Preparing for a challenging winter 2020/21

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The Academy of Medical Sciences

Preparing for a challenging winter 2020/21

Executive summary

July and August must be a period of intense preparation for our reasonable worst-case scenario for health in the winter that we set out in this report, including a resurgence of COVID-19, which might be greater than that seen in the spring. The assumptions that we have made should be tested as new evidence emerges (including analysis of the evidence from the first wave) to enable prevention and mitigation strategies to be adapted and refined. Mitigation strategies should not pose further disadvantage to the most vulnerable in society or the highest risk patients or communities. To maximise their effectiveness (and to ensure they do not exacerbate inequalities), preparations for winter must be informed by engagement with patients, carers, public and healthcare professionals (as we have benefitted from in this report); and, whenever possible, be developed through co-production. Implementation of prevention and mitigation strategies requires enhanced coordination, collaboration and data sharing between central and local initiatives.

Challenges

The need for health and social care undergoes large seasonal fluctuations, peaking in the winter. The NHS and social care systems typically operate at maximal capacity in the winter months, with bed occupancy regularly exceeding 95% in recent years.[1] As recently as in 2017/18, England and Wales experienced approximately 50,000 excess winter deaths.[2,3,4] In the same year, there were approximately 4,800 and 1,500 excess winter deaths in Scotland and Northern Ireland, respectively.[5,6] Four additional challenges have great potential to exacerbate winter 2020/21 pressures on the health and social care system, by increasing demand on usual care as well as limiting surge capacity:

1. A large resurgence of COVID-19 nationally, with local or regional epidemics. Modelling of our reasonable worst-case scenario – in which the effective reproduction rate of SARS-CoV-2 (R_t) rises to 1.7 from September 2020 onwards – suggests a peak in hospital admissions and deaths in January/February 2021 of a similar magnitude to that of the first wave in spring 2020, coinciding with a period of peak demand on the NHS. We are already seeing local outbreaks. The modelling estimates 119,900 (95% CrI 24,500 - 251,000) hospital deaths between September 2020 and June 2021, over double the number that occurred during the first wave in spring 2020.

2. Disruption of the health and social care systems due to reconfigurations to respond to and reduce transmission of COVID-19 with a knock-on effect on the ability of the NHS to deal with non-COVID-19 care. The remobilisation of resources for COVID-19 (staff and facilities) that occurred during the first wave of COVID-19 is unlikely to be possible this winter, due to other winter pressures, urgent delayed care, and a likely increase in staff sickness absence, among others.

3. A backlog of non-COVID-19 care following the suspension of routine clinical care that is likely to result in an increased number of poorly-managed chronic conditions or undiagnosed diseases and be combined with a surge in post-COVID-19 morbidity (which needs to be quantified). Estimates suggest that the overall waiting list in England could

increase from 4.2 million (pre-COVID-19) to approximately 10 million by the end of the year.[7] Reducing the backlog of care will be hampered by reduced operational capacity across NHS organisations designed to prevent nosocomial transmission of COVID-19.

4. A possible influenza epidemic that will be additive to the challenges above. The size and severity of the influenza epidemic in winter 2020/21 will be particularly difficult to estimate, but the most recent significant influenza season in winter 2017/18 coincided with a colder winter; led to over 17,000 excess respiratory deaths;[8,9,10,11] and caused NHS Trusts to cancel all elective surgery in January 2018, resulting in 22,800 fewer elective hospital admissions when compared to the previous year.[12] A generalised increase in respiratory infections over the winter could also rapidly overwhelm test and trace capacity.

Priorities for prevention and mitigation

There is a need for urgent preparation to mitigate the risks of a particularly challenging winter 2020/21, including:

Minimising community SARS-CoV-2 transmission and impact

- Developing effective policies to maximise population engagement in essential control measures. These include: physical distancing; wearing face coverings in settings where physical distancing is not possible; regular hand and respiratory hygiene; high levels of hygiene in the home; heating and ventilation of homes; self-isolation and participation in the test, trace and isolate (TTI) programme when symptomatic, or following contact with a COVID-19 case. Identifying and addressing structural and socio-economic barriers to adherence will require engagement with target communities, and national and local consideration of a wide range of incentivising levers (including financial).
- Launching an extensive public information campaign in the autumn, co-produced and optimised by members of target communities working together with professional organisations to minimise transmission and improve levels of population resilience/health. A local and multi-ethnic focus will be key.
- Tailoring guidance for commercial, public and domestic properties on optimising indoor environments (temperature, humidity and ventilation) to reduce virus transmission indoors. Specific consideration of those most vulnerable to COVID-19 who are also likely to have the poorest quality housing, highest levels of overcrowding and be least able to heat their homes adequately in winter.
- Significantly expanding the capacity of the TTI programme to cope with increasing demands over the winter and ensure that it can respond quickly and accurately. Testing should harness partnerships between the NHS, academia and industry. Multiplex influenza and SARS-CoV-2 testing would distinguish the cause of influenza-like illnesses – essential to informing recommendations on quarantine (and clinical management). Working with communities and groups, and developing options (including financial), to overcome barriers to engagement, particularly by vulnerable groups.

Organising health and social care settings to maximise infection control and ensure that COVID-19 and routine care can take place in parallel. In particular:

- Prioritising system-wide infection prevention and control measures across the health and care systems to minimise nosocomial infection. Ensuring timely reporting, investigation and root-cause analysis of hospital acquired infection in both patients and staff.
- Adequate provision, training in, and use of personal protective equipment (PPE) and other infection prevention and control measures across health and social care.
- Minimising agency/multi-site staffing and staff movements between sites/hospitals.
- Using point-of-care multiplex testing to inform cohort selection and clinical management.
- Maximising the use of remote consultations for hospital and community care.
- Cohorting staff to limit physical overlap and movement between zones.
- Stratifying entire healthcare settings (or zones within settings) into 'hot' and 'cold' areas. Considering the optimum use of Nightingale hospitals (subject to workforce capacity) and private healthcare settings, including for 'step-down' COVID-19 care or isolation.
- Testing and quarantining of patients being discharged into the community or into institutional care.
- Prioritising the backlog of clinical care strictly by clinical need, not waiting times. Primary care should target acute care, prevention and screening of those whose physical and mental health is most at risk.
- Establishing services to support rehabilitation of a growing number of patients with post-COVID-19 conditions. A better understanding of these conditions is urgently required.

Improving public health surveillance for COVID-19, influenza and other winter diseases

- Maintaining a comprehensive, population-wide, near-real-time, granular health surveillance system to ensure rapid identification, investigation and management of local COVID-19 outbreaks across community, work, and health and social care settings. This should integrate the data available through Public Health England (PHE), the NHS, the Office for National Statistics (ONS) (and their equivalents in the devolved administrations), and other sources, including from research, and enable public health bodies to work closely with local Directors of public health departments and health protection teams.
- Conducting large-scale population surveys to inform estimates of infection prevalence and incidence, as well as effective control measures. Targeted surveys of populations where COVID-19 incidence is high or unknown should be prioritised to monitor for early evidence of a resurgence in cases.
- Ensuring that comparable data are collected for surveillance in hospitals and the community, TTI and outbreak investigations using standardised tools and definitions, to maximise their applications and usefulness. Information must be shared quickly and intelligence exchange between local and national systems should be optimised, and made available to the research community.
- Maintaining an adequately resourced central overarching body (such as the recently announced Joint Biosecurity Centre) to oversee and coordinate data

collection, processing and distribution, as well as to engage effectively with local public health bodies that should also be appropriately resourced.

Minimise influenza transmission and impact

- Maximise the uptake of influenza vaccination by health and social care workers and other priority groups identified by guidelines. This will require creative approaches to delivering the programme while minimising the risk of transmission and ensuring an adequate supply of vaccines.
- Effective implementation of guidelines for the use of antivirals to mitigate the impact of influenza, particularly in high risk groups. This might be informed by point-of-care-testing (POCT).

1. Overview of this report

At the request of the Government Office for Science, the Academy of Medical Sciences established in June 2020 an Expert Advisory Group chaired by Professor Stephen Holgate CBE FMedSci to inform:

- A clear understanding of what a challenging winter 2020/21 may look like – a likely mix of COVID-19, bad seasonal influenza and cold weather.
- An understanding of what this would mean for deaths, NHS capacity and social care.
- An understanding of what challenges this would present for surveillance; test, trace and isolate (TTI); and non-pharmaceutical interventions.
- Plans being developed by policy/operational colleagues to manage this.

The Expert Advisory Group completed this rapid review to define the extent of the challenges that might be faced this winter in terms of health, and health and social care delivery, as well as potential options to mitigate these. The deliberations of the Expert Advisory Group were informed by a Patient and Carer Reference Group, which provided guidance on priorities and concerns for winter 2020/21. A follow-on perspective piece from the Patient and Carer Reference Group, which focuses on the need for shared decision-making ahead of this winter, is provided in Annex 1. The development of this report was also supported by early to mid-career researchers. The composition of the Expert Advisory Group, Patient and Carer Reference Group, and early to mid-career researchers is provided in Annex 2.

