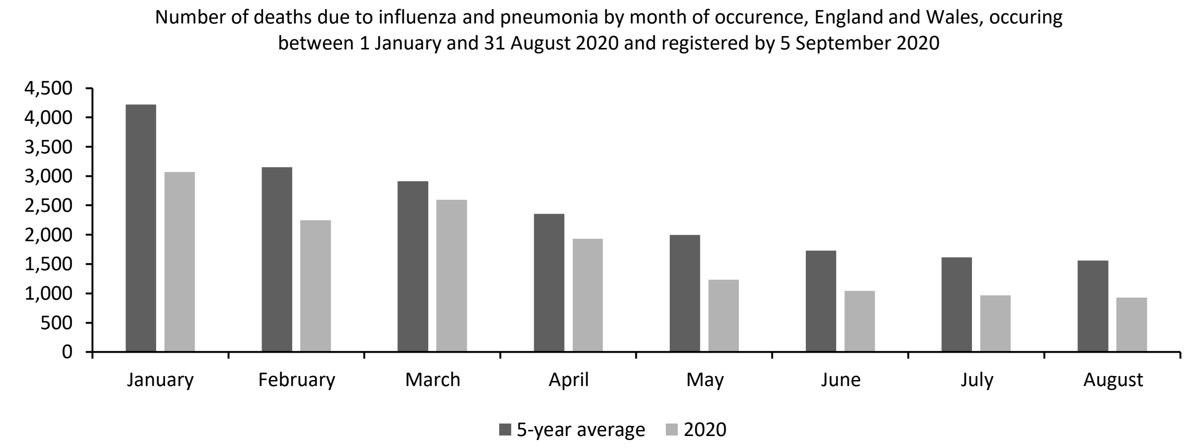
which suggests that, once weather effects are accounted for, mean reductions in urban NOx averaged over the 'high' restrictions period have been 30-40%.[lxxiii] Therefore, we assume that the mortality and morbidity impacts of **air pollution** has fallen during the pandemic.

8. With the guidance to work from home where possible in place for much of the pandemic, it is likely that there will be a fall in occupational injuries but an increase in **musculoskeletal disorders** as many workers will likely have less access to professional ergonomic advice, and will be using ergonomically worse furniture and IT. Also, home accidents have likely increased due to a higher proportion of time being spent at home. There is limited evidence, this impact is hard to measure. We assume that new cases of musculoskeletal disorders would increase by 25% during national restrictions, and 20% when people return to work between June and November.

9. There is currently a lack of data around the rate of **STI transmission** during the 'high' restrictions and pandemic. Preliminary data suggests that clinic visits dropped to 20% during the 'high' restrictions in March-June[lxxiv]. However, this does not necessarily mean there were less incidences of STIs, as individuals may have had an STI and believed that the clinic services were unavailable during this period. As a result of social distancing measures, there was likely some level of decrease in STI transmission. In the absence of better evidence, we retain our original assumptions and estimates for the impact during March-June, a 70% fall. We estimate that this returns closer to pre-pandemic levels as restrictions are eased, although not to 0% as some restrictions remain.

10. Data from southern hemisphere countries that have just exited their winter suggest that **flu** levels could be lower this year.[lxxv,lxxvi] Data from the ONS (see Figure 9) shows that deaths from influenza and pneumonia is lower in 2020 compared to the 5-year average. However, this difference existed prior to restrictions being imposed in March so we cannot attribute all reductions in deaths to COVID-19-related restrictions. Experts have indicated that lower reported levels of flu are unlikely to be due to a less infectious flu circulating, but instead due to the social distancing measures in place to fight the COVID-19 pandemic, since flu is transmitted between people in a similar way to coronavirus. This evidence relates to the southern hemisphere countries, meaning there may be some differences. However, if there are stringent restrictions in place during the winter in the UK, there may be a reduction in the level of influenza cases, especially as there is a mass flu vaccination programme being conducted by the UK government.[lxxvii] This is already potentially being seen in England. Data up to August from ONS shows lower deaths from influenza and pneumonia in 2020 are lower than the five-year average[lxxviii]. However, they were lower in January and February before the COVID-19 epidemic in England, so conclusions from this must be drawn with caution.

*Figure 9 – Number of deaths due to influenza and pneumonia by month of occurrence, England and Wales, 2015-2019 five-year average and 2020*




Source: ONS (2020), Deaths due to COVID-19 compared with deaths from influenza and pneumonia

In terms of **other infectious diseases**, data suggests that hexavalent and MMR vaccinations decreased during the beginning of the 'high' restrictions to levels lower than in 2019;[lxxix] however, vaccinations recovered two weeks later to levels higher than during the same weeks in 2019, potentially as a result of the messaging released by the Joint Committee on Vaccination and Immunisation (JCVI) that immunisation programmes were still operating[lxxix]. However, data suggests that it is unlikely that the dip in vaccine uptake resulted in a spike in infections, as stringent social distancing measures likely led to a significant drop in the prevalence of mumps in the UK.[lxxx] The implementation of future social distancing measures could help maintain low levels of these infectious diseases which could have health benefits. We assume an 80% fall in normal levels during the stricter restriction, and a 50% fall otherwise.

11. The direction of the impact of the pandemic and related restrictions on **diet** depends on many factors. The British Nutrition Foundation found that 27% reported they were eating less healthily compared to before the lockdown and 22% reported they were eating more healthily.[lxxxi] The COVID-Symptom study found that 29% of 1.6 million respondents reported gaining weight since March,[lxxxii] related to factors such as increasing alcohol consumption, reducing physical activity, increased snacking and an unhealthier diet.[lxxxii] On the other hand, 25% of adults responding to a survey by the Feed Britain and Northumbria University's Healthy Living Lab reported having struggled to access food during the pandemic[lxxxiii] and the Food Standards Agency suggest that around 8 million people have been forced to skip a meal or cut their meal portions because they did not have enough money during the pandemic.[lxxxiv]

    In terms of **child malnutrition**, the National Food Strategy indicated that children from lower economic backgrounds were more likely to say they ate more snacks and more junk food but less likely to say they ate more fruit and vegetables during restrictions compared to children from higher economic backgrounds.[lxxxv] Also, data from Feed Britain found 1 in 4 adults looking after children have eaten less so they can feed the children in their household.[lxxxvi] This may suggest worsening diets for some children during the 'high' restrictions.

The conflicting information on the impact of restrictions on diets means we do not quantify this effect. However, we do assume a 5% increase in child malnutrition during this period.

12. Data on **anxiety** from ONS demonstrates the sharp increase in anxiety rates in March 2020 as the pandemic spread, in comparison to rates predating the pandemic.[lxxxvii] They have since fallen since their peak in late March but are still above pre-pandemic levels and have risen again in the Autumn. For **anxiety** and **depression** rates in adults we use the UCL COVID-19 Social study time series and compare average estimated anxiety and depression scores at different times compared to pre-pandemic levels.[lxxxviii] The same study is used to estimate the impact of increased levels of self-harm in adults as a proportion of respondents.

13. Emerging data from the March/April lockdown period provides growing indicative evidence that interventions such as social distancing and stay at home guidance including closures of education settings, have likely had an adverse effect on the **mental health and wellbeing of children and young people**.[lxxxix] A report from NHS Digital suggests that in 2020, one in six children (16%) aged 5-16 were identified as having a probable mental disorder, compared to one in nine (10.8%) in 2017.[xc] Children and young people with a probable mental disorder were more likely to say that lockdown had made their life worse (54.1% of 11-16 year olds and 59% of 17-22 year olds), than those unlikely to have a mental disorder. There is minimal time series data on the impact of the pandemic on the mental wellbeing of young people so the 18-29 age category in the UCL social study is used as a proxy for the rates of anxiety, depression and self-harm in young people.

14. According to the Home Office, by April 2020 violence against the person offences fell by 10% compared to 2019,[xci] although this reduction fell to 4% in May 2020 compared with the previous year. The increase in offences in May could be due to the beginning of the easing of restrictions. Overall, it seems possible that the introduction of more stringent restrictions could lead to a similar drop in violence against the person offences in the future. We use these changes to estimate the impact of the restrictions in place. Given the rate had already reduced to 4% by May 2020, we assume that during periods of lower restrictions there was no reduction in **interpersonal violence**. We assume that the new restrictions in November had a similar impact to those in March – June.

15. Data from the Ministry of Justice suggests that **domestic abuse** and **sexual violence** increased throughout the pandemic. On average, between March and June, calls for help via domestic abuse helplines and webchats/online support was 52% higher than compared to pre-COVID-19 levels, with a spike in April that saw the level rise to 85% higher than pre-COVID-19 levels.[xcii] As restrictions eased, the level of traffic on domestic abuse webchats and helplines fell to 33% higher in September to November than pre-COVID-19 levels.[xcii] Whilst sexual violence did not see similar increases during the most stringent measures (a 9% increase), as restrictions began to ease between June and September, the volume of traffic on sexual violence helplines and webchats increased on average by 112% and have remained 70% higher than pre-COVID-19 levels between September and November 2020.[xcii] This increase may reflect the increased privacy individuals may have experience when workplaces reopened, as well as an increased opportunity for these violent acts to occur as social distancing measures were relaxed.

A recent study estimated the health impacts of domestic abuse (including physical and emotional harms) to be around 676,000 QALYs per year, or 0.35 QALY on average for each of the 1,946,000 adult victims per year (2016/17 figure).[xciii] This includes around 27.5 QALYs on average (or 34.6 life years lost) for each of the 108 fatalities per year (2016/17). We use this to estimate the impact of higher levels of abuse during the pandemic on the health of the population.

16. For **accidents in the home**, despite children spending more time at home during the pandemic, anecdotal evidence suggests that there has not been a corresponding increase in the rates of A&E visits[xciv] with University Hospital Wales seeing roughly a 50% reduction in the number of child emergency department and minor injury attendances during the pandemic. Whilst the incidence of injuries may have decreased, is it possible that more people have been dealing with minor injuries at home to avoid attending hospital. With people spending more time at home, it seems likely there may have been an increase in home accidents, so in the absence of robust evidence, we retain our original estimates of a 25% increase in domestic accidents across duration of the pandemic.

*Unquantified impacts*

There will be additional impacts on mortality and morbidity as a result of the pandemic that we are unable to quantify.

17. During initial restrictions, nearly 15,000 vulnerable people who were **sleeping rough** or at risk of sleeping rough were provided with emergency accommodation as of May 2020,[xcv] which may have reduced the risk of short-term health impacts associated with rough sleeping. However, evidence from London suggests that two thirds of people who were known to be sleeping rough between April and June 2020 were doing so for the first time, which is a 77% increase on the same period in 2019.[xcvi] Some reports suggest approximately 20,000 households have been made homeless in England during the pandemic so far.[xcvi] Whilst this does not equate to 20,000 more sleeping rough, some of these may end up sleeping rough if they cannot find shelter. Going forwards, it is possible that the number of people rough sleeping could rise again, possibly due to financial pressures from the recession, and this could have health impacts as a result.

18. There have been some significant impacts on **reproductive health** during the pandemic. Previously we discussed possible changes in the number of pregnancies as a result of living under pandemic restrictions. A survey of 1000 women by Ipsos on behalf of Marie Stopes International found that over a third of UK women (36%) have been unsure how to access contraception during the pandemic.[xcvii] Some women who tried to access contraception services during the pandemic reported worse contraceptive services and an inability to get an appointment in their area. Being unable to access contraceptive services could lead to an increase in unwanted pregnancies, as well as other health impacts that are normally controlled with certain contraceptives, such as endometriosis and polycystic ovary syndrome (PCOS).

    Between January and June 2020 there was a 4% increase in abortions performed in England and Wales compared to the same time period in 2019[xcviii]. The number of abortions in 2020 so far peaked in April 2020 with 4,500 more abortions compared with April 2019. During May and June 2020, the number of abortions was lower compared to the same period in 2019. As a result of the pandemic and changes to NHS care, there was a temporary change to the law that allowed both sets of pills needed for early termination to be taken at home[xcix].