A series of public discussion workshops were also undertaken as part of this project. Ipsos MORI conducted three online workshops with members of the public, with individuals who had received shielding letters or were caring for someone who had received one, and with individuals from Black, Asian and Minority Ethnic (BAME) groups to explore patient and public views on preparing for the challenges this winter. A summary of initial findings is provided in Annex 3. The full report will be provided separately.

This report considers our reasonable worst-case scenario for winter 2020/21 and identifies actions that should help to mitigate the impact of COVID-19 on the expected seasonal surge in healthcare demand. We believe the actions set out in this report will enable the health and social care system to better cope in the face of new winter pressures resulting from the COVID-19 pandemic, and thereby help to protect the health of the nation and save as many lives as possible.

While we know that winter climatic conditions and more time spent indoors will favour the spread of SARS-CoV-2 (see section 3.1.3), there is still a lot of uncertainty and our understanding of other elements described in this report (e.g. the severity of the influenza season) is likely to evolve as additional evidence emerges over the coming months. There will be a critical window from now until early autumn to use such information to prepare, adapt and refine planning to mitigate the most likely risks. Knowledge exchange between the four nations will be vital; for example, we are aware of the Scottish Government's COVID-19 Advisory Sub-Group on Public Health Threat Assessment that is considering NHS Scotland winter planning.

This report is a rapid review and provides a summary of the current research available at the time of writing (including those in pre-print which are clearly noted in the references) rather than an exhaustive literature review. It draws on the most recent evidence and has not been subject to formal peer-review. We were unable to obtain as much input on social care and medicines supply as we wanted, and this should be a focus for those addressing the priorities set out in the report. The report is the considered input of the Expert Advisory Group and does not necessarily represent the position of the Academy of Medical Sciences or the individual members of the group. This independent overview of the science has been provided in good faith by members of the Expert Advisory Group and the Academy of Medical Sciences, who accept no legal liability for decisions made based on this evidence.

2. Health and wellbeing in winter

The need for health and social care undergoes large seasonal fluctuations, peaking in the winter. The winter burden on the healthcare system is not only affected by increased incidence of infectious diseases, but also non-infectious conditions that increase in prevalence or are exacerbated during the winter months, such as asthma, chronic obstructive pulmonary disease (COPD), ischaemic heart disease, myocardial infarction and stroke. Every winter results in considerable extra mortality and burden on NHS resources.[13] As recently as in 2017/18, England and Wales experienced approximately 50,000 excess winter deaths (Figure 1).[14,15] In the same year, there were approximately 4,800 and 1,500 excess winter deaths in Scotland and Northern Ireland, respectively.[16,17]

Adverse winter weather also negatively impacts on both physical and mental health, and access to healthcare. Table 1 illustrates the relative health impact of different aspects of winter weather. Cold winter temperatures contribute to increases in cardiorespiratory disease and increase the survival time of respiratory viruses.[18,19,20] There is cumulative evidence that mortality, especially among the elderly, and demand for healthcare services in the UK are linked to cold temperatures: for every 1ºC temperature drop below 5ºC, respiratory infections increase by 10-20%, with high local variation, and emergency hospital admissions increase by approximately 1%.[21,22,23,24] However, the negative health effects of cold temperature start at 4ºC-8ºC and, due to the number of such days, it is this temperature band within which the greatest health burden occurs.[25,26]

In our reasonable worst-case scenario, four additional challenges would exacerbate pressures on the health and social care system in winter 2020/21, by increasing demand on usual care as well as limiting surge capacity:

1. **A large resurgence of COVID-19** nationally, with local or regional epidemics.
2. **Disruption of the health and social care systems** due to reconfigurations to respond and reduce transmission of COVID-19. This has had knock-on effects on the ability of the NHS to deal with non-COVID-19 work.
3. **A backlog of non-COVID-19 care** that has accumulated as routine clinical care has been suspended during the first outbreak.
4. **A possible influenza epidemic** that will be additive to the challenges above.

These factors need to be considered in the context of winter when:

- Pressures on NHS services are high (see Figures 2 and 3) and the NHS and social care systems are typically operating at maximal capacity. In recent years, bed occupancy over winter has regularly exceeded 95%,[27] despite rates of over 90% being associated with increased morbidity and mortality.[28]
- Availability of NHS staff and facilities (including support facilities such as laboratories) may be reduced due to winter health impacts and winter weather disruption (e.g. snow and flooding).

Combined, these factors mean that mitigations for a resurgence of COVID-19 this winter will need to be substantially different to that used for the first wave of infection in spring 2020.

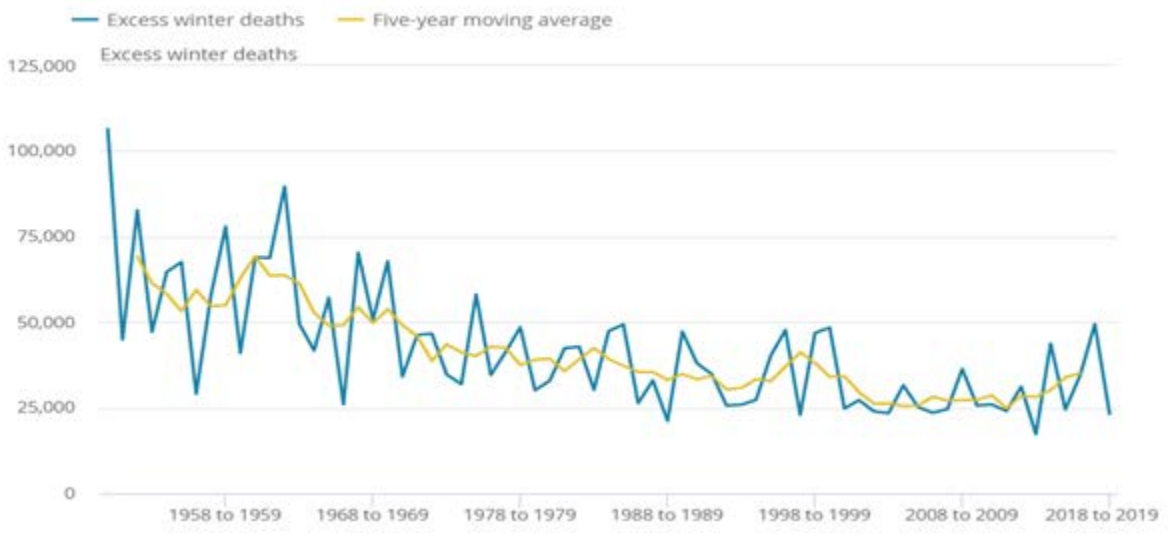
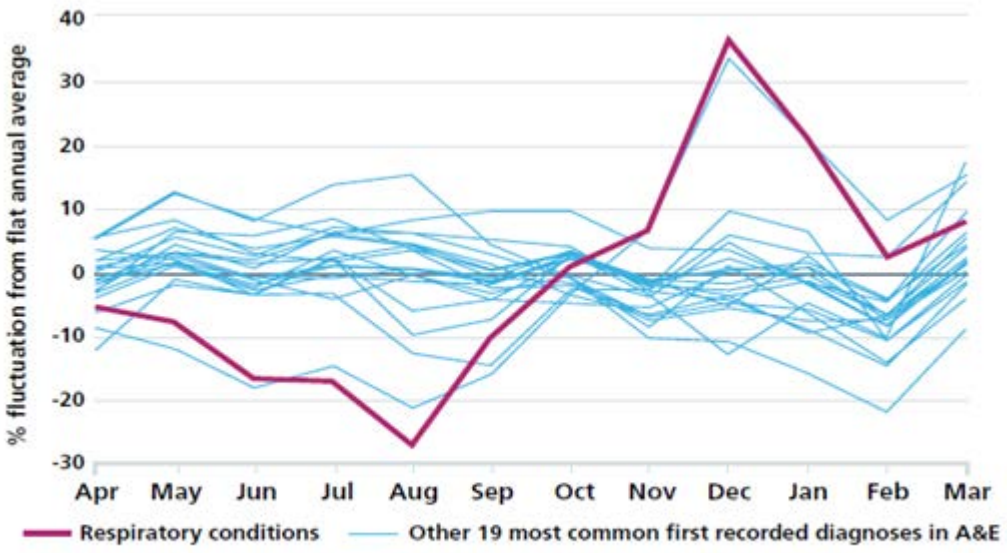


Figure 1. *Excess winter deaths and five-year central moving average (based on death occurrences), England and Wales, between 1950 to 1951 and 2018 to 2019 (taken from 'Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)', Office for National Statistics).*[29]



Source: British Lung Foundation. Lung disease, the hidden driver of NHS winter pressure. December 2017.

Figure 2. *How respiratory conditions add to NHS 'winter pressures' - average fluctuations in monthly admissions, 2010 to 2017 (taken from 'The NHS Long Term Plan', NHS).*[30]

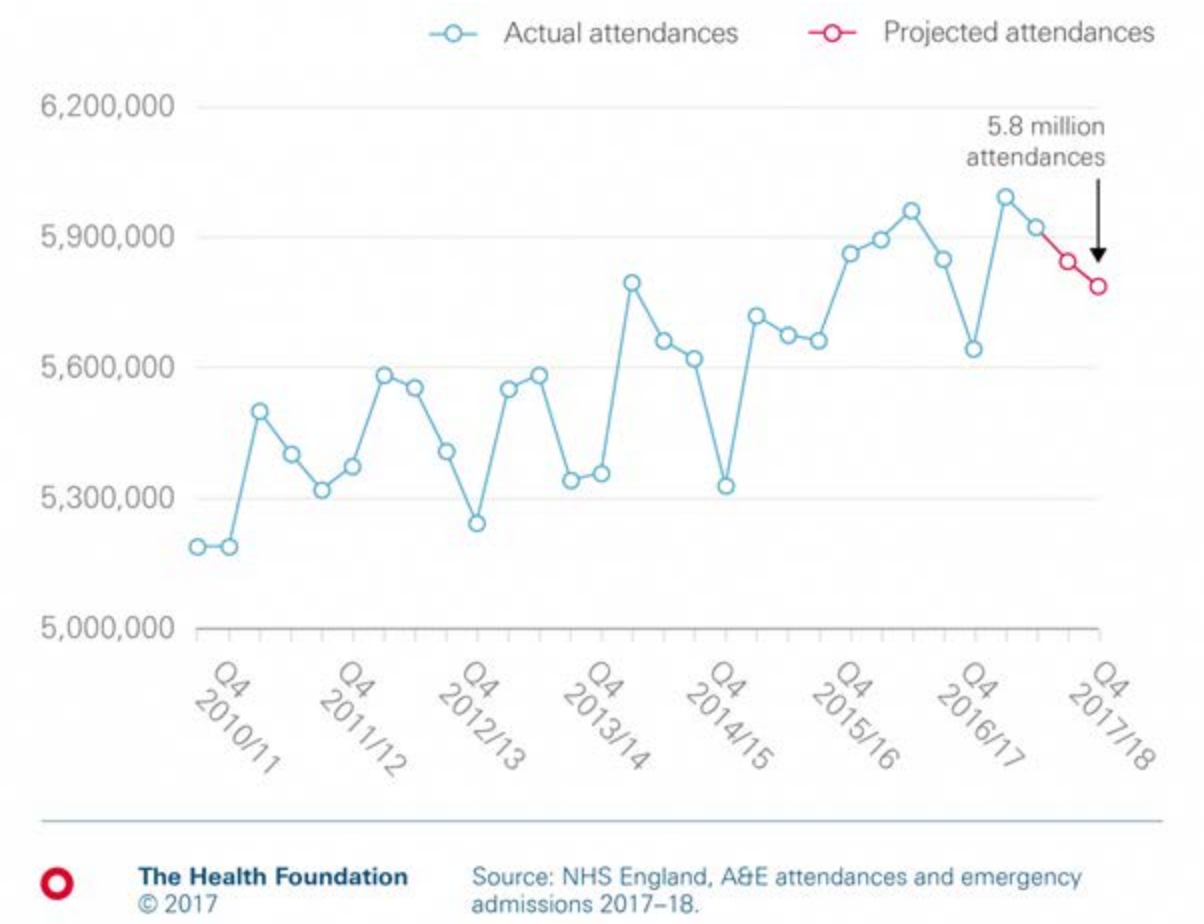


Figure 3. *Number of attendances at accident and emergency (A&E) departments in England Q3 2010/11-Q4 2017/18 (taken from 'Winter is coming: How much would it cost to keep the pressure down?', The Health Foundation).*[31]

	Respiratory	Cardiac	Trauma	Mental Health	NHS logistics
Low temperature	+++	+++	-	+	
Humidity	++	-	-	-	
Air pollution	++	+	-	-	
Snow/ice	-	++	+++	+	+++
Rainfall/Floods	+	-	++	+++	+++

Table 1. *The impact of adverse winter weather on human diseases and access to healthcare and NHS logistics. + low impact; ++ moderate impact; +++ high impact.*[32,33,34,35,36]

3. Challenges for winter 2020/21

In this section, we explore the potential impact of a resurgence of COVID-19, the disruption to health and social care delivery, a significant backlog of COVID-19 and non-COVID-19 care, and a possible influenza epidemic on the ability of the health and social care systems to cope this winter.

3.1 The unknown magnitude of the potential winter resurgence of COVID-19

3.1.1 Our reasonable worst-case COVID-19 winter resurgence

A clear pattern of disease severity is now emerging. With reliable serological tests, better estimates of the infection fatality ratio (IFR) can be made. The overall IFR is 0.5-1.0% depending on the age distribution of the population (and at the time of writing was estimated to be 1.1%, 95% credible interval (CrI) 0.9-1.4% in England), with a strong increase with age (see Table 2).[37,38,39] In a large cohort of over 20,000 UK patients admitted to hospital with COVID-19 and follow-up time of at least two weeks, 17% were admitted to critical care.[40]

Age	Median	95% CrI (lower)	95% CrI (upper)
<1year,1-4	0.00045%	7.8e-05%	0.002%
5-14	0.0013%	0.00071%	0.0023%
15-24	0.0043%	0.0029%	0.0062%
25-44	0.029%	0.025%	0.034%
45-64	0.44%	0.4%	0.49%
65-74	2.9%	2.6%	3.2%
75+	17%	14%	22%

Table 2. *Infection fatality ratio by age group.[41] (Accessed: 30/06/2020)*

The introduction of wide-scale physical distancing in the UK from 23 March 2020 onwards is estimated to have reduced the reproduction number from R_0~3 to R_t ~0.7-0.9 (R_0, basic reproduction number; R_t, effective reproduction rate). It has been estimated that these measures resulted in an 80% reduction in transmission and that 470,000 (95% CrI 370,000-580,000) deaths had been averted in the UK up to 4 May 2020 due to such interventions.[42] As these restrictions are eased, it is likely that R_t will rise such that R_t remains close to 1.[43]

Serology studies suggest that ~5-10% of the UK population has been infected to date, with levels up to 15% in some areas, but infection levels of approximately 70% may be required to achieve herd immunity, bearing in mind that the degree to which immunity is conferred by past infection is still unknown (see section 3.1.2).[44,45,46] The potential for future resurgence remains high as COVID-19 containment measures are relaxed, unless

additional targeted measures are put in place. This high level of susceptibility raises the potential for resurgence even in warmer summer months.[47]

There is a high degree of uncertainty in how the COVID-19 epidemic in the UK will evolve in the coming months. We consider a scenario in which it is not possible to respond to a rising incidence of COVID-19 with a lockdown of similar effectiveness to that imposed in March. Under our reasonable worst-case scenario – in which R_t rises to 1.7 from September onwards (just over half of the initial level of transmission experienced in early March 2020) – **infections could be expected to rise gradually with a peak in hospital admissions and deaths of a similar magnitude to the first wave** (Figure 4). This is projected to occur in January/February, coinciding with a period of peak demand on the NHS. The broader shape of the epidemic curve reflects the lower R_t assumed, but would result in an estimated total number of hospital deaths (excluding care homes) between September 2020 and June 2021 of 119,900 (95% CrI 24,500 - 251,000), over double the number occurring during the first wave in spring 2020. It should be noted that these projections do not take account of recent results from the dexamethasone trial, which could substantially reduce mortality.[48]