Research conducted at the end of March/beginning of April with a small sample of 236 young people (aged 18-34) in the UK who were planning to have a child in 2020 found a reduction in the overall intentions to maintain their plans around having children.[c] Some participants were still planning to have children (23%), whilst others were either postponing (58%) or abandoning their plans entirely (19%). The economic uncertainty connected to the pandemic and individuals' perceived income related risk was associated with a higher probability of abandoning or postponing fertility plans. Whilst a small sample, the preliminary evidence could suggest that the country may not see an increase in future births as previously thought.

### *No expected impacts*

In the previous version of this paper, we discussed whether there could be effects from the pandemic on the following health impacts; however, based on the available data, we suggest no significant impacts occurred and subsequently will not be included in our discussion of impacts in the current paper. The impacts are listed below for completeness.

19. **Blood donation:** Data from the NHS suggest that there have been no issues exceeding their service level target to hospitals despite issues with staff shortages, social distancing measures being in place in sessions and some venues being closed.[ci]

20. **Community pharmacy:** There was some evidence of pharmacies and GPs being unable to access prescription medicines (possibly due to interruptions in the international supply chain) and people being unable to purchase paracetamol and ibuprofen (possibly due to stockpiling).[cii] However, these issues were subsequently rectified. Despite issues with the supply of certain medications, Understanding Society's COVID-19 survey suggested that during period [1], 98% of those who needed prescription medications were able to obtain them and 75% of those who needed the pharmacist still received the services they required.[ciii] Consequently, this may suggest that people's ability to continue acquiring their medication were overall not impeded by the restrictions.

### *Wider health impacts to-date*

This section quantifies the impacts outlined above the present estimated changes in morbidity and mortality. We distinguish between four time periods with different transmission rates and stringency levels of restrictions, as these will determine the impact on the health harms, to calculate an estimated impact to-date from 23 March 2020 to 2 December 2020. These dates have been chosen to reflect major changes in the regulations used to control the spread of COVID-19. The summary below sets out the four periods with examples of restrictions in place during this time. This is not an exhaustive list of the restrictions but gives an idea of the stringency of restrictions in place and the main differences across periods:

[1] **High**: The initial national restrictions (*March – June*). E.g. working from home is encouraged; non-essential retail, accommodation and food services and education services are closed; household mixing is generally not permitted.
[2] **Low**: Restrictions eased (*June – September*). E.g. non-essential retail, restaurants, bars and pubs re-open; some household mixing.
[3] **Medium:** Restrictions strengthened *(September – November*). E.g. the 'rule of six', 10pm curfew and the introduction of the first tier system.

[4] **High:** New national restrictions *(November – December*). E.g. working from home is encouraged, non-essential retail and accommodation and food services must close, and households mixing limited to specific reasons. Education services remain open.

For most of the conditions/harms, there is evidence to suggest that the differing stringency of restrictions in place at different times since March 2020 will have varying effects on health. health differs across the four periods. For example, we see improvements in mental health as measures become less stringent and transmission falls.[civ] However, for some of the conditions/harms examined, there is insufficient evidence to estimate different impacts across the four periods, so the estimated impact is kept constant between March and December.

For the purposes of this modelling, the time periods are treated as non-overlapping despite some restrictions being present across all four periods. The main mortality impacts of these restrictions come from reductions in air pollution, increases in self-harm and alcohol use. The main morbidity impacts come from musculoskeletal disorders, domestic abuse and mental health problems.

The summary tables below present the total estimated health impacts for the four periods between 23 March 2020 and 2 December 2020, under central, pessimistic and optimistic scenarios:

- **Central scenario**: Assumes changes in severity of harm according to changes with the severity of restrictions, as detailed above.
- **Pessimistic scenario**: Assumes the impact of the initial lockdown in March persists for the rest of the period (i.e. there is no time dimension included in the estimates).
- **Optimistic scenario**: Assumes the impact of the restrictions in place in period [3] persist into period [4] instead of returning to the level of impact experienced during the first period of nationwide restrictions ([1]).

The negative estimates represent the positive health impacts (QALYs, deaths and YLL saved) and the positive estimates represent negative health impacts (QALYs, deaths and YLL lost).

### *Methodology*

The methodology using the Global Burden of Disease, 2019[cv] has been retained from the previous paper, but the assumptions of changes to health impacts have been updated and are now time dependent as the restrictions in place have changed during the period examined. For some health harms (e.g. alcohol use), there is insufficient evidence that there are significant changes between the four periods [1]-[4] so the assumption is held constant.

*Table 18 – Changes to morbidity and mortality March – December 2020, central scenario*

| Central | Change in morbidity (QALYs) | Change in Deaths | Change in Years of Life Lost (for those who die)) | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|
| **Estimated impacts of restrictions 23 March 2020 - 2 December 2020** | | | | | |
| Alcohol use | +8,700 | +700 | +17,800 | +11,600 | +20,300 |
| Drugs misuse | -2,800 | -60 | -2,000 | -1,300 | -4,100 |
| Tobacco | -15,500 | -2,700 | -46,700 | -31,400 | -46,900 |
| Air pollution | -14,000 | -2,600 | -42,900 | -29,000 | -42,900 |
| Low physical activity | +1,900 | +300 | +3,900 | +2,600 | +4,500 |
| Child malnutrition | +4,500 | +50 | +3,800 | +1,900 | +6,400 |
| Occupational injuries | -6,000 | -70 | -3,100 | -1,800 | -7,800 |

| | | | | | |
|---|---|---|---|---|---|
| Road injuries | -5,700 | -300 | -12,700 | -7,800 | -13,500 |
| Musculoskeletal disorders | +252,700 | +400 | +6,300 | +4,300 | +257,000 |
| Sexually transmitted infections | -3,700 | -100 | -4,600 | -2,700 | -6,500 |
| Other infectious diseases | -4,900 | -400 | -11,600 | -7,500 | -12,500 |
| Anxiety disorders (adults) | +65,700 | 0 | 0 | 0 | +65,700 |
| Depressive disorders (adults) | +231,200 | 0 | 0 | 0 | +231,200 |
| Self-harm (adults) | +800 | +500 | +19,700 | +12,000 | +12,700 |
| Anxiety disorders (children) | +11,100 | 0 | 0 | 0 | +11,100 |
| Depressive disorders (children) | +8,700 | 0 | 0 | 0 | +8,700 |
| Self-harm (children) | +10 | <10 | +1,000 | +500 | +600 |
| Interpersonal violence | -600 | -10 | -400 | -200 | -800 |
| Domestic abuse | +203,300 | +30 | +1,100 | +900 | +204,200 |
| Home accidents | +69,900 | +1,300 | +19,200 | +13,000 | +82,900 |
| ***sub-total*** | ***+805,000*** | ***-2,935*** | ***-51,000*** | ***-35,000*** | ***+770,000*** |

*Table 19 – Changes to morbidity and mortality March – December 2020, pessimistic scenario*

| Pessimistic | **Change in morbidity (QALYs)** | **Change in Deaths** | **Change in Years of Life Lost (for those who die))** | **Change in mortality (QALYs)** | **Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain]** |
|---|---|---|---|---|---|
| **Estimated impacts of restrictions 23 March 2020 - 2 December 2020** | | | | | |
| Alcohol use | +8,700 | +700 | +17,800 | +11,600 | +20,300 |
| Drugs misuse | -6,000 | -100 | -4,500 | -2,800 | -9,000 |
| Tobacco | -8,000 | -1,400 | -23,400 | -15,800 | -23,500 |
| Air pollution | -18,800 | -3,500 | -57,800 | -39,000 | -57,800 |
| Low physical activity | +3,100 | +500 | +6,400 | +4,300 | +7,400 |
| Child malnutrition | +4,500 | +50 | +3,800 | +1,900 | +6,400 |
| Occupational injuries | -7,800 | -90 | -4,100 | -2,400 | -10,300 |
| Road injuries | -14,100 | -800 | -31,300 | -19,200 | -33,200 |
| Musculoskeletal disorders | +283,900 | +500 | +7,100 | +4,800 | +288,700 |
| Sexually transmitted infections | -5,100 | -100 | -6,300 | -3,800 | -8,900 |
| Other infectious diseases | -6,200 | -500 | -14,600 | -9,500 | -15,700 |
| Anxiety disorders (adults) | +89,900 | 0 | 0 | 0 | +89,900 |
| Depressive disorders (adults) | +294,700 | 0 | 0 | 0 | +294,700 |
| Self-harm (adults) | +1,300 | +700 | +31,400 | +19,000 | +20,300 |
| Anxiety disorders (children) | +13,600 | 0 | 0 | 0 | +13,600 |
| Depressive disorders (children) | +10,700 | 0 | 0 | 0 | +10,700 |
| Self-harm (children) | +10 | +20 | +1,500 | +800 | +800 |
| Interpersonal violence | -1,300 | -20 | -800 | -500 | -1,800 |
| Domestic abuse | +238,800 | +40 | +1,300 | +1,100 | +239,800 |
| Home accidents | +69,900 | +1,300 | +19,200 | +13,000 | +82,900 |
| ***sub-total*** | ***+952,000*** | ***-2,700*** | ***-54,300*** | ***-36,500*** | ***+915,000*** |

*Table 20 – Changes to morbidity and mortality March – December 2020, optimistic scenario*

| Optimistic | **Change in morbidity (QALYs)** | **Change in Deaths** | **Change in Years of Life Lost (for those who die))** | **Change in mortality (QALYs)** | **Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain]** |
|---|---|---|---|---|---|
| **Estimated impacts of restrictions 23 March 2020 - 2 December 2020** | | | | | |
| Alcohol use | +8,700 | +700 | +17,800 | +11,600 | +20,300 |
| Drugs misuse | -2,100 | -40 | -1,500 | -900 | -3,000 |
| Tobacco | -15,500 | -2,700 | -46,700 | -31,400 | -46,900 |
| Air pollution | -13,600 | -2,600 | -42,000 | -28,300 | -42,000 |

| | | | | | |
|---|---|---|---|---|---|
| Low physical activity | +1,600 | +300 | +3,400 | +2,300 | +3,900 |
| Child malnutrition | +4,500 | +46 | +3,800 | +1,900 | +6,400 |
| Occupational injuries | -5,800 | -60 | -3,000 | -1,800 | -7,700 |
| Road injuries | -4,800 | -300 | -10,600 | -6,500 | -11,200 |
| Musculoskeletal disorders | +246,300 | +400 | +6,100 | +4,200 | +250,400 |
| Sexually transmitted infections | -3,400 | -90 | -4,200 | -2,500 | -6,000 |
| Other infectious diseases | -4,700 | -400 | -11,000 | -7,100 | -11,800 |
| Anxiety disorders (adults) | +66,100 | 0 | 0 | 0 | +66,100 |
| Depressive disorders (adults) | +226,500 | 0 | 0 | 0 | +226,500 |
| Self-harm (adults) | +700 | +400 | +16,900 | +10,200 | +10,900 |
| Anxiety disorders (children) | +11,100 | 0 | 0 | 0 | +11,100 |
| Depressive disorders (children) | +8,700 | 0 | 0 | 0 | +8,700 |
| Self-harm (children) | <10 | +10 | +900 | +500 | +500 |
| Interpersonal violence | -500 | >-10 | -300 | -200 | -600 |
| Domestic abuse | +193,400 | +30 | +1,100 | +900 | +194,300 |
| Home accidents | +69,900 | +1,300 | +19,200 | +13,000 | +82,900 |
| ***sub-total*** | ***+787,000*** | ***-3,000*** | ***-50,000*** | ***-34,100*** | ***+753,000*** |

### *Forecasted impacts after 2 December*

Beyond the 2 December, the impact of the restrictions in place are unknown and any potentially changes to policy cannot be predicted. Therefore, an average monthly impact alongside three central, upside and downside scenarios are presented. This provides us with illustrative scenarios to estimate the impact of different restrictions scenarios in place from December 2020. For this forecasting, we introduce a fifth period of restrictions:

[5] **Medium to High:** Restrictions post December 2. E.g. introduction of the second tier system. Assumed to be an average of the impact between period [3] and [4] as, at time of writing, the impacts of these restrictions are yet to be determined.

The scenarios are as follows and are, as far as possible, aligned with the three scenarios in the OBR November economic forecast for consistency with section D2.

- **Central forecast**: Equivalent to pre-lockdown tier 3 until end of February 2021 (i.e. presumed to be '*medium to high'***,** the average of the effects seen in periods [3] and [4]).
- **Upside forecast**: 'Broadly' the same as the whole country remaining in equivalent of pre-lockdown tier 2 restrictions until end of February 2021 (i.e. remaining under the '*medium'* restrictions seen in period [3]).
- **Downside forecast**: 'Broadly' the same as somewhere between pre-lockdown tier 3 and national lockdown until end of February 2021 (i.e. assumed to be the same as the '*high'* restrictions seen in period [4]).

*Table 21 – Changes to morbidity and mortality December 2020 – end of February 2021, all forecasts*

| | **Change in morbidity (QALYs)** | **Change in Deaths** | **Change in Years of Life Lost (for those who die))** | **Change in mortality (QALYs)** | **Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain]** |
|---|---|---|---|---|---|
| **Upside forecast** – 3 months of 'medium' impacts | +249,400 | -1,100 | -17,900 | -12,200 | +237,000 |
| **Central forecast** – 3 months of 'medium – high' impacts | +278,800 | -1,100 | -19,400 | -13,100 | +265,200 |

| | | | | | |
|---|---|---|---|---|---|
| **Downside forecast** – 3 months of 'high' impacts | +307,800 | -1,200 | -21,100 | -14,200 | +293,300 |

An average monthly impact for each of the health conditions examined is presented in Table 22, Table 23 and Table 24.

*Table 22 – average monthly impact on morbidity and mortality for the 'upside' forecast*

| Impact of one month of 'Upside forecast' restrictions | Change in morbidity (QALYs) | Change in Deaths | Change in Years of Life Lost (for those who die)) | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|
| Alcohol use | +1,100 | +80 | +2,200 | +1,400 | +2,500 |
| Drugs misuse | 0 | 0 | 0 | 0 | 0 |
| Tobacco | -2,400 | -400 | -7,100 | -4,800 | -7,200 |
| Air pollution | -1,200 | -200 | -3,800 | -2,600 | -3,800 |
| Low physical activity | +100 | +20 | +200 | +200 | +300 |
| Child malnutrition | +600 | <10 | +500 | +200 | +800 |
| Occupational injuries | -500 | >-10 | -300 | -200 | -700 |
| Road injuries | 0 | 0 | 0 | 0 | 0 |
| Musculoskeletal disorders | +27,700 | +50 | +700 | +500 | +28,200 |
| Sexually transmitted infections | -300 | >-10 | -400 | -200 | -500 |
| Other infectious diseases | -500 | -40 | -1,100 | -700 | -1,200 |
| Anxiety disorders (adults) | +7,600 | 0 | 0 | 0 | +7,600 |
| Depressive disorders (adults) | +22,700 | 0 | 0 | 0 | +22,700 |
| Self-harm (adults) | +30 | +20 | +800 | +500 | +500 |
| Anxiety disorders (children) | +700 | 0 | 0 | 0 | +700 |
| Depressive disorders (children) | +500 | 0 | 0 | 0 | +500 |
| Self-harm (children) | 0 | 0 | 0 | 0 | 0 |
| Interpersonal violence | 0 | 0 | 0 | 0 | 0 |
| Domestic abuse | +18,500 | <10 | +100 | +80 | +18,600 |
| Home accidents | +8,500 | +200 | +2,300 | +1,600 | +10,100 |
| ***sub-total*** | ***+83,100*** | ***-400*** | ***-5,900*** | ***-4,100*** | ***+79,000*** |

*Table 23 – average monthly impact on morbidity and mortality for the 'central' forecast*

| Impact of one month of 'central forecast' restrictions | Change in morbidity (QALYs) | Change in Deaths | Change in Years of Life Lost (for those who die)) | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|
| Alcohol use | +1,100 | +80 | +2,200 | +1,400 | +2,500 |
| Drugs misuse | -400 | >-10 | -300 | -200 | -600 |
| Tobacco | -2,400 | -400 | -7,100 | -4,800 | -7,200 |
| Air pollution | -1,400 | -300 | -4,300 | -2,900 | -4,300 |
| Low physical activity | +200 | +40 | +500 | +300 | +600 |
| Child malnutrition | +600 | <10 | +500 | +200 | +800 |
| Occupational injuries | -600 | >-10 | -300 | -200 | -800 |
| Road injuries | -500 | -30 | -1,100 | -700 | -1,200 |
| Musculoskeletal disorders | +31,200 | +50 | +800 | +500 | +31,700 |
| Sexually transmitted infections | -500 | -10 | -600 | -300 | -800 |
| Other infectious diseases | -600 | -50 | -1,500 | -900 | -1,600 |
| Anxiety disorders (adults) | +7,300 | 0 | 0 | 0 | +7,300 |
| Depressive disorders (adults) | +25,200 | 0 | 0 | 0 | +25,200 |
| Self-harm (adults) | +90 | +50 | +2,300 | +1,400 | +1,500 |
| Anxiety disorders (children) | +700 | 0 | 0 | 0 | +700 |
| Depressive disorders (children) | +500 | 0 | 0 | 0 | +500 |
| Self-harm (children) | <10 | <10 | +90 | +50 | +50 |
| Interpersonal violence | -80 | >-10 | -50 | -30 | -100 |

| | | | | | |
|---|---|---|---|---|---|
| Domestic abuse | +23,800 | <10 | +100 | +100 | +23,900 |
| Home accidents | +8,500 | +200 | +2,300 | +1,600 | +10,100 |
| ***sub-total*** | ***+92,800*** | ***-400*** | ***-6,500*** | ***-4,400*** | ***+88,400*** |

*Table 24 – average monthly impact on morbidity and mortality for the 'downside' forecast*

| Impact of one month of 'downside forecast' restrictions | Change in morbidity (QALYs) | Change in Deaths | Change in Years of Life Lost (for those who die)) | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|
| Alcohol use | +1,100 | +80 | +2,200 | +1,400 | +2,500 |
| Drugs misuse | -800 | -20 | -500 | -300 | -1,100 |
| Tobacco | -2,400 | -400 | -7,100 | -4,800 | -7,200 |
| Air pollution | -1,600 | -300 | -4,800 | -3,300 | -4,800 |
| Low physical activity | +400 | +60 | +800 | +500 | +900 |
| Child malnutrition | +600 | <10 | +500 | +200 | +800 |
| Occupational injuries | -600 | >-10 | -300 | -200 | -800 |
| Road injuries | -1,000 | -60 | -2,300 | -1,400 | -2,400 |
| Musculoskeletal disorders | +34,700 | +60 | +900 | +600 | +35,200 |
| Sexually transmitted infections | -600 | -20 | -800 | -500 | -1,100 |
| Other infectious diseases | -800 | -60 | -1,800 | -1,200 | -1,900 |
| Anxiety disorders (adults) | +7,100 | 0 | 0 | 0 | +7,100 |
| Depressive disorders (adults) | +27,700 | 0 | 0 | 0 | +27,700 |
| Self-harm (adults) | +200 | +90 | +3,800 | +2,300 | +2,500 |
| Anxiety disorders (children) | +700 | 0 | 0 | 0 | +700 |
| Depressive disorders (children) | +500 | 0 | 0 | 0 | +500 |
| Self-harm (children) | <10 | <10 | +200 | +90 | +100 |
| Interpersonal violence | -200 | >-10 | -100 | -60 | -200 |
| Domestic abuse | +29,100 | <10 | +200 | +100 | +29,300 |
| Home accidents | +8,500 | +200 | +2,300 | +1,600 | +10,100 |
| ***sub-total*** | ***+102,600*** | ***-400*** | ***-7,000*** | ***-4,800*** | ***+97,800*** |

## D2. Medium to long-term health impacts from the economic downturn

### *Introduction*

COVID-19 has induced a sharp global economic downturn. Recessions can have a number of effects on people's lives through increased unemployment, impact on mental health, reductions in income and wealth, and increased uncertainty about future jobs and income.

In this section, we consider the medium to long-term health impacts from an economic downturn induced by the pandemic. The estimates of the impacts presented in this section are relative to mitigated scenario where government intervention is in place to control the transmission of the virus. We do not present an unmitigated counterfactual with little or no government intervention and thus these impacts cannot be separated into impacts due to intervention and impacts due to voluntary social distancing and behaviour change in response to the pandemic. A discussion of the impacts presented relative to an unmitigated counterfactual is presented in Annex E.

We have also updated our methodology to reflect the latest evidence and current circumstances. In the previous version of this paper published in September 2020[cvi], we presented short-term impacts from the recession which we have excluded in this update. This is because the impacts presented were relatively small and are largely accounted for elsewhere in this document.

Recent academic evidence has shown that recessions have large and persistent negative effects on health at the population level. The impacts are particularly significant when one accounts for the compounded impacts over time and spill over impacts across local areas. The health effects caused by adverse macroeconomic conditions are complex, and differ across generations, regions and socioeconomic groups. Groups that are vulnerable to poor health are likely to be hit hardest even if the crisis hit all individuals equally, but evidence suggests that the economic repercussions of the crisis are falling disproportionately on young workers, low-income families and women.[cvii]

### *Brief survey of the academic literature*

There is an extensive literature studying the impact of economic business cycles on health and mortality rates across different time periods and countries, across different age groups and across indicators of socioeconomic status. In addition, while there is some evidence on the impact on morbidity and health related behaviours, it comparatively limited to the evidence on mortality.

Earlier studies found that mortality was procyclical over the business cycle in many countries, such as the United States, Germany, Spain, France and Canada – that is, as economic activity increases so does mortality. Evidence on the relationship between mortality and economic cycles in the UK is less clear. In addition, more recent studies examining the effects on mortality of the global financial crisis are less conclusive, finding mortality to be less procyclical, or even countercyclical – that is, mortality decreases during economic expansion.

An explanation for less conclusive results in studies using more recent data could be that recessions that are followed by slower recoveries (such as the 2008 recession) have a negative impact on long-term health as compared to recessions that are followed by quick recoveries.

Overall, mental health impacts are widely shown to be countercyclical in the literature and are also shown to have the greatest impact on health during recessions. Impact on healthy behaviours, such as exercising and consumption of healthy food, is largely shown to be negative during economic downturns as well. Impact on neonatal mortality have mixed results in the literature, as well as impacts on childhood obesity. Alcohol consumption too has mixed results, though the evidence suggests that while alcohol consumption is procyclical, binge and heavy drinking is counter cyclical. There is also evidence from the US that shows that opioid and drug related mortality is counter cyclical. See Table 25 below for a brief summary of recent papers from this literature.