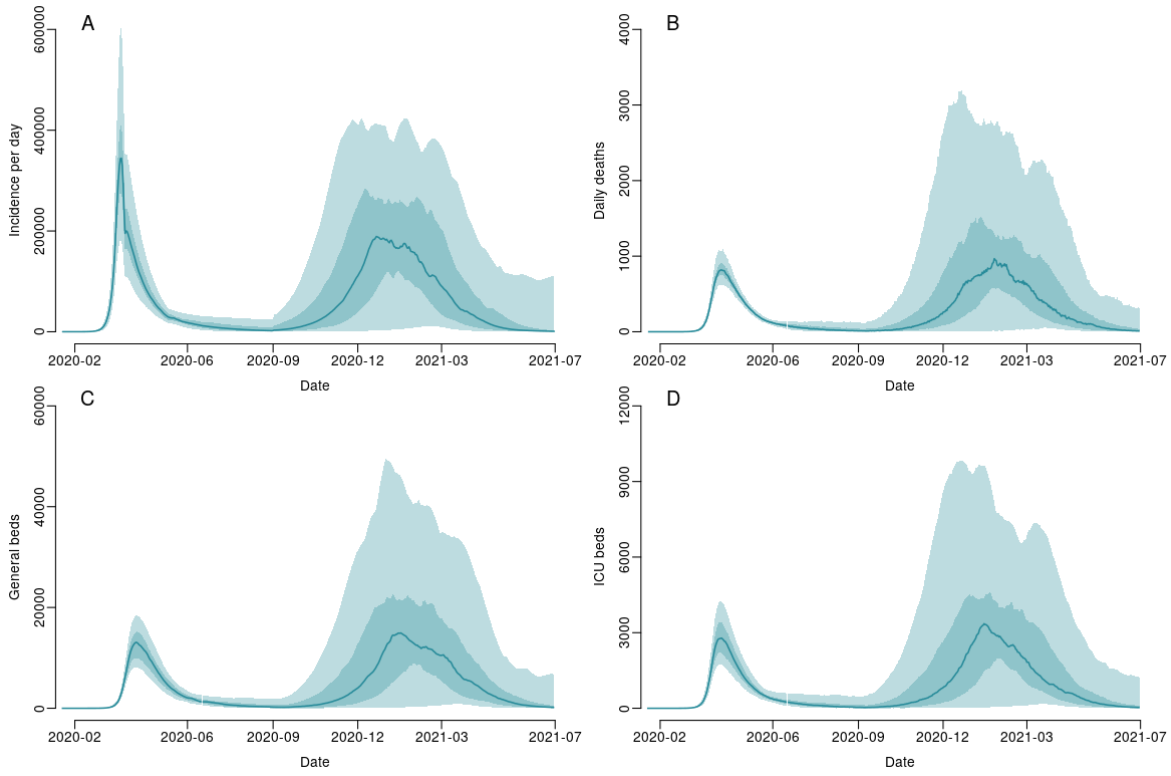


Figure 4. *Our reasonable worst-case scenario for the winter COVID-19 epidemic in the UK. The model assumes that R_t rises to 1.7 from September 2020 through to July 2021. (A) daily infections, (B) COVID-19-attributable deaths in hospital (i.e. excluding care homes and excess deaths in the community), (C) general beds occupied and (D) critical care beds occupied. The solid line shows the median, dark band the interquartile range, and pale band the 95% credible interval (CrI). Less severe epidemic scenarios where R_t = 1.1 or 1.5 from September 2020 through to July 2021 are provided in Annex 4.*

It is therefore important to closely monitor trends to ensure that R_t does not exceed this level. **Even scenarios with R_t in the range 1.1-1.5 are likely to stretch NHS**

capacity (see Annex 4) given the demand from other health conditions coupled with the delay to routine procedures that has occurred over the past few months (see section 3.2).

Our reasonable worst-case scenario applies to the initial period of the winter season: we would not expect R_t or incidence to remain constant over long periods of time. We expect incidence and R_t to remain relatively low over the summer months, but then to increase because of increased mixing and environmental conditions (see section 3.1.3). However, if R_t were to rise sharply and so generate higher levels of incidence, we would expect government intervention in the form of additional non-pharmaceutical interventions, such as physical distancing measures. These would likely be decided on more quickly than was possible during February and March 2020 because of improved surveillance.

Although these models provide a high-level national outlook, **large local or regional resurgences are possible**, which could stretch health and social care systems locally rather than nationally. Plans to mitigate local/regional outbreaks should be developed, including how local outbreaks might impact on neighbouring healthcare systems, which might not themselves be faced with a resurgence in COVID-19 cases.

In addition, despite systems in place for infection prevention and control in the care sector, including processes for containment and testing, **outbreaks of COVID-19 in hospitals and care homes are likely to become common again** and may be exacerbated by simultaneous transmission of influenza in these settings, as well as transmission between settings (see sections 3.2.3 and 4.2.1). Outbreaks are also likely in environments with groups at high risk, such as hostels for the homeless (especially dormitory-style night shelters); asylum seekers in Home Office accommodation; prisons; Roma, Gypsy and Traveller encampments; and migrant workers in shared accommodation. Mortality rates are likely to continue to be highest in older adults, those with chronic diseases, those from BAME groups, those in high exposure occupations, and urban areas with high levels of poverty.[49] The workplace represents a further risk environment with major outbreaks reported in food manufacturing settings, as were religious gatherings and social events prior to closure of mass gatherings.[50,51,52]

3.1.2 What is not known about seasonal variation in COVID-19 transmission

The following factors are likely to affect the impact of winter resurgence of COVID-19 but, at the time of publication, their relative impact is unknown:

- **The degree to which immunity is conferred by past infection.** It is not known whether those infected in the winter and spring of 2020 will be protected against reinfection, and how long such protection might last. Future research including longitudinal serological studies involving subjects with a confirmed diagnosis of COVID-19 will provide important new information on this subject. Preliminary data suggest that T cell immunity may also be important, generating memory responses combating the virus upon re-infection.[53,54,55]
- **The impact of protective or harmful interactions between SARS-CoV-2 and other infections** (e.g. common cold coronaviruses, rhinovirus, respiratory syncytial virus (RSV), influenza and bacterial pathogens). There is evidence of positive and negative interactions among them, and the mechanisms and consequences of underpinning such interactions are not known.[56] Co-infections

between seasonal coronaviruses and other respiratory viruses are common.[57] The presence of interactions between SARS-CoV-2 and other respiratory viruses has not been tested but is urgently required. Rapid implementation of multiplex polymerase chain reaction (PCR) to diagnose multiple respiratory viruses will provide important information about the role of other respiratory viruses on the burden of respiratory infections, and the level of SARS-CoV-2 co-infections and how they might affect disease outcome.

- **The mutation potential of SARS-CoV-2** and whether this would alter its infectivity and virulence. Coronaviruses do, however, typically exhibit lower mutation rates compared to other viruses.[58]
- **Whether COVID-19 is enhanced by prior immunity.** While this is theoretically possible, previous studies on seasonal coronaviruses suggest that most reinfections result in mild virus replication.[59]
- **The likely impact of lockdown on the levels of exposure to other pathogens, vitamin D metabolism,[60] and the activity of adrenocortical hormones**, which affect immunity. These factors are likely to play an important role on the immunological resistance to infections and their influence needs to be considered in the approach to winter, including how best to modify these factors if possible.[61,62,63]
- **The most effective ways to interrupt transmission** in communities, hospitals, care homes, workplaces, commercial outlets, hospitality settings, transport, schools and universities, that also allow increased social and economic activity.
- **Transmission in high risk groups, including BAME groups.** It is not yet known the extent to which excess BAME mortality is due to increased risk of infection, or increased risk of death if infected, or both. During the period of the pandemic, all-cause mortality has been highest among Black ethnic groups (4 to 7.3 times higher than expected)[64,65] followed by Asian and South Asian groups (2.5 to 3 times higher).[66,67] COVID-19 related deaths have been higher for people in Black ethnic groups (1.71 to 4.2 times higher)[68,69,70,71] and Asian/South Asian groups (1.32 to 3.29 times higher)[72,73,74,75] compared to White ethnic groups. Accounting for sex, age, ethnicity, deprivation and region, people of Bangladeshi ethnicity have twice the risk of a confirmed COVID-19 related death compared to White British[76] and Chinese/Indian/Pakistani/Other-Asian/Caribbean/Other-Black ethnicity have between 10-50% higher risk of death.[77] The reasons for this are not fully understood, but appear to include co-existing diabetes.
- **The level of adherence to COVID-19 protection measures** in various settings and communities.

Although schools re-opening is known to increase the transmission of influenza,[78] this has not yet been demonstrated for SARS-CoV-2, and there is substantial uncertainty around the likely impact of schools re-opening on R_t and the implications for this winter. Current data are from the period of widespread school closure, and there is a need for intensive surveillance as schools reopen to understand and track transmission. Currently, some evidence indicates that children play a lesser role in SARS-CoV-2 transmission on a population level than adults,[79] with modelling suggesting a potentially lower susceptibility to infection.[80] TTI systems will be important in controlling transmissions as population contact and mixing patterns change with children's return to school.[81,82] Empirical data from different countries will be available on this by the autumn. The risks

of increasing transmission via schools reopening needs to be balanced against the longer-term impacts of school closure on child and adolescent development, as well as the economic and social impact of school closure on parents.[83,84,85,86,87,88,89] A relatively small increase in R_t due to schools re-opening could potentially be mitigated by other non-pharmaceutical interventions as described below, provided that adherence to COVID-19-security measures are good.[90] It should be noted that the re-opening of schools and universities will result in the generation of wider community networks, which will likely change the patterns of community spread even if the impact on transmission is small.

In anticipating winter scenarios in the UK, it is important to carefully monitor the trends in countries in the southern hemisphere as they enter the winter season in coming months. However, any comparisons should be made carefully as there are important factors, such as differences in containment of the first outbreak and climatic conditions, that limit the extrapolation of scenarios to the UK:

- Australia and New Zealand both reacted quickly to the threat from COVID-19 and in doing so have managed to keep virus transmission at very low levels. Assuming that they maintain control, their winter season will be very different from that which is likely in the UK.
- South America is currently experiencing a rapid increase in cases. Most countries in this region also reacted very promptly to the threat from COVID-19, initiating either national or localised lockdowns. However, as these have been relaxed there has been a rapid increase in cases.
- Chile is perhaps the most relevant comparator, in terms of economic conditions and ongoing transmissions at the onset of winter; cumulative confirmed cases have more than doubled in the month of June.[91]
- South Africa has also experienced a similar increase in cases, although climatic and economic conditions differ significantly from the UK.

3.1.3 Factors that are likely to enhance COVID-19 transmission in winter

The role of climatic conditions, atmospheric pollutants and indoor environments in potentially enhancing COVID-19 transmission this winter is explored in further detail below. Other factors that may increase transmission of respiratory viruses in winter months include immunological changes (with the possible protective role of vitamin D supplementation)[92] and differences in contact mixing patterns.