*Table 25 - Summary of recent papers studying the impact of the economic cycle on health.*

| Study | Country | Health Measures | Economic Conditions Measure | Methods | Findings |
|---|---|---|---|---|---|
| Janke et al. (2020)[108] | UK | Self-reported health problems and disabilities categorised into 5 broad categories: (1) Musculoskeletal conditions, (2) Cardiovascular conditions, (3) Respiratory conditions, (4) Mental health conditions, and (5) Other conditions | Growth in local employment rates | Global Vector Autoregression to allow dynamic feedback across areas and over time | Counter-cyclical morbidity for chronic illnesses: a one percentage point increase in the unemployment rate is associated with a 2% increase in the long-term prevalence of chronic health condition |
| Aparicio and González (2014)[109] | Spain | 1) Birthweight in grams 2) Low and very low birthweight (<2,500, <1,500 g) 3) Late foetal death (<24 h) 4) Neonatal mortality (1–28 days) 5) Post-neonatal mortality (28 days–1 year) 6) Fertility rates 7) Composition of the families giving births (mother's age, marital status, fraction of babies with no registered father, parental occupation, birth order and multiplicity) 8) Mother's employment status during pregnancy 9) Women's health or health-related behaviour | 1) Province unemployment rate 2) Province non-employment rate | 1) FE model with province and year fixed effects 2) To control for selection, add parents fixed effects (subsample of siblings) | Procyclical neonatal, post-neonatal mortality, and late foetal death, low and very low birthweight, fertility, first births, multiple births, and babies with no registered father Countercyclical birthweight, mothers who are married. Results are stronger for the subsample of low-skill parents, and the birthweight effects are driven by the low-income provinces, while the effects on mortality are stronger in high-income regions Recessions leads to lower fertility among low-skilled parents |
| Ariizumi and Schirle (2012)[110] | Canada | 1) Age-specific mortality rates (all, females and males) | 1) Province unemployment rate | FE model with age, province, year FE, and province-specific time trends | Procyclical mortality for middle-aged individuals (30–39) No relationship on mortality for infants and seniors |
| Bellés-Obrero et al. (2016)[111] | Spain | Children's (2–15 years): 1) BMI 2) Overweight 3) Obesity 4) Underweight 5) Exercise 6) Fruit daily 7) Mediterranean diet 8) Breakfast with protein 9) Sweets every day | 1) Regional-level unemployment rate | FE model with region, trimester FE, and regional- specific linear time trends | Only effects for children <6 or >12 years Obesity and exercise is procyclical Underweight is countercyclical No relation with BMI, overweight Mixed results for diet |
| Bor et al. (2013)[112] | US | Past month's: 1) Drinking participation 2) Number of drinks 3) Binge drinking 4) Heavy drinking (>60) 5) Light drinking 6) Moderate drinking 7) Frequent binge drinking | None | OLS comparing the mean variables two years before vs. two years after | Procyclical drinking participation and light drinking Countercyclical frequent binge drinking, moderate and heavy drinking |

| Study | Country | Health Measures | Economic Conditions Measure | Methods | Findings |
|---|---|---|---|---|---|
| Bradford and Lastrapes (2014)[113] | US | For all the population and for patients age 19 to 64 1) Number of prescriptions for anti-depressants or anti-anxiety drugs 2) Number of prescriptions specifically for anti-depressants 3) Number of prescriptions for anti-anxiety drugs 4) Total number of drug prescriptions of any kind 5) Total number of doctor visits 6) Number of doctor visits resulting in a drug prescription 7) Number of visits for mental health issues | 1) Regional unemployment rate 2) Regional level of employment | Time-series regressions and vector autoregression models | Countercyclical mental health drug prescriptions for the Northeast region, also countercyclical but weaker for doctor visits with mental health diagnoses Countercyclical total drug prescriptions and doctor visits for all regions |
| Carpenter et al. (2017)[114] | US | Alcohol, marijuana, any illicit drug, cocaine, crack, stimulants, methamphetamines, analgesics, oxycodone, heroin, hallucinogens, LSD, PCP, ecstasy, sedatives, and tranquilizers Inhalants: 1) Past month participation 2) Past year participation 3) Past year disorder 4) Past year disorder conditional on past year use | 1) State-level unemployment rate | FE models with state and time FE (robustness with state-specific linear time trends) | Analgesic and hallucinogen participation countercyclical No relation with marijuana, any illicit drug, sedatives, tranquilizers, inhalants, methamphetamines, oxycodone LSD participation procyclical, but ecstasy participation countercyclical Ambiguous relationship of alcohol participation and disorders |
| Colman and Dave (2013)[115] | US | 1) Work minutes excluding job search 2) Work minutes × Metabolic Equivalent of Task (MET) 3) Exercise > 10 min 4) Exercise min 5) Exercise × MET 6) Min exercise < 4 METS 7) Min exercise > 4 METS 8) Total minutes × MET MET-adjusted time use: 9) Sleep 10) Personal care 11) Housework 12) Childcare 13) Care of HH adults 14) Purchasing goods and services 15) Eating and drinking 16) Socializing and relaxing | 1) State-level employment-to-population ratio 2) Gender-specific state-level employment-to-population ratio | FE model with region, day and month FE (excluding year FE) | Exercise, sleep, childcare, and television is countercyclical Time spend at work and purchasing goods and services is procyclical Physical exertion is procyclical |
| Dave and Kelly (2012)[116] | US | Month's consumption of 1) Healthy products (fruit, fruit juice, carrots, green salad, vegetables) 2) Unhealthy products (snacks, hamburgers, hot dogs, french fries, fried chicken, doughnuts) | 1) State-level unemployment rate | FE model with month, year, and region FE | Procyclical consumption of healthy foods Countercyclical relationship with unhealthy food but only significant for females and individuals with good health |
| Hollingsworth et al. (2017)[117] | US | 1) Opioid-involved drug death rates (per 100k) 2) All drug mortality rate (per 100k) 3) Opioid overdose ED visit rates (per 100k) 4) Drug overdose ED visit rates (per 100k) | 1) County or state-level unemployment rate 2) Employment-to-population ratios or percent changes in manufacturing employment or import exposure between 1990 and 2007 | FE models with county (or state), year, and state-by-year or county-by-year FE | Opioid and other drug mortality rate and opioid ED visits are countercyclical Not enough power to detect the relationship for other drug overdose ED visits |

| Study | Country | Health Measures | Economic Conditions Measure | Methods | Findings |
|---|---|---|---|---|---|
| Martín and Castelló (2016)[118] | Spain | Consumption in the last month and year: 1) Alcohol 2) Tobacco, smoke every day, number of cigarettes a day 3) Marijuana 4) Hard drugs: cocaine, crack, heroin, inhalants, hallucinogens, and ecstasy 5) Cocaine 6) Ecstasy | 1) Province-level unemployment rate | FE models with province and year FE | Tobacco, marijuana, and cocaine are countercyclical Alcohol participation procyclical only for the year consumption.<br><br>No relation with hard drugs and ecstasy |
| McInerney and Mellor (2012)[119] | US | 1) Mortality rate for the elderly (≥65 years) 2) Measures of general health for the elderly (poor or fair health, health limits activity, mental disorders) 3) Elderly's health behaviours (smoking, weight disorders) 4) Healthcare utilization by the elderly | 1) State unemployment rate | FE model with state, year FE, and state-specific time trends | Procyclical elderly mortality in 1976–1991 but countercyclical in 1994–2007 Procyclical physical and mental health No effect on smoking and procyclical BMI.<br><br>No significant effect over healthcare utilization |
| Ruhm (2015)[120] | US | 1) Total mortality rate 2) <25, 25–44, 45–64, 65–74, ≥75 years mortality rates 3) Deaths due to diseases (cardiovascular disease, cancer, other diseases), external causes (transport accidents, other accident, suicides, homicides), and other accidents (falls, drowning/submersion, smoke/fire/flames, poisoning/noxious) | 1) State unemployment rate 2) State nonemployment rate | FE model with state, year and state-specific time trends | Procyclical total mortality (stronger for men and young and middle-aged individuals), deaths from diseases, external causes, and other accidents 1976–1993 Procyclicality of mortality disappears for all ages in the recent years (1991–2010) and becomes countercyclical deaths from external causes and other accidents |
| Tekin et al. (2013)[121] | US | 1) General health (excellent; poor; fair to poor) 2) Poor mental health (>10 and >20 days/month) 3) Current smoker 4) Daily smoker 5) Current drinker 6) Binge drinker 7) Chronic drinker 8) Physical exercise 9) Overweight 10) Obese 11) Severely obese | 1) State-level unemployment rate 2) State-level employment rate | FE model with state, year, month FE, and state- specific linear time trends Weighted data | No relationship (estimates small and imprecisely estimated) with self-reported health and mental health Smoking is procyclical, although the relationship gets weaker during the Great Recession No robust significant relation with physical exercise and overweight, obesity or severe obesity |

Source: Selection of recent papers surveyed in Bellés-Obrero and Castelló. (2018)[122] with some more recent additions

### *UK Economic Forecasts*

To evaluate the impact of a COVID-19 induced recession on medium to long-term health impacts, an evaluation of the impact of the pandemic on the economy is needed. After two consecutive quarters of negative growth, gross domestic product (GDP) grew by 15.5% in Q3 2020,[123] suggesting that the UK is on the road to recovery. Consensus forecasts in November suggested that UK is likely to see a 10.6% fall in GDP over the course of the year[124] (see below for more details), compared to a consensus 6.6% fall in July[125]. This suggests that the pace of recovery is likely to be slower than previously predicted and new restrictions put in place in November may further slow this recovery.

A number of organisations publish macroeconomic forecasts regularly, such as the Office of Budget Responsibility (OBR), the Bank of England (BoE), Institute of Fiscal Studies (IFS), National Institute of Economic and Social Research (NIESR) alongside various private sector financial institutions. Figure 10 - Forecasts for UK GDP growth for 2020presents a summary of recent forecasts for GDP growth and the employment rate collated by HMT[126]. Forecasts for GDP range between -8.9% to – 12.4% in 2020 and 4.5% to 9.1% for the unemployment rate, with a consensus value of -10.6% for GDP and just over 6.3% for the unemployment rate.

*Figure 10 - Forecasts for UK GDP growth for 2020*

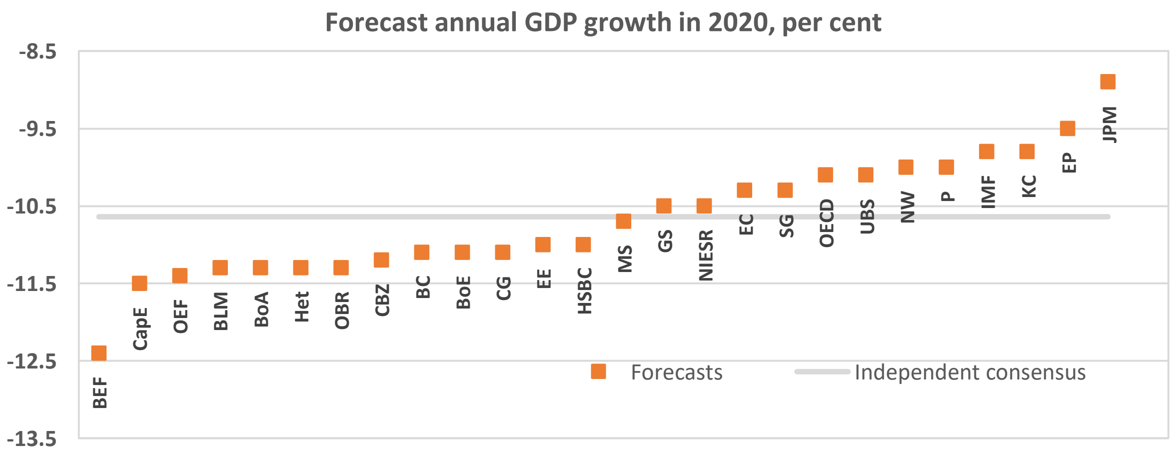
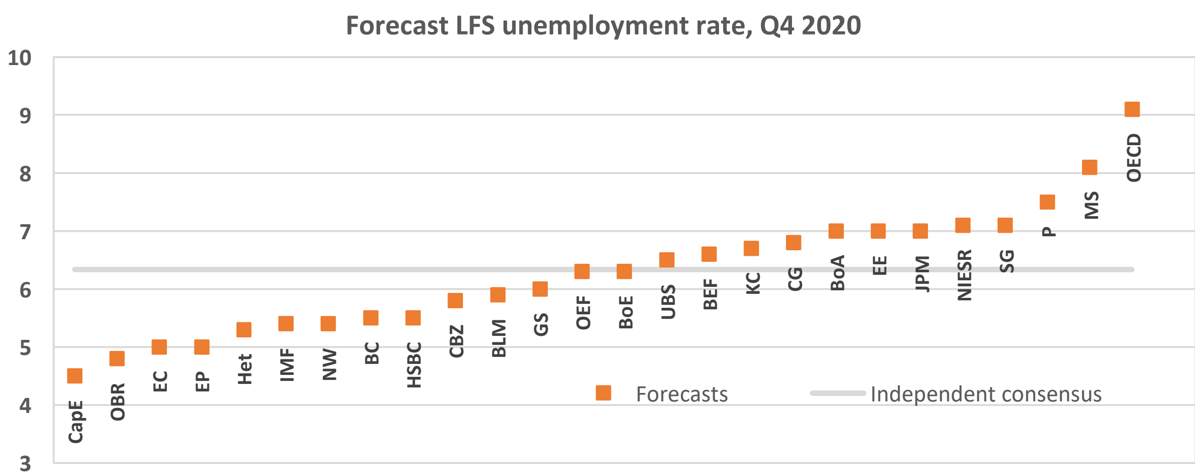