3.1.3.1 Climatic conditions

In the winter months, lower temperatures and humidity may facilitate SARS-CoV-2 transmission,[93,94] as is the case for other endemic respiratory viruses.[95] Increased spread may occur as a result of the direct weather effect on virus survival (e.g. temperature and humidity - see section 3.1.3.3); the effect of climatic conditions on host resistance to infection (human immune system function, seasonal variations in vitamin D); and the influence of weather on behavioural changes. However, these may be relatively less important to the potential spread of SARS-CoV-2 than the role of population immunity and effective control measures.[96]

3.1.3.2 Atmospheric pollutants

Exposure to air pollution is associated with increased morbidity and mortality. Some of the same conditions have also been identified as increasing the risk of severe SARS-CoV-

2 symptoms. As such, it would not be surprising if there was a link between exposure to past or present air pollution and the occurrence or severity of SARS-CoV-2 infection.

For example, in China, an association between NO_2 and O_3 particulate pollution and newly confirmed cases of SARS-CoV-2 infection has been reported.[97] In a study in Italy, correlation between longer term air pollution trends and SARS-CoV-2 cases suggests the importance of respiratory and cardiac comorbidities linked with air pollution for severity of COVID-19 disease and SARS-CoV-2 spread.[98] Correlations have also been made between PM2.5 concentration and severity of COVID-19 disease.[99,100] Although restrictions in movement during lockdown have resulted in substantial declines in some atmospheric pollutants in cities around the world,[101] these are expected to rise again as restrictions are eased and may exceed pre-lockdown levels in some cities as cars replace public transport. Greater exposure to air pollution is also linked with colder weather and more time spent indoors, and contributes to asthma exacerbations.

3.1.3.3 Indoor environments

Transmission of SARS-CoV-2 and all viruses is dominated by indoor pathways. People spend significantly more time indoors during the winter and indoor environments impact on health in four main ways:

1. **Direct person-to-person transmission of viruses:** Due to less daylight and adverse weather, more people stay indoors for longer periods during winter. In addition, people are more likely to drive or use public transport than walk or cycle, and people are more likely to favour social activities that are inside, increasing the chance of close interactions with more people. Transmission risk of respiratory infections increases exponentially the closer two people are, and increases with the duration of exposure.[102] Coughing, sneezing and activities such as singing, increase the rate of droplet and aerosol generation.[103,104] Concurrent winter viral infections (influenza, common cold, norovirus, etc.) can increase the risk of sneezing and coughing to provide more vectors for COVID-19 transmission.
2. **Aerosol transmission:** Poor ventilation and overcrowding increases the density of virus particles accumulating in a room, both in the air and on surfaces leading to greater risk of transmission. Concentration of viral particles in the air is inversely proportional to the ventilation rate in a room.[105] A large proportion of UK buildings are naturally ventilated and rely on occupants opening windows and vents for ventilation.[106] This includes domestic environments, schools, workplaces and healthcare environments, including care homes and hospital wards (including respiratory departments). In cold, wet or windy weather people are reluctant to open windows as they create cold draughts and hence they often have lower ventilation rates in winter.[107] This can be a particular challenge in modern airtight buildings which have very low infiltration rates for energy efficiency,[108] and for people on low incomes who are trying to keep heating costs down. Low humidity winter conditions also allow for greater evaporation of respiratory droplets,[109] resulting in the potential for smaller aerosols to remain suspended for longer.
3. **Surface contact transmission:** Evidence suggests viruses can persist on surfaces at a level that may pose a risk for up to 48 hours, while in most environments it is unlikely to persist in air at a level that poses a risk for more than 30 minutes after an infected person leaves.[110,111] Lower humidity, cooler temperatures and darker conditions during winter months are likely to favour this

persistence and increase the risk of transmission via contaminated surfaces and objects.[112,113]

4. **Changes in susceptibility:** Poorer quality housing tends to have lower temperatures due to poor insulation, inadequate heating or inappropriate use of heating.[114] Low temperatures can reduce the body's immunity to all viruses as well as favour virus survival. There is also a greater risk of developing community acquired pneumonia and having cardiovascular events with low indoor temperatures below a minimum of 18ºC.[115,116] These households can also have a higher density of occupants. In more modern well-insulated homes central heating may reduce levels of relative humidity below 40%, which can dry out the nasal mucosa and reduce muco-ciliary clearance that increases susceptibility of COVID-19 and influenza infection.[117] There is evidence that some airtight homes have high concentrations of indoor air pollutants, which may also influence susceptibility to respiratory conditions.[118] Long-term home working, isolation of vulnerable people or a further period of lockdown in winter months may raise related issues across all housing.

Socio-economically disadvantaged communities are more likely to experience poor housing, transport and healthcare access.[119] This includes some BAME communities,[120] which are also more likely to live in houses with multiple occupancy and generations.[121,122] Evidence shows that COVID-19 mortality rates are twice as high in the most deprived areas,[123] and that socio-economically disadvantaged communities live in geographic regions of outbreak.[124]

3.2 Disruption of the health and social care systems

The requirements for intensive care beds and significant concerns around nosocomial transmission of COVID-19 have resulted in significant reorganisation of the health and social care systems. This in turn has impacted the ability of the NHS to deal with non-COVID-19 work. This winter, this reorganisation is also likely to impair the ability of the health and social care systems to deal with a higher than average non-COVID-19 excess winter mortality, significant health event(s) or events that will impact on staff and non-COVID-19 logistics, such as flooding. COVID-19 related logistics (e.g. delivery of tests and test results) may be impacted by seasonal weather, and especially by any severe weather events such as snow fall and flooding.

3.2.1 Addressing the need for intensive care beds and NHS capacity

The UK has historically lower levels of critical care beds when compared to its European counterparts.[125] The NHS rapidly scaled up critical care capacity in the first wave of infection in spring 2020, with many organisations using theatre recovery or other critical parts of their estate. **These will need to be available this winter to provide greater resilience for urgent activity and time critical surgery, in addition to the seasonal increase in critical care capacity requirements.** The Government also provided funding to access capacity in the independent sector, but we understand that funding has not yet been allocated for access this winter.

In addition to the rapid reorganisation of hospitals to accommodate the increase in numbers of patients that were admitted with COVID-19, staff were reassigned from

elective care wards to COVID-19 care, and extra healthcare workers were recruited from research and recent retirement. **Remobilisation of resources at such scale is unlikely to be possible this winter**, when wards will need to resume normal function to address seasonal healthcare demands and other delayed clinical care that has become urgent as a consequence. **Discharge of patients to domiciliary and care homes will also be slowed by a requirement to test individuals for COVID-19 and other viruses prior to transfer.** These factors will impact both on bed capacity and on healthcare staff resources.

It will be difficult to expand the healthcare workforce further than that already achieved, especially given the likely impact on staff sickness absence this winter (see section 3.2.2). Winter 2020/21 will also coincide with the end of the transition period for the UK's departure from the EU. This may pose additional challenges for recruitment to fill NHS and social care staff vacancies, which currently stand at 9% of posts (100,000 staff).[126,127] Indeed, both the health and social care sectors have become increasingly reliant on EU migrants.

3.2.2 Impact of COVID-19 on staff absence

The implications of COVID-19 for workforce planning and management are challenging. **It is largely unknown to what extent sickness absence and post-COVID-19 syndromes have affected, and will affect, the capacity of the health and social care workforce.** Though national sickness absence data from March 2020 onwards has yet to be published,[128] we have heard of significantly higher levels of absence in the first wave of COVID-19 infection due to staff experiencing COVID-19 symptoms, shielding or self-isolating, in addition to the usual sickness absence, with high levels of regional variation. Staff sickness linked to the use of agency staff is also a risk factor for transmission of COVID-19 between hospitals and other care settings. Data on agency staff use and COVID-19 infection in this group are also needed.

Mental health disorders are the leading cause of long-term staff absence. Previous pandemics and early signals from COVID-19 indicate significant increases in burnout and distress among front line staff, but it is unclear whether this distress becomes a more chronic disorder.[129,130] Positive actions to improve staff morale and boost resilience will be important as we enter the winter period (see section 4.1.2).

It is also not known to what extent school and nursery closures have impacted the workforce. As we go towards winter, further reactive school and nursery closures could have an additional major impact on the health and care workforce. **The need for healthcare staff to self-isolate when symptomatic may also lead to high levels of absence during the winter months, exacerbating winter pressures.**

The disproportionate effect of COVID-19 on some BAME groups is a particular concern. In England, 20.7% of the NHS workforce and 21% of the adult social care workforce (67% in London) are of BAME background.[131,132]

3.2.3 Infections acquired in hospitals and other care settings

Infections acquired in hospitals and other care settings have been a concerning feature of the COVID-19 epidemic, due in part to the lack of personal protective equipment (PPE) and testing in healthcare workers and patients. **It has been estimated that at**

least 10% (95% confidence interval: 4-15%) of all COVID-19 infections in England between 26 April and 7 June were among patient-facing healthcare workers and resident-facing social care workers.[133] Hospital-acquired infections are particularly concerning since patients often have comorbid conditions that increase disease severity and mortality, while staff illness leads to workforce shortages and many staff are at risk of poor COVID-19 outcomes, for example, as members of BAME or low socio-economic groups. Moreover, infections within hospitals may have an amplifying effect through onward transmission within local communities and care settings (Figure 5).[134,135] In addition, some people receive care in their home, including from multiple carers who may carry COVID-19 which could lead to infection between patients unless careful infection control measures are strictly and routinely observed. Some countries have largely prevented or eliminated hospital transmission.[136]

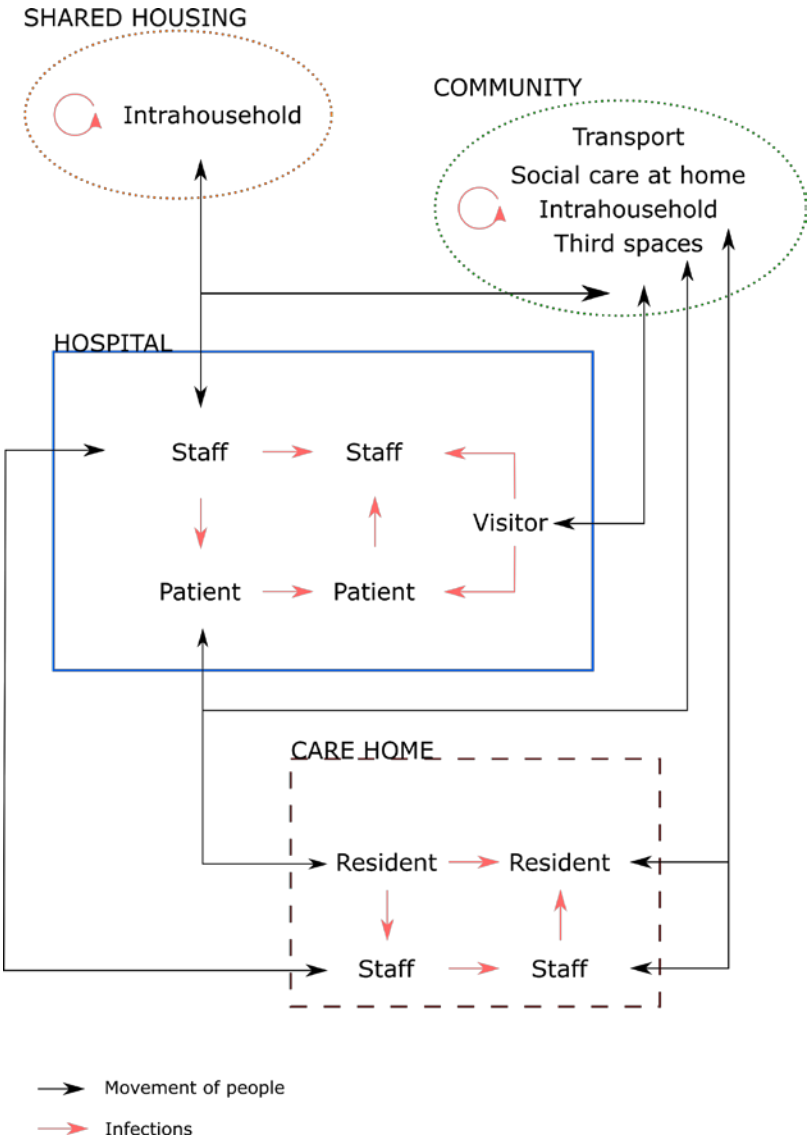


Figure 5. *Schematic of the flow of individuals and possible routes of infection in and around hospital settings (taken from the Data Evaluation and Learning for Viral Epidemics (DELVE) 'Scoping report on hospital and health care acquisition of COVID-19 and its control').*[137]

However, until recently, there have been limited and disconnected data sources that have been readily available on infections acquired in hospitals, meaning that it has not been possible to precisely answer important questions, such as whether inpatient infections were hospital-acquired or only hospital-onset, the level of staff absence due to COVID-19 or for other reasons (e.g. childcare provision), and the extent of onward transmission into the community. Data sources have improved recently with the launch of large-scale prospective research studies such as SIREN in healthcare workers,[138] and regular reports from the COVID-19 Clinical Information Network (CO-CIN) to the Scientific Advisory Group for Emergencies (SAGE);[139] although these are either not currently available (SIREN) or available only on request through a governed process (CO-CIN). Public Health England (PHE) has developed a dashboard to identify and monitor trends in Trust-level hospital onset cases in patients. Overall, **learning from experiences in the first wave of COVID-19, coordinating timely surveillance linked to rapid outbreak response efforts, and improving infection control in health and social care settings, will be vital for the coming winter.**

As of 12 June 2020, 30% of COVID-19 fatalities in England, 28% in Wales, 46% in Scotland and 42.4% in Northern Ireland were in care homes.[140,141] Elsewhere, the share of care home fatalities ranged from 37% in Germany, 50% in France and 66% in Spain.[142] **Introduction of COVID-19 to care homes, for example by discharging patients with unrecognised infection from hospital or through sharing of staff (e.g. via agency contracts), has the potential to generate large outbreaks with substantial risk of morbidity and mortality due to the advanced age and comorbidities of many residents.**[143,144] A similar phenomenon was recognised for Methicillin-Resistant Staphylococcus Aureus (MRSA) (albeit a pathogen with very different epidemiology). National guidelines were revised in 1998 and updated in 2006, and a concerted response led to successful prevention and control.[145,146] A similar coordinated response is required for COVID-19.

The absence of a central repository or reporting system for care home COVID-19 cases is likely to be harder to resolve than for hospitals and **improved systematic surveillance systems in institutions with high risk residents are urgently needed**. Effective surveillance of the care home sector needs to complement large-scale research programmes such as the VIVALDI observational study, which has recently been launched to measure care home prevalence, incidence and immunity data.[147] Practical aspects also need careful consideration, for example, quarantining patients upon discharge might be desirable but requires resources and infrastructure that may not be currently widely available in the NHS or care system.

Hospitals are re-opening and face a number of challenges, including addressing the backlog in routine and 'non-urgent' care and providing support for patients with COVID-19 sequelae (see section 3.3). At the same time, while case numbers have fallen, hospitals remain an important environment where cases reside, and transmission risk, with the potential to re-seed outbreaks in the wider community, remains. While mandating all staff, visitors and outpatients to wear face masks and coverings in hospitals represents a positive step, **clear planning and concerted action on infection prevention and control is needed to prevent further hospital-related clusters and outbreaks, and to respond rapidly where these do occur.**[148,149] This will require a clear mandate, allocation of resources, and senior leadership. This is

important over the summer and early autumn, and to protect against future outbreaks in the winter season. In Scotland, routine testing currently offered to care home staff is being expanded to staff working in specialist cancer services and in residential mental health, and to those providing long-term care for the elderly.[150] A recent letter from NHS England and NHS Improvement has set out guidelines on patient and staff testing, risk assessment and management of healthcare-associated COVID-19 cases, and the need for root cause analysis and executive-level responsibility at each Trust.[151] However, clear mechanisms and resources are still needed to manage implementation, monitoring and support for Trusts lacking relevant specialised human resources for these tasks.[152]

3.3 Managing the significant backlog of COVID-19 and non-COVID-19 care

The COVID-19 pandemic led to the suspension of elective hospital work across the NHS on 17 March 2020 in order to increase acute and intensive care capacity. For patients with chronic diseases, **the suspension of elective services and routine outpatient appointments during the pandemic has increased the backlog of patients waiting to be seen**. This has also led to a substantial increase to the NHS waiting list, which will continue to grow as services operate at reduced capacity. **Recent estimates suggest that the overall waiting list could increase from 4.2 million (pre-COVID-19) to approximately 10 million by the end of the year in England.**[153] Resuming routine clinical care and addressing the backlog was a critical issue for our Patient and Carer Reference Group. However, there did not appear to be an awareness of the backlog among participants in our public dialogue sessions (Annex 3).

If, as expected, COVID-19 transmission reduces over the summer, there is a window of opportunity to resume elective procedures safely and start to address the backlog of care. The risk is that a large number of patients will at best have poorer outcomes or at worst die unnecessarily due to delays in accessing care. We look at the challenges for this in section 3.3.1.

However, **addressing the backlog will be challenging given the reduced operational capacity across NHS organisations**. Indeed, separating COVID-19 and non-COVID-19 patients, maintaining physical distancing and implementing other safeguards to reduce transmission of COVID-19 (e.g. isolation, use of PPE and environmental cleaning) have meant that hospitals are running at a significantly lower occupancy level than normal, with reduced theatre utilisation that is critical for urgent and elective work. This has restricted their capacity to deliver patient care and will constrain how quickly hospitals can begin to recommence non-COVID-19 services.[154]

Of note, **there is already evidence of a delay in seeking medical attention in primary and secondary care for acute medical conditions** due to patients' concerns regarding COVID-19 infection or a desire not to overburden the health service.[155,156,157,158] If this continues, it will lead to later patient presentation, more severe disease burden and an increased risk of complications. The suspension of screening programmes and other routine surveillance programmes may also lead to an increase in diseases presenting clinically this winter. According to NHS England, the number of urgent cancer referrals made by GPs in April 2020 dropped by 60% compared

to 2019.[159] Similar significant drops were seen in Scotland, Wales and Northern Ireland.[160,161,162] This is likely to lead to an increase in referrals that will need to be treated quickly or urgent emergency presentations, which will place additional pressure on the NHS through winter and beyond.