*Figure 11 - Forecasts for UK unemployment rate for 2020*



*Source:* Forecasts for the UK Economy, November 2020, HMT. Grey line = average. Legend:

| | | | | | |
|---|---|---|---|---|---|
| **BoA** | Bank of America - Merrill Lynch | **EE** | Experian Economics | **KC** | Kern Consulting |
| **BC** | Barclays Capital | **EC** | European Commission | **Liv** | Liverpool Macro Research |
| **BCC** | British Chambers of Commerce | **EIU** | Economist Intelligence Unit | **MS** | Morgan Stanley |
| **BEF** | Beacon Economic Forecasting | **EP** | Economic Perspectives | **N** | Nomura |
| **BLM** | Bloomberg Economics | **FC** | Fathom Consulting | **NIESR** | National Institute of Economic and Social Research |
| **CapE** | Capital Economics | **IHS** | IHS Markit Economics | **OECD** | Organisation for Economic Cooperation & Development |
| **CG** | Citigroup | **GS** | Goldman Sachs | **OEF** | Oxford Economic Forecasting |
| **CBI** | Confederation of British Industry | **Het** | Heteronomics | **P** | Pantheon |
| **CEBR** | Centre for Economics & Business Research | **HSBC** | HSBC Global Research | **NW** | NatWest Markets |
| **CBZ** | Commerzbank | **ING** | ING Financial Markets | **Sa** | Santander GBM |
| **CS** | Credit Suisse | **IMF** | International Monetary Fund | **S** | Schroders Investment Management |
| **DCM** | Daiwa Capital Markets | **ITEM** | EY ITEM Club | **SC** | Scotiabank |
| **DB** | Deutsche Bank | **JPM** | JP Morgan Chase | **SG** | Societe Generale |
| **IFS** | Institute for Fiscal Studies | **BoE** | Bank of England | **OBR** | Office for Budget Responsibility |

In this section we consider forecasts from the OBR in November to impute the potential impact of COVID-19 on the economy and consequently population health in the medium to long-term. We use the OBR forecasts for our analysis as they are the Government's official forecaster. However, note that the OBR estimates are slighter higher than average in terms of the annual percentage fall in GDP in 2020 (11.3% fall compared to the consensus 10.6%) and at the lower of unemployment forecasts for Q4 2020 (4.8% compared to 6.3%).

In November, the OBR published a comprehensive assessment of how the virus, restrictions and other measures and therefore the economy might evolve.[127] Recognising the very high level of uncertainty which faces the UK economy at this time they set out three scenarios. To construct these scenarios, the OBR have made a series of detailed assumptions about how the epidemic progresses, the nature of restrictions in place and their effect on the economy. These are subject to a high degree of uncertainty given the unprecedented and evolving nature of COVID-19 and how the assumptions interact. Note that none of these scenarios are not linked to the unmitigated health counterfactual presented throughout this paper.

The scenarios include – among others - assumptions on the impacts of the November restrictions, the level of restrictions in place from 2 December and the potential impacts of revised restrictions to be applied from 2 December.

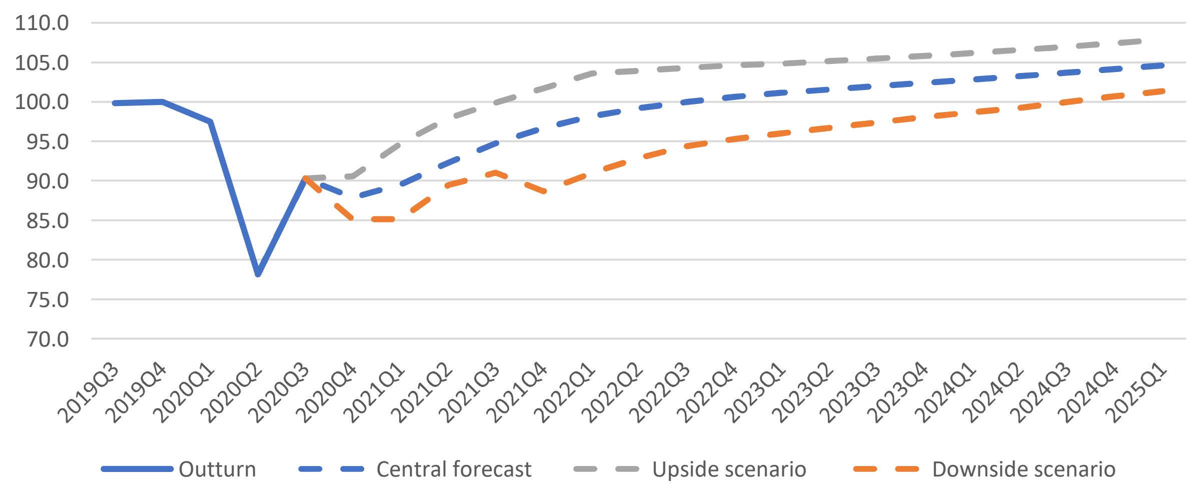
- In their upside scenario, the November restrictions substantially reduce infection rates by 2 December. After that point, the testing system is combined with a return to tiering which would vary in intensity regionally and over time but be "broadly the same as remaining at the equivalent of England's pre-lockdown Tier 2 until the spring". Then "an effective vaccine becomes widely available… permitting a further easing of health restrictions";
- In their central forecast, a more stringent set of public health restrictions are in place over the winter, which may vary regionally and over time but are "broadly the same as remaining at the equivalent of England's pre-lockdown Tier 3 until the spring. The arrival of warmer weather then allows an easing of the restrictions. An effective vaccine becomes widely available in the latter half of the year"; and
- In their downside scenario, more stringent public health measures (varying regionally and over time but "broadly equivalent to somewhere between England's pre-lockdown Tier 3 and the November lockdown") are in place throughout the winter. The arrival of spring again permits some easing of restrictions but, unlike in the central scenario, a sufficiently effective vaccine does not become available. Subsequent waves of infection then require further re-imposition of health restrictions.

These reflect a range of plausible scenarios but, due to the uncertainty, the OBR "make no attempt to assign probabilities to any particular outcome" and they note that "ultimately these are judgement-based scenarios". They do not model the precise detail of specific restrictions and quantifying the specific impact of any marginal additional restriction compared to them is difficult to do with any precision. That said, these scenarios provide a broad range of the possible economic outcomes we could expect in the coming months and years.

- In the OBR's upside scenario, real GDP in 2020 falls by 10.6% but recovers to its pre-virus peak by Q4 2021. Unemployment peaks at 5.1% in Q2 2021. There are negligible long-term impacts on the long-term productive capacity of the economy.
- In the OBR's central forecast, real GDP in 2020 falls by 11.3% but recovers to its pre-virus peak by Q4 2022. Unemployment peaks at 7.5% in Q2 2021. In the long-term GDP is 3% less than the trajectory pre-COVID-19.
- In the OBR's downside scenario, real GDP in 2020 falls by 12.0% and doesn't recover to its pre-virus peak until Q4 2024. Unemployment peaks at 11.0% in Q1 2022. In the long-term GDP is 6% less than the trajectory pre-COVID-19.

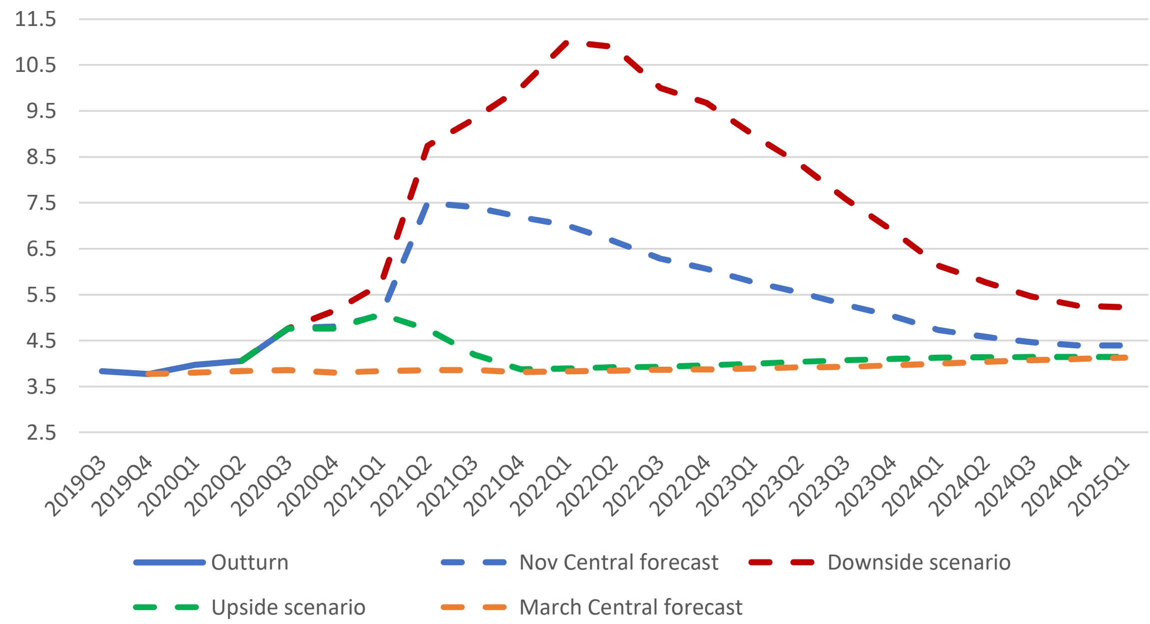
Figure 12 - OBR GDP forecast, November 2020 (2019 Q4 =100)presents the OBRs quarterly GDP forecast from November's Economic and Fiscal Outlook report for the three scenarios set out above.

*Figure 12 - OBR GDP forecast, November 2020 (2019 Q4 =100)*




The fall in economic activity is accompanied with an increase in the unemployment rate. OBR's central forecast for the unemployment rate over the next 18 quarters is set out in Figure 13 - OBR central forecast for unemployment rate, November 2020 below, along with forecasts for the upside and downside scenarios and the forecast for unemployment from January 2020.

*Figure 13 - OBR central forecast for unemployment rate, November 2020*




The current economic downturn is driven by a number of factors, notably a collapse in demand for some sectors of the economy, as consumers voluntarily adjust their consumption preferences to mitigate the risk of infection. Additionally, measures introduced to contain the pandemic will have led to a further decline in economic activity. However, as noted before, we cannot assess how much of the economic impact is due to voluntary social distancing, and how much is due to the measured introduced for reasons set out at beginning of this section.

Based on the forecasts set out above, we estimate the impact of the pandemic on the unemployment rate. The pandemic and the measures taken to control its spread have affected sectors differently, and consequently workers employed, and capital invested in those sectors that have seen demand fall will have to be reallocated to sectors that have seen demand increases over the pandemic. The Bank of England's Monetary Policy Report suggests that reallocation of resources across sectors is likely to result in some temporary mismatch between the skills of those looking for jobs and the sectors with vacancies, increasing unemployment in the short-term.[128]

We compare the November forecast against the OBR's central forecast for the unemployment rate in March 2020. The difference between the two is assumed to reflect the impact of the pandemic on the economy, although it is recognised that this is a simplifying assumption and that other macroeconomic factors, beyond the pandemic, may have contributed to changes to forecasts. Note that the OBR forecasts do assume that a free trade agreement will be in place with the European Union by the end of the year, and therefore any macroeconomic impacts associated with EU Exit are not included in this counterfactual.

In addition to the central forecast, we conduct sensitivity analysis using an upside and downside forecasts from OBR.

In the central scenario unemployment peaks in Q2 of 2021 at a value of 7.5%, while unemployment under the downside scenario peaks at 11.0% in Q1 2022 and unemployment under the upside scenario peaks at 5.1% in Q1 2021. In January 2020, the central forecast for Q2 2021 was 3.8%, implying a 3.6% increase in the unemployment rate, largely due to the pandemic and measures put in place to contain it.

*Impact of increased unemployment rate on medium and long-term morbidity and mortality*

In this section, we estimate the impact of the pandemic induced economic downturn on medium and long-term morbidity and mortality. Note that this presents the impact of the pandemic as a whole on morbidity and mortality – we do not separate out the effects of measures put in place to contain the virus and voluntary changes in behaviour by the population to mitigate the risk of getting infected.

For our analysis, we use a recent paper[129] which employs data from the Quarterly Labour Force Survey (QLFS) in the UK, which estimates the impact of economic shocks on morbidity for Britain allowing for different responses by local area, for persistence in the effect of past shocks and for feedback from national changes in levels of morbidity to the local level. The QLFS has measures of self-reported health alongside estimate for local unemployment – self-reported health has been categorised into five broad categories as set out in Table 26 – Categorisation of chronic health conditions in Janke et al. (2020)below.

*Table 26 – Categorisation of chronic health conditions in Janke et al. (2020)*

| **Group of chronic conditions** | **Specific Health Problems in Group** |
|---|---|
| Musculoskeletal | Problems or disabilities (including arthritis or rheumatism) connected with arms or hands; legs or feet; back or neck |
| Cardiovascular | Heart, blood pressure or blood circulation problems |
| Respiratory | Chest or breathing problems, asthma, bronchitis |
| Mental health | Depression, bad nerves or anxiety; Mental illness, or suffer from phobia, panics or other nervous disorders |
| Other conditions | Difficulty in seeing (while wearing spectacles or contact lenses); Difficulty in hearing; A speech impediment; Severe disfigurement, skin conditions, allergies; Stomach, liver, kidney or digestive problems; Diabetes; Epilepsy; Severe or specific learning difficulties (mental handicap); Progressive illness not included elsewhere (e.g. cancer, multiple sclerosis, symptomatic HIV, Parkinson's disease, muscular dystrophy); Other health problems or disabilities |

The authors find that employment changes during and after the 2008 financial crisis had a strong adverse effect on chronic health for five broad types of health conditions, with the strongest effects being for mental health conditions[viii],[130]. Quantitatively, they estimate that a 1% fall in employment leads to an approximately 2% increase across all 5 categories of chronic illness. They estimate that majority of this impact will be felt two years after the increase in unemployment. For each categories of choric illness, specifically mental health, musculoskeletal, cardiovascular, respiratory conditions and 'other' they estimate corresponding elasticities of 4.2%, 2.7%, 2.4%, 2.1% and 2.4%, respectively. That is to say, a 1 percentage point increase in the unemployment rate increases mental health prevalence by 4.2%, musculoskeletal prevalence by 2.7%, cardiovascular conditions by 2.4%, respiratory conditions by 2.1% and finally other chronic conditions by 2.4%.

Figure 14 – Projected increase in prevalence of chronic illnesses under central scenario presents the projected increase in the prevalence of chronic illnesses based on these elasticities under the central

[viii] It is acknowledged that the impacts of increased unemployment will not be limited to the chronic conditions evaluated in this paper. As outlined by Layard et al (2020), unemployment has significant effects on self-esteem, self-worth and loss of social ties. Unemployment also results in society-wide anxieties. As these impacts are likely to be partially captured by the mental health impacts quantified in this section and captured by the mental health impacts calculated in section D1, to avoid double counting it is not calculated here.

forecast for unemployment. Estimates for the current prevalence under each category are obtained using data from the Global Burden of Disease Study.[131] Note that as the impact on prevalence is not immediately realised, this graph does not represent the increase in prevalence in a given quarter, but the impact in the longer-term of an increase in unemployment in a given quarter. A reasonable rule of thumb would be to assume a two-year delay for the majority impacts to be realised from the quarter in which it is presented in this graph.

Table 27 presents the annualised increase in the number of cases for each category under the central scenario.

*Figure 14 – Projected increase in prevalence of chronic illnesses under central scenario*

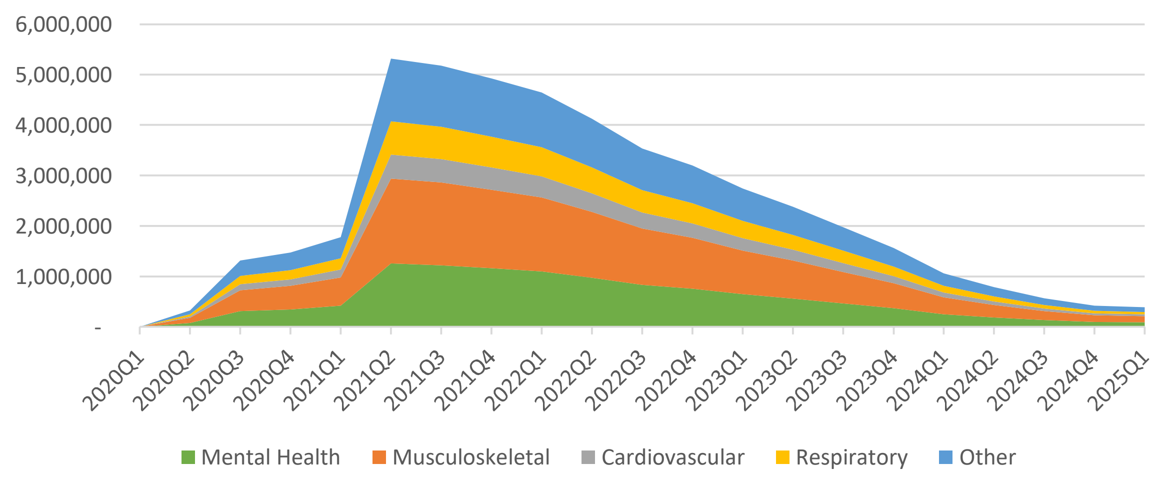



*Table 27 – Increase in the annualised number of cases (prevalence) in each category of chronic illness*

| | **Change in Prevalence (change in existing number of cases)** | | | |
|---|---|---|---|---|
| | **2020** | **2021** | **2022** | **2023** |
| Mental Health | 180,000 | 1,020,000 | 920,000 | 510,000 |
| Musculoskeletal | 250,000 | 1,360,000 | 1,220,000 | 680,000 |
| Cardiovascular | 70,000 | 380,000 | 350,000 | 190,000 |
| Respiratory | 100,000 | 530,000 | 480,000 | 270,000 |
| Other | 180,000 | 1,010,000 | 910,000 | 510,000 |
| ***Total*** | ***780,000*** | ***4,300,000*** | ***3,870,000*** | ***2,160,000*** |

*Note: Figures are rounded and may not add to the totals which are calculated using unrounded numbers*

Finally, we convert prevalence and incidence of chronic illnesses into the medium and long-term impacts on morbidity and mortality. To generate these estimates, we use disease-specific incidence (I), prevalence (P), deaths (D), years of life lost (YLL), and years lived with disability (YLD) estimates by the Global Burden of Disease Study (GBD). As YLD is calculated as YLD=I*DW*L[132] (where DW = disability weight, L = average duration of the resulting condition(s)), in effect YLD expresses the number of years lived with full (i.e. 100%) disability by all new cases within a year. Since GBD publishes prevalence and incidence data by disease, we can then calculate L for diseases and injuries as: L=P/I. Then, the morbidity Quality Adjusted Life Year (QALY) for the average sufferer can be calculated as the present discounted value (with 1.5% discount rate) of the future DW stream for L time periods using the annuity due formula: DW * ((1-(1.015^-L))/0.015) * 1.015.

To estimate the change in mortality QALYs, first, the remaining life expectancy (LE) of the average fatality is calculated as: D/YLL[133] using GBD disease specific data. Then, the mortality QALYs for the average fatality using parameters from the estimated relationship between the sum of discounted quality adjusted life years and life expectancy. Total QALYs are the sum of morbidity and mortality QALYs.

Table 28 presents the impact on morbidity and mortality under the central forecast and Table 29 and Table 30 conduct sensitivity analysis using the OBR's upside and downside scenarios.

*Table 28 – Central scenario*

| | Change in incidence between 2020/23 | Change in morbidity (QALYs) | Change in Deaths | Change in years of Life Lost | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|---|
| Mental disorders | 1,170,000 | 380,000 | - | 200 | 100 | 380,000 |
| Musculoskeletal disorders | 690,000 | 340,000 | 600 | 10,000 | 6,000 | 350,000 |
| Cardiovascular diseases | 100,000 | 40,000 | 30,000 | 380,000 | 260,000 | 310,000 |
| Chronic respiratory diseases | 110,000 | 70,000 | 10,000 | 100,000 | 60,000 | 130,000 |
| Other | 2,120,000 | 70,000 | 10,000 | 100,000 | 70,000 | 140,000 |
| ***Total*** | ***4,180,000*** | ***900,000*** | ***40,000*** | ***590,000*** | ***400,000*** | ***1,300,000*** |

*Table 29 – Upside scenario*

| | Change in incidence between 2020 /23 | Change in morbidity (QALYs) | Change in Deaths | Change in years of Life Lost | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|---|
| Mental disorders | 210,000 | 70,000 | - | - | - | 70,000 |
| Musculoskeletal disorders | 120,000 | 60,000 | 100 | 2,000 | 1,000 | 60,000 |
| Cardiovascular diseases | 20,000 | 10,000 | 5,000 | 70,000 | 50,000 | 50,000 |
| Chronic respiratory diseases | 20,000 | 10,000 | 1,000 | 20,000 | 10,000 | 20,000 |
| Other | 380,000 | 10,000 | 1,000 | 20,000 | 10,000 | 20,000 |
| ***Total*** | ***740,000*** | ***160,000*** | ***10,000*** | ***100,000*** | ***70,000*** | ***230,000*** |

*Table 30 – Downside scenario*

| | Change in incidence between 2020/23 | Change in morbidity (QALYs) | Change in Deaths | Change in years of Life Lost | Change in mortality (QALYs) | Change in morbidity and mortality (QALYs) [positive: QALY loss; negative: QALY gain] |
|---|---|---|---|---|---|---|
| Mental disorders | 2,430,000 | 780,000 | - | 400 | 200 | 780,000 |
| Musculoskeletal disorders | 1,430,000 | 710,000 | 1,000 | 20,000 | 10,000 | 720,000 |
| Cardiovascular diseases | 200,000 | 90,000 | 60,000 | 800,000 | 540,000 | 630,000 |
| Chronic respiratory diseases | 220,000 | 140,000 | 10,000 | 200,000 | 130,000 | 270,000 |
| Other | 4,400,000 | 150,000 | 10,000 | 210,000 | 140,000 | 290,000 |
| ***Total*** | ***8,670,000*** | ***1,870,000*** | ***90,000*** | ***1,220,000*** | ***830,000*** | ***2,700,000*** |

Under our **central scenario** there is a loss of approximately **1.3m QALYs** as a consequence of this pandemic induced recession. These health losses are largely accrued in the medium to long-term, with the morbidity affects largely falling in the medium term and the resultant mortality impacts falling in the longer-term. Under the **upside scenario**, there is an estimated **0.23m QALY loss** in the medium and long-run and under the **downside scenario**, there is an estimated **2.7m QALY loss** in the medium and long-run from COVID-19.

### Conclusion

Overall, our analysis suggests that the recession resulting from COVID-19 and restrictions on activities to contain it could have large effects on lives through unemployment, mental health impacts, loss of income and increased financial uncertainty. These impacts are likely to have medium and long-term consequences on population health in terms of increased morbidity and mortality.