As discussed in section 4.2, **there is an urgent need to better organise the NHS into COVID-19 free areas so that routine clinical care can be resumed as rapidly as possible.**[163,164] There has been a widespread adoption of virtual consultations in primary and secondary care since the beginning of the pandemic and this needs to continue and be expanded where appropriate. **Urgent action is also needed to eliminate as far as possible nosocomial transmission within the health and social care system** (see sections 3.2.3 and 4.2.1). This priority organisational activity will be essential to reduce the impact of COVID-19 infection on both staff and patients, thereby helping to control the pandemic, and to allow elective work to commence urgently and continue through the winter. Importantly, waiting lists should have regular clinical reviews and access to treatment should be clinically prioritised rather than by length of wait. This will ensure those who need access the most receive care as quickly as possible. Ongoing clinical review of patients on the waiting list will be important to monitor any potential deterioration.

3.3.1 Exacerbation of long-term conditions and falls

The increase in backlog combined with a reduced ability to review patients face-to-face, reduced access to routine investigations, and avoidance of or difficulty in accessing care during the pandemic is likely to result in an increased number of poorly-managed chronic conditions or undiagnosed conditions this winter.[165] This was a key concern for the Patient and Carer Reference Group. There is good evidence that the onset of winter can exacerbate symptoms of chronic diseases such as ischaemic heart disease, asthma and arthritis.[166,167,168] This suggests an increased risk of flare or crisis of chronic diseases over winter that will necessitate acute medical input.

Further, it has been suggested that comorbid chronic disease may create greater risk of severe COVID-19 disease or death due to higher inflammatory burden, pathophysiological differences in susceptibility or response to infection, and risk of organ damage.[169] Some BAME groups have high prevalence of diabetes, which has been associated with COVID-19 death;[170,171,172] cardiovascular disease,[173,174,175] which may increase risk of complications and cardiac injury;[176,177] renal disease, which may increase risk of acute kidney injury;[178,179,180] hypertension, which has been linked to COVID-19;[181] and obesity, which has a potential link to severity at a younger age.[182,183] These groups are also at potential greater risk of admission for acute respiratory tract infections.[184]

In addition, **falls and associated fractures in the elderly are more common in the winter months**, though the number of emergency admissions to hospitals due to falls on snow or ice varies considerably from year to year. Colder temperatures are associated with increased admissions and this is greater for temperatures below 1°C. Previous harsh winters have doubled the number of trauma procedures performed at NHS hospitals.[185] While analysis of previous years' data will allow planning for the

increased capacity to deal with winter falls and fractures, a particularly harsh winter, such as occurred in 2009/10, could dramatically increase requirements.[186,187]

Consideration also needs to be given to the potential wider physical and mental health implications of the lockdown, which has likely negatively impacted on activity levels, calorie and alcohol intake, and mental wellbeing, with potentially greater impacts on lower socio-economic and some BAME groups.[188,189,190] Such factors may lead to a 'deconditioned' and more vulnerable society, less likely to cope with the usual winter pressures and additional challenges.[191] This point was emphasised by the Patient and Carer Reference group, in particular for those that have been shielding for extensive periods.

3.3.2 The likely impacts of post-COVID-19 care which may be exacerbated in the winter

During the upcoming winter, the NHS will need to provide ongoing care for those who have had COVID-19 infection and who are suffering from post-viral sequelae. Although there is a paucity of data to accurately estimate the extent of post-COVID-19 sequelae, post-viral syndromes are well documented following other viral infections including severe acute respiratory syndrome (SARS), Chikungunya and Ebola. SARS resulted in chronic widespread musculoskeletal pain, fatigue, depression and disordered sleep in chronic post-SARS syndrome.[192] Chikungunya leaves 20% of patients with post-viral chronic inflammatory joint disease.[193] Ebola resulted in 70% of survivors suffering from musculoskeletal pain.[194,195,196,197] About 80% had major limitations in mobility, cognition and vision one year after discharge. Each of these post-viral syndromes have their own set of symptoms – and COVID-19 will probably be different again. In addition, data from the COVID Symptom Study suggest that while most people recover from COVID-19 within two weeks, one in ten people may still have symptoms after three weeks, and some may suffer for months.[198,199]

The long-term consequences of COVID-19 in those that recover from acute infection are uncertain. Researchers working in this area, including those on our Expert Advisory Group, suggest that possible effects include pulmonary fibrosis, pulmonary and systemic vascular disease, bronchiectasis, chronic fatigue, sarcopaenia and deconditioning, mental disorders including post-traumatic stress disorder, depression and anxiety. There is good evidence to suggest persistent physical and psychological sequelae and increased use of healthcare services following intensive care unit (ICU) admission for severe lung injury.[200] Paediatric inflammatory multisystem syndrome temporally associated with severe acute respiratory syndrome coronavirus (PIMS-TS) is a rare post-infectious immune mediated response to COVID-19 infection described in children and some younger adults.[201] The wider impact of similar immune-mediated diseases triggered by asymptomatic COVID-19 infection is unknown. The magnitude of the burden of post-COVID-19 disorders to the NHS will become more apparent after six months follow-up but are likely to be significant.

While the majority of burden of long-term follow-up of patients with COVID-19 is expected to fall to respiratory and infectious diseases clinicians, the extent of systemic manifestations from COVID-19 suggests that **inpatient and outpatient services across the UK will have to be prepared for an increase in patients with multimorbidity presenting with post-COVID-19 complications**. Some post-COVID-

19 symptoms may have multiple possible aetiologies – particularly mental health, cognitive impairment, chronic pain and chronic fatigue – which will benefit from a multidisciplinary approach for diagnosis, treatment and long-term management to avoid long-term disability.

An increase in outpatient requirements for imaging, outpatient review and therapy for pulmonary and non-pulmonary disorders can be expected. An increase in patients with complex medical problems may lead to increased hospital admissions for patients with exacerbations of chronic lung and non-pulmonary disease. Increased pressure on existing post-ICU and pulmonary rehabilitation services can be expected at a time when capacity and capability of these services are impacted by the requirement for physical distancing and PPE.

3.3.3 Mental health considerations

Mental health impacts of the pandemic are complex. Data on mental health is limited but urgently needed given the many stresses the pandemic has caused.[202] The impact of the pandemic on mental health and how this can be managed this winter was a key consideration for the Patient and Carer Reference Group.

For people infected with SARS-CoV-2 there is growing evidence that neurological and psychiatric manifestations are common,[203,204] and the accumulation of longer term mental disorders and debility including depression, anxiety and PTSD are to be expected given the known impact of severe acute illness on mental health. At the same time, mental health and rehabilitation services have been disrupted, limiting capacity to address the needs of this population.

For the **wider population**, there is some evidence from high-quality population studies (e.g. Understanding Society, Avon Longitudinal Study of Parents and Children (ALSPAC) and Generation Scotland), that within the first month of lockdown there was a surge in mental distress in the UK.[205,206] This mostly affected young people aged 16-25, women, those living with young children, people in employment and those in lower socio-economic groups.[207] Preliminary evidence suggests this effect is sustained.[208] However, the data suggest that the closure of nurseries, schools and universities, and the difficulties faced by those in (precarious) employment, may have significant impacts on population mental health in adults, particularly women on whom most childcare responsibilities are likely to have fallen.

For **child mental health,** urgently required population studies have recently been funded and will provide important data. Data from convenience samples indicate that there has been a significant increase in behaviour problems among primary school age children, with high levels of anxiety across all age-groups.[209] Schools and nurseries provide a universal service and their closure is likely to have disproportionately impacted those from lower socio-economic groups, key workers and those living in crowded accommodation, which in turn over-represent BAME groups and people with pre-existing mental health disorders.

Among the **NHS and social care** workforce, robust data are limited on mental health impacts, though data from previous pandemics show clear mental health effects.[210] During the COVID-19 pandemic, convenience samples and preliminary data from a

population study again suggest a surge of mental health symptoms. It is unclear whether these will become sustained.

Individuals with established mental disorders are already disadvantaged, for example with significantly reduced life expectancy.[211] During the immediate phase of the pandemic, mental health services made wide-ranging changes to their working practice which had to be rapidly implemented, in particular a reduction of in-patient and face to face service provision.[212] The effects of these measures on longer term health of the people receiving mental healthcare is, so far, poorly understood.