This analysis also presents an increase in the impact of the recession on medium and long-term health compared to our previous update. This is because more recent economic forecasts suggest the bounce-back and recovery are likely to be at a slower pace than previously predicted, and therefore the health impacts from the economic downturn accumulate over a longer period of time than previously considered.

## Annex E: Comparison with counterfactual (three-month period)

The following annex provides a comparison between the main estimates presented throughout this paper, which are based on a mitigated scenario where measures are put in place to control the transmission of COVID-19, and a counterfactual, where there is minimal government intervention. The counterfactual presented is just one possible counterfactual that could be used for this purpose; others could be worse or could be better depending on unknown behavioural responses. Quantified estimates are provided for the three-month period between the end of December 2020 and the end of March 2021 only.

Where possible, we have provided quantified comparisons using a modelled counterfactual. The details of the counterfactual used to quantify health impacts can be found below and present one of many possible scenarios (see Counterfactual modelling). While epidemiologically possible, this counterfactual does not represent a plausible scenario for the future as no intervention is not Government policy. Quantified estimates, where possible, are summarised in the table below. We have also provided fuller discussion of the implications for health under the counterfactual for Category B. We provide estimates for a **three-month period between the end of December 2020 and the end of March 2021 only**, comparing between estimates in our Winter Scenario and this counterfactual; if the counterfactual time period was longer, it is likely direct COVID-19 harms would be greater than the estimates presented here.

In some cases, it has not been possible to quantify health impacts under a counterfactual, either due to uncertainty around the extent of impact in a counterfactual or due to a lack of available data upon which to base a counterfactual comparison. As a result, we have also provided discussion of the implications for health under the counterfactual for Category D.

It is also important to note that our previous paper included a comparison with an unmitigated scenario; this is now considered to be out of date. The counterfactual presented in this paper suggests lower levels of excess deaths and lost QALYs for Categories A and B than the previously cited unmitigated scenario. The differences are discussed further in Comparison with March unmitigated scenario, including differences in the scenarios used; the previous unmitigated scenario assumed no action is taken at all to reduce transmission of the virus, whereas the counterfactual in this paper assumes significant mitigation (albeit with minimal government intervention).

### Summary of mortality impacts

The following table compares estimates of excess deaths and associated lost QALYs from mortality in our main scenario (the Winter Scenario, or other scenario used instead) and a counterfactual (described below) for a **three-month time period from the end of December 2020 to the end of March**. This specific time period in the near future has been chosen to illustrate what may happen under a counterfactual; however, it is important to note this counterfactual is one of many possible scenarios and these estimates and discussion should be read in conjunction with the explanation of the counterfactual modelling included below (see Counterfactual modelling).

As the table shows, it has been possible to quantify the difference in excess deaths and associated lost QALYs for direct COVID-19 deaths (Category A), deaths from a lack of NHS critical care capacity (Category B), and from changes to emergency (Category C1) and adult social care (Category C2). However, we have been unable to quantify the impact on elective (Category C3), and primary and community care (Category C4) due to uncertainty about the scale of impact and a lack of data upon which to base our estimates; it seems likely that under a counterfactual, these health impacts would be significantly amplified if providers were over-run with caring for COVID-19 patients.

We are also unable to provide quantified estimates for Category D, impacts on the wider population living through a pandemic and from the recession. As discussed below, under a counterfactual we would expect some levels of voluntary behaviour change and social distancing, and wider health impacts (e.g. mental health consequences of experiencing living through a pandemic) to exist. We would also expect more of an impact under a situation of NHS capacity breach as the population will likely take more drastic measures to protect themselves against the virus; however, we are unable to quantify these impacts due to difficulty in determining the degree of voluntary behaviour change and social distancing in the absence of government intervention and the impact of this on the economy.

*Table 31. Comparison of excess deaths and mortality lost QALYs between main scenarios and a counterfactual, between the end of December 2020 and end of March 2021*

| Category | Excess deaths (3-month period, end of December 2020 to end of March 2021) | | Lost QALYs (3-month period, end of December 2020 to end of March 2021) | |
|---|---|---|---|---|
| | *Main Scenario* | *Counterfactual* | *Main Scenario* | *Counterfactual* |
| A | 45,000 | 143,000 | 344,000 | 942,000 |
| B | Not quantified | 76,000 | Not quantified | 450,000 |
| C1 | 6,000 | 18,000 | 15,000 | 43,000 |
| C2 | 14,000 | 57,000 | 39,000 | 158,000 |
| C3 | No comparable estimates available for the time period | No quantified estimate, but likely to be more significant impacts under the counterfactual | No comparable estimates available for the time period | No quantified estimate, but likely to be more significant impacts under the counterfactual |
| C4 | No updated, comparable estimates available for the time period | No quantified estimate, but likely to be more significant impacts under the counterfactual | No updated, comparable estimates available for the time period | No quantified estimate, but likely to be more significant impacts under the counterfactual |
| D1 | No comparable estimates available for the time period | No quantified estimate | No comparable estimates available for the time period | No quantified estimate |
| D2 | No comparable estimates available for the time period | No quantified estimate | No comparable estimates available for the time period | No quantified estimate |

### Summary of morbidity impacts

In the event of the counterfactual, there are also likely to be morbidity impacts for patients with COVID-19, as described in Annex B: Category B – Health outcomes for COVID-19 patients, worsened because of lack of NHS critical care capacity. As with mortality impacts, it has not been possible to quantify the morbidity impacts as a result of Categories C and D due to uncertainty about the scale of impact.

The following sections discuss in further detail the implications for health impacts in Categories B, C and D specifically.

### Category B – Health outcomes for COVID-19 patients, worsened because of lack of NHS critical care capacity

This update relates to whether NHS critical care capacity in England will be breached in the winter of 20/21. In the event that capacity is breached, it is likely that deaths rates would climb sharply at the margins and disproportionately raise the total societal costs of COVID-19. This analysis is based on a simulation model that matches COVID-19 patients requiring hospitalisation to the capacity that is available, combined with an excess mortality model to determine the hazard ratios where the required care is not provided. This model was provided courtesy of the Institute and Faculty of Actuaries (IFoA) and is available as a pre-print[134]. The model is explained briefly below.

#### *Description of Category B model*

At its core, this model is designed to estimate clinical outcomes for COVID-19 patients compartmentalized according to the severity of their symptoms and where they are cared for. This is illustrated by the flow chart in Figure 15, provided by IFoA. As the flow chart demonstrates, people who contract COVID-19 are likely to have a range of symptoms and require differing levels of treatment, including general ward care or intensive/critical care. The model estimates for mortality hazard ratios for those in intensive/critical care that would occur if that level of care was not available. It then produces estimates of the number of patients requiring ward and ICU admission, and their estimated admission outcome, which is multiplied by estimated mortality rates for ward and ICU patients (which incorporate additional mortality if they do not get the required admission). These are turned into hazard ratios for not getting the required admission, which are then applied to age-specific hospitalisation fatality rates.

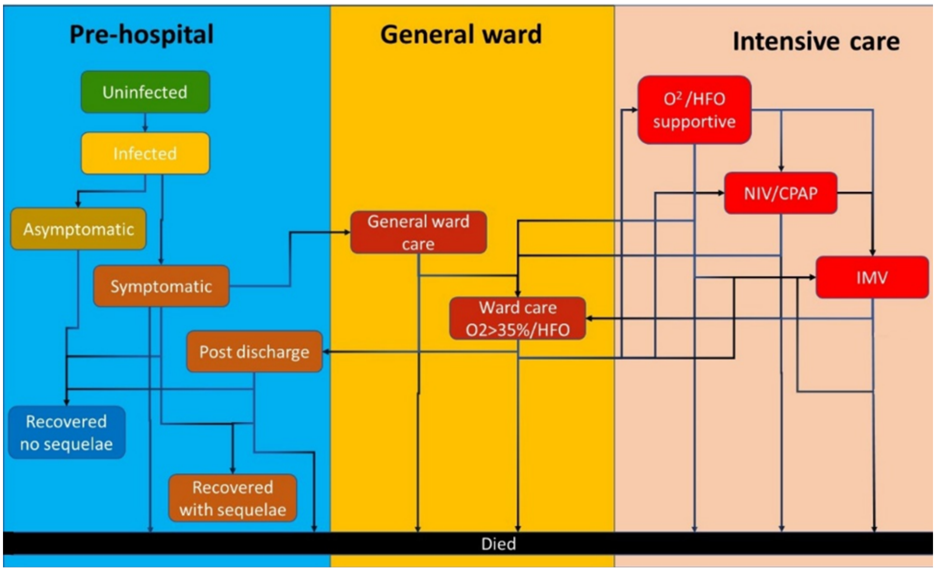



*Figure 15. Produced by IFoA: Flow of patients through compartments of care from uninfected through to death or recovery after infection with COVID-19. O2 is oxygen therapy, HFO is 'high flow oxygen' therapy, NIV is 'non-invasive ventilation', CPAP is 'continuous positive-airways pressure' therapy, IMV is invasive mechanical ventilation.*

IFoA have designed this model in consultation with data and clinical staff at Nottingham University Trust. This has been quality assured by DHSC analysts.

This model looks at the impact of breaching general ward beds as well as critical care beds. It does not prioritise between patients, but rather treats the stock of beds on a "first come first served" basis. It treats ward beds and ICU beds as separate stocks but for patients requiring ICU, if this is not available it simulates them receiving general ward care instead, subject to that being available. However, in the counterfactual scenario, general bed capacity is breached before ICU capacity and so this dynamic does not come into play. When the stated bed capacity runs out, patients are turned away.

Table 32. Fatality rates for patients requiring hospital treatment

| **Care Required** | **ICU** | **ICU** | **ICU** | **Ward** | **Ward** |
|---|---|---|---|---|---|
| **Care Received** | **ICU** | **Ward** | **None** | **Ward** | **None** |
| **Overall Mortality** | 39% | 60% | 94% | 22% | 51% |
| **Additional Mortality (absolute)** | 0% | 21% | 55% | 0% | 29% |

## Run Inputs

The model is run using admissions by 5-year age group from the counterfactual peak for 13 weeks. It assumes NHS capacity of 20,000 general ward beds and 5,000 ICU beds available to Covid-19 patients. In Annex B: Category B – Health outcomes for COVID-19 patients, worsened because of lack of NHS critical care capacity, we explain the difficulty in estimating a precise figure for the level at which NHS capacity will be breached.

### *Results*

The key results are provided below.

*Table 33. Estimate of Category B deaths in the counterfactual*

| Treatment required | Total patients requiring hospitalisation | … of whom breach capacity and cannot be admitted | … of whom die due to not being admitted | … of whom would not have died within 12 months (excess deaths) |
|---|---|---|---|---|
| Hospitalisation, no CCU | 530,000 | 280,000 | 83,000 | 71,000 |
| Hospitalisation with CCU | 49,000 | 10,000 | 6,000 | 5,000 |
| **Total** | 579,000 | 290,000 | 89,000 | 76,000 |

- Over the three-month period an estimated 579,000 patients will require hospital care. 290,000 are turned away due to capacity being full. Of these patients, 68,000 would have died anyway. Of the remaining, an additional 89,000 die due to lack of treatment. This equates to a total of **76,000** excess deaths.
- Using the same methodology for estimating QALYs as for Category A, this equates to **450,000** lost QALYs.
- All of these excess deaths are in addition to the Winter Scenario which we estimate to not breach NHS capacity.
- Only 6% of these additional deaths are in patients who would have required CCU beds. This is firstly because these patients make up only 8% of all patients requiring hospital care, and secondly because, with the parameters in this run of the model, the general beds fill up before the CCU beds reach full capacity.

## Discussion

This analysis demonstrates that exceeding capacity for hospital and ICU beds may not be the most likely outcome, but it remains plausible in any scenario worse than the Winter Scenario and would result in a substantial increase in the number of deaths from COVID-19.

For further comparison to our April paper where we included an estimate for an unmitigated scenario, please see section "Counterfactual modelling".

## Long Covid

In the counterfactual compared to the Winter Scenario there are an *additional* 395,000 Covid-19 patients requiring hospitalisation over the three-month period. Based on the Category B calculations there will be 200,000 additional patients who survive. This will include 130,000 patients who survive without being admitted. Assuming these have the same long-term impact on their morbidity as those who are hospitalised, then this would equate to a morbidity impact from Long Covid of **68,000** QALYs lost in the first year after discharge. However, there is significant uncertainty as to what morbidity impact there will be on patients who do not receive hospitalisation despite it being indicated as necessary, and the long-term morbidity could be significantly worse.

## Category C

As Table 31 suggests, there are likely to be a higher number of excess deaths and lost QALYs related to changes in emergency care (Category C1) and adult social care (Category C2) under the counterfactual than in our main Winter scenario. It has not been possible to provide quantified, comparable estimates for harms occurring as a result of changes to elective care (Category C3) or primary and community care (Category C4) but it seems likely that there would be more significant harms in terms of excess deaths and morbidity impacts under the counterfactual than our main estimated scenarios.

## Category D

### Discussion of counterfactual and impacts presented in Category D

We do not explicitly quantify a counterfactual with little or no government intervention in this section. Producing estimates for this would involve quantifying the level of behavioural change and voluntary social distancing in individuals as a result of unmitigated increases in transmission and the impact of this on the economy. There is evidence that these behavioural changes will take place: for example, the International Monetary Fund use mobility data and a restriction stringency index to show that, during the first three months of the pandemic, in developed economies, around 50% of reductions in mobility was as a result of voluntary social distancing.[135] This is supported by a paper from the University of Kent that implies that levels of social distancing are partially determined by the rate of infection in the country at the time, i.e. levels of voluntary social distancing increases as the pandemic worsens with little or no government intervention.[136] Furthermore, a paper from April suggests that individuals do voluntarily social distance but only towards the peak of the epidemic.[137] Therefore, the impact of the pandemic itself on voluntary social distancing will be determined by the level of infection in the community, and vice versa. We would expect some levels of voluntary social distancing to exist under the counterfactual, and it to have more of an impact under a situation of NHS capacity breach as the population will likely take more drastic measures to protect themselves against the virus. However, given the level of voluntary social distancing is unknown, we do not provide quantified estimates of the D1 and D2 impacts under the counterfactual, instead we provide a discussion of the potential impacts under the counterfactual.

#### D1 impacts under the counterfactual

We cannot distinguish the impact on the morbidity and mortality of the wider population of the pandemic under the counterfactual as we cannot distinguish between the impact of experiencing living in a pandemic (e.g. on mental health), the restrictions, and voluntary social distancing. Under the counterfactual of little or no intervention, we would still expect to see a reduction in mobility and, for example, a fall in road traffic accidents, air pollution and an increase in those working at home compared to pre-pandemic levels due to individual's perceived risk to their health. However, we may expect the magnitude of these changes to be lower than under the mitigated scenario. On the other hand, in a scenario with a breach in NHS capacity, higher rates of post-traumatic stress disorder (PTSD) may be seen amongst health and social care staff,[138] patients who contract COVID-19 (including those hospitalised and in intensive care),[139] and the relatives of those who die.[140] People in the high-risk category may also experience higher levels of worry, PTSD and anxiety due to increased fear of transmission.[141] As WHO and others have noted, "COVID-19 itself can lead to neurological and mental complications, such as delirium, agitation, and stroke".[142] The prevalence of the COVID-19 is an important stressor for mental health; UCL Social Study has tracked the development of stressors throughout the pandemic and has indicated that rates of participants reporting major stress due to COVID have varied between 13-29%.[143] Therefore, higher numbers of cases, hospitalisations and deaths may lead to a worsening of mental health and increased bereavement in the population.

#### D2 impacts under the counterfactual

Under D2, there would likely be significant immediate economic impacts under a counterfactual where this is no government intervention and a potential breach in NHS capacity, in addition to the significant health impacts. These economic costs are likely to be the consequence of large numbers of people infected and/or isolating resulting in higher worker absenteeism, and sharp falls in demand for certain types of goods and services to minimise the risk of getting infected.

Note that impacts to date cannot be separated into impacts due to intervention and impacts due to voluntary social distancing or behaviour change in response to the pandemic, and therefore cannot be used as a guide for what would happen under a counterfactual. This is because the degree to which policies constrain behaviour are related to the disease dynamics – that is, when cases are high, individuals are more likely to voluntarily social distance or self-regulate their behaviour, relative to when cases are low. However, if restrictions are not in place well before the transmission rate and number cases reach a critical level and NHS capacity is overwhelmed, then along with significant health costs there are likely to be significant economic costs, potentially greater than those associated with the restrictions. These economic costs are likely to be the consequence of large numbers of people infected and/or isolating resulting in higher worker absenteeism, and sharp falls in demand for certain types of goods and services to minimise the risk of getting infected. Given this dynamic interplay, it is very difficult to separate out the degree to which the economic downturn is due to voluntary social distancing and the degree to which it is impacted by the measures in place to contain COVID-19.

## Counterfactual modelling

### *Summary*

The Scientific Pandemic Influenza group on Modelling (SPI-M-O) was tasked by the Scientific Advisory Group for Emergencies (SAGE) to support the analysis in this paper by creating a counterfactual against which health impacts can be assessed. This counterfactual considers what the impact of little or no government intervention might look like. It has been deliberately and explicitly designed for this purpose alone. It is just one possible counterfactual that could be used for this purpose; others could be worse or could be better depending on unknown behavioural responses. While epidemiologically possible, this counterfactual does not represent a plausible scenario for the future as no intervention is not Government policy.

Through an iterative process, SPI-M-O co-chairs, secretariat, and one modelling group have developed a profile of infections that increases until hospital capacity is breached, at which point the general public moderate their behaviour to slow transmission. There is no further intervention or mitigation. This counterfactual has been deemed reasonable for its purpose, from an epidemiological standpoint.

### *Context to date*

Previous iterations of this paper[144,145] have used reasonable worst-case and/or completely unmitigated scenarios that were available at the time to act as counterfactuals to illustrate outcomes with little or no intervention.

SAGE asked SPI-M-O to provide the Department of Health and Social Care, the Government Actuary's Department, and the Office for National Statistics with an epidemiologically sensible counterfactual that could be used in these calculations of harms; this counterfactual's only reason for existing is to support this work considering the potential scale of harm as a result of intervention or not. It has been deliberately and explicitly designed for this purpose. It is just one possible counterfactual that could be used for this purpose; others could be worse or could be better.

### *What is the counterfactual?*

Over the course of this counterfactual, infections and hospitalisations increase until secondary healthcare becomes overwhelmed, including any additional capacity such as Nightingale hospitals and cancelling some elective procedures. At this point, it is assumed that people's behaviour changes, which causes R to reduce to 1. The number of susceptible individuals in the population continues to deplete and so viral transmission slows. Behaviour returns to the level of R = 1 a week later, and this cycle of decrease R below 1 and return to R = 1 for a further week later, leads to a longer wave of infections with a higher peak.

Creating a suitable counterfactual has been an iterative process and deliberately kept simple.

**Capacity:** The exact capacity limit in secondary care is unknown as this depends on a range of factors, including underlying demand from other procedures and flexibility within the health system. For the purposes of this counterfactual, capacity has been assumed to be approximately 25,000 hospital beds in England or the equivalent for the other UK nations or regions of England. It is possible that capacity limits may, in practice, be higher or lower than this, depending on other factors. The peak occupancy due to COVID-19 in the first wave of the epidemic (April to June 2020) in England was approximately 18,500 and 14,400 in the second wave (October 2020 to date)[146].

**Behavioural changes** are assumed to happen at a regional level, once that region hits a hospital occupancy that is equivalent to 25,000 for England, scaled by the regional population. It is very possible that people may not behave in this way over time to reduce transmission as hospitals become fully occupied, neither regionally nor at all. This is one assumption for a "trigger" that might happen. Other possible triggers for behaviour change could be, for example, a significant number of daily deaths that could therefore trigger behavioural changes sooner or later than assumed in this counterfactual.

**R:** Two different R values were considered – 1.4 (approximate doubling time of two weeks – as seen in England around mid-October 2020) and 1.7 (approximate doubling time of one week – as used in the Academy of Medical Sciences planning for winter scenario[147]).1.4 was chosen rather than 1.7 to reflect the fact that moderate viral transmission could slowly fill hospital occupancy, and still lead to a very large peak, without intervention. R could be higher or lower than either of these two possibilities too.

**Repeated oscillation around R = 1 for three times:** R = 1 is set at three timepoints reflecting changes in behaviour as viral transmission slows. By setting this to happen three times instead of once, a broader peak of infections occurs and reflects mixed behavioural patterns over the course of the counterfactual.

*Table 34. Comparison between counterfactual and observed data*

| | Counterfactual (28 December 2020 to 29 March 2021) | | | Observed data |
|---|---|---|---|---|
| | Total over 14 weeks | Average per week | Peak week's value | Week ending 6th November 2020 |
| Infections | 13,000,000 | 900,000 | 1,700,000 | 360,000[148] |
| Hospitalisations | 570,000 | 41,000 | 62,000 | 9,294[149] |
| ICU beds occupied | n/a | 35,000 | 52,000 | 975[ix][150] |
| Deaths | 170,000 | 12,000 | 18,000 | 1,771[x][151] |

[ix] Average mechanical ventilation beds occupied over w/c 2nd November.

[x] Number of deaths registered in w/e 6th November.

### *What the modelling shows*

One SPI-M-O group have provided the detailed data behind the counterfactual where R = 1.4, hospital bed occupancy threshold for England of 25,000 (and equivalents for other UK nations), and R=1 is set on three occasions, each a week apart.

From Table 34, it can be seen that leaving "intervention" until hospital occupancy is breached results in a substantial overshoot in capacity that would overwhelm secondary care many times over. Infections that have already occurred prior to this response being triggered leads to increases in numbers of hospitalisations, adding further pressure to hospital capacity, and numbers of deaths. Once hospital capacity is breached, the total numbers of deaths as a result of a scenario such as this counterfactual would exceed those directly due to COVID-19, shown here. This is discussed earlier in this annex.

## Comparison with March unmitigated scenario

In March an unmitigated scenario was created, based on the understanding of the virus at the time. The April version of this paper estimates Category A and B deaths in the unmitigated scenario.[152] The results are below:

- Category A: Between 420,000 and 470,000 excess deaths
- Category B: Large numbers of deaths, potentially greater than 1 million.

Most of the difference is due to the assumptions around mitigations – the counterfactual presented in this paper (December 2020) assumes significant mitigation (albeit with minimal government intervention), whereas the March unmitigated scenario assumes no action is taken at all to reduce transmission. There will also be differences in the parameterisation of the virus's characteristics, adjustments for improved treatment for COVID-19, and adjustment for natural immunity in the population due to prior exposure to infection. These assumptions will make a small impact compared to the different assumptions around mitigation.

### *Impact of the new Variant*

As previously noted, the novel SARS-CoV-2 variant 'VUI - 202012/01', emerged in September 2020 and circulated at low levels in the population until mid-November.[153] In December 2020, evidence of increased transmissibility was provided to NERVTAG; it has been suggested that the new variant has a growth rate 71% higher than other variants[154] and could increase the R number by 0.4 to 0.7 compared to the previous strain.[155]

As outlined earlier in this paper, the main scenarios used in this paper to estimate potential health impacts do not explicitly account for the new variant. As a result, harms could be worse than those estimated, both direct (if increased transmissibility leads to higher numbers of infections, hospitalisations and deaths from COVID-19) and indirect (if increased transmissibility leads to more significant disruption to health and social care and increased levels restrictions).

The counterfactual presented in this paper (see Counterfactual modelling) also does not explicitly account for the new variant. As with the main analysis, if transmissibility is higher, this could mean that direct and indirect harms would also be worse under the counterfactual.

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