In addition, **seasonal/winter weather influences also have a significant effect on mental health for many**.[213] Severe winter weather events (e.g. flooding) have major impacts on mental health, and are linked to depression, anxiety and suicides.[214] Future restrictions on social contact may be felt particularly in winter, when reduced daylight and bad weather make it more difficult to use outdoor space. **While there is considerable uncertainty, it seems likely that the combination of factors will result in an increased mental health burden this winter.**

3.4 A possible influenza epidemic

As the UK enters the winter and measures to contain SARS-CoV-2 transmission are relaxed, there is likely to be an increase in influenza and other seasonal infectious diseases that will impact on urgent activities in the health and social care systems. This will be dependent on the extent of the easing of restrictions by the start of the respiratory diseases season (typically November/December for influenza, but starting earlier for other diseases such as RSV).

Influenza and other respiratory infections consistently cause substantial NHS pressures and excess mortality each winter. These respiratory viruses have very well described seasonal patterns,[215] with excess winter mortality due to respiratory infections typically concentrated between November and February. Ordinarily, presentation of respiratory illness to general practice is lowest at the start of the school autumn term (18 per 10,000 registered per week), which trebles between September and end of December (52 cases per 10,000 registered per week) and stays high through to March.[216] Pronounced seasonality is also seen in non-SARS coronaviruses (common cold seasonal coronaviruses) with transmission many fold higher in winter than in summer.[217]

Seasonal patterns exhibit high degrees of variability from year to year; retrospective studies have been used to understand mechanisms with forecast models developed extensively over recent years. However, accurate forecasts are generally only possible at a timescale of weeks, rather than months and the best models draw heavily on historical examples. **The size and severity of the influenza epidemic in winter 2020/21 will be particularly difficult to project**: physical distancing measures implemented around the world in the past months might impact overall influenza infections; the actions to reduce COVID-19 transmission in spring 2020 might have diminished exposure to influenza (although influenza activity had declined before lockdown was implemented);[218] and it is not clear whether the incidence of influenza infection will continue to be suppressed by physical distancing in winter 2020/21 or may be high

because of a mild influenza season in 2019/20. Nonetheless, it is likely that some influenza will circulate.

The winter of 2017/18 was the most recent significant influenza season and can be used as our reasonable worst-case scenario when planning for winter 2020/21. That winter, excess winter mortality amounted to approximately 49,410 deaths (Figure 1), with over one-third (34.7%) of all excess winter deaths caused by respiratory diseases.[219,220,221,222] Excess winter deaths were highest in females and people aged 85 and over, and excess winter deaths doubled among males aged 0 to 64 years between 2016 to 2017 and 2017 to 2018.[223] The impact of increased influenza and a colder winter was felt across primary and secondary care (Figures 6 and 7). To relieve pressure on the NHS, the National Emergency Pressures Panel issued guidance to Trusts to cancel all elective surgery in January 2018, leading to 22,800 fewer elective admissions to hospital in January 2018 compared to January 2017.[224]

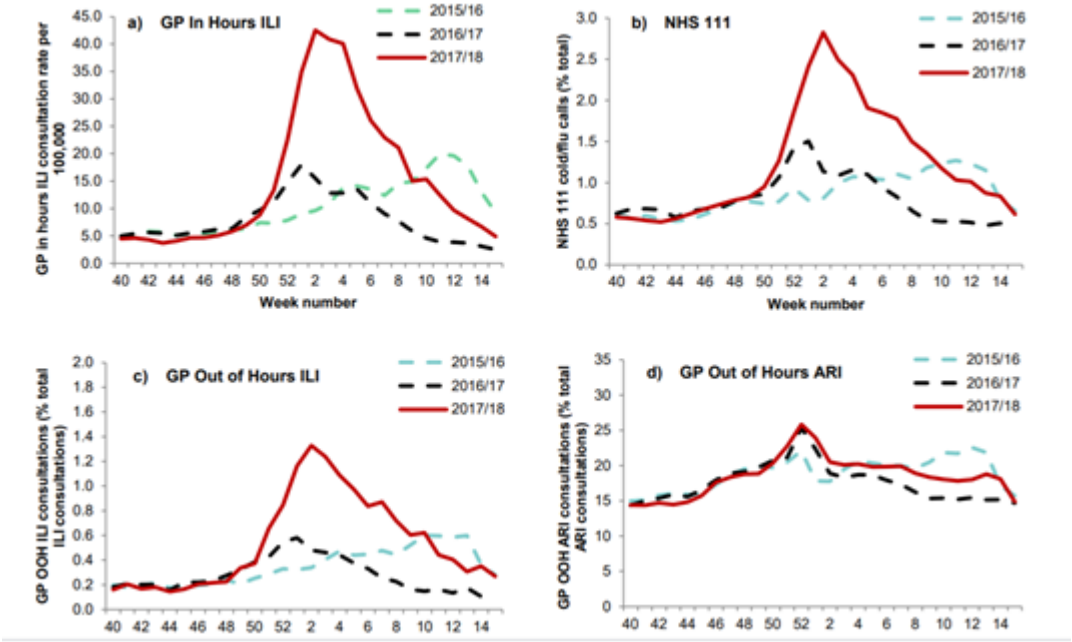


Figure 6. *Weekly all age (a) GP in hours consultations for influenza like illness (ILI), (b) NHS 111 cold/flu calls, (c) GP out of hours consultations for ILI, and (d) GP out of hours consultations for acute respiratory infections (ARI) for winter 2015 to 2018 in England (taken from 'Surveillance of influenza and other respiratory viruses in the UK: Winter 2017 to 2018', PHE).*[225]

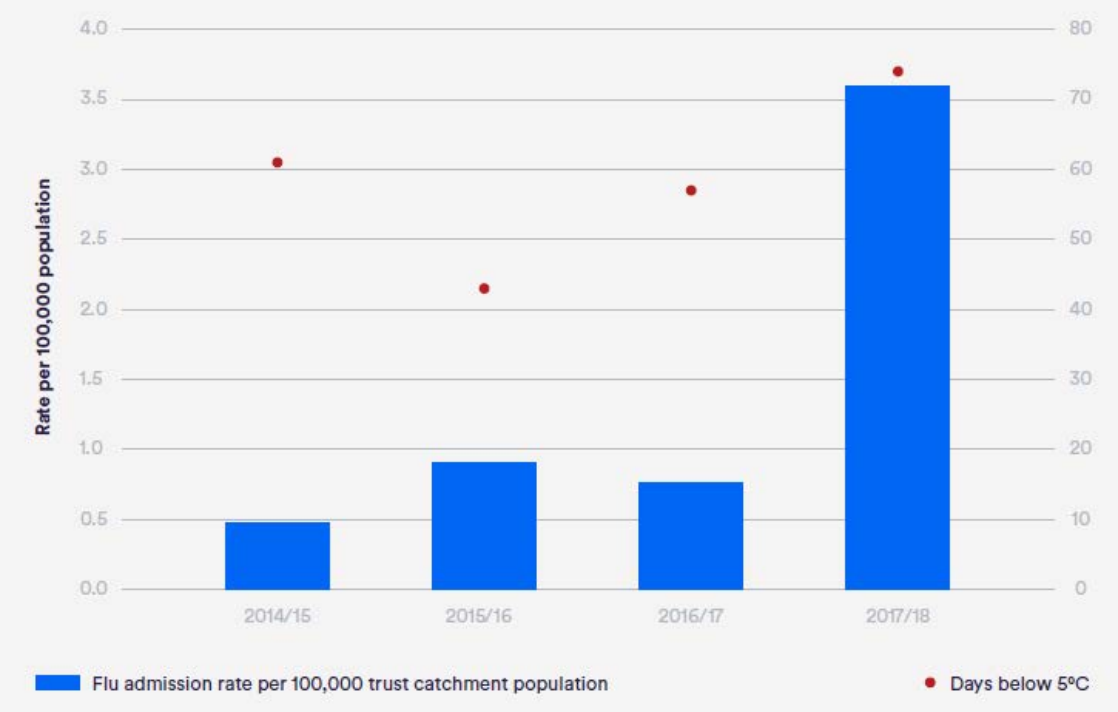


Figure 7. *Rate of influenza-confirmed admissions to hospital through the UK Severe Influenza Surveillance System (USISS) sentinel scheme, 2014/15 to 2017/18 (taken from 'Snowed under: understanding the effects of winter on the NHS', Nuffield Trust).*[226]

A resurgence of COVID-19 this winter is likely to coincide with outbreaks of other respiratory viruses such as RSV and influenza. Co-infections might enhance disease, co-infections with seasonal coronaviruses could facilitate recombination events and give rise to novel viruses, and **hospital admissions for influenza, RSV and COVID-19 would be additive, with some patients presenting with dual infections.** Actions must therefore be taken to both diminish influenza circulation and mitigate its impacts - these are explored in section 4.4.

In addition, **a generalised increase in respiratory infections over the winter could rapidly overwhelm test and trace capacity**. The usual number of winter respiratory viruses, which have symptoms similar to early SARS-CoV-2 will lead to a rapid rise in testing and potential quarantine requirements; usual influenza surveillance methods may also be challenged due to COVID-19.[227] Data from the 2018/2019 Economic and Social Research Council Bug Watch study, prior to COVID-19 circulation, examined the community incidence of symptoms. This suggests the expected number of people in England and Wales who will meet current case definitions for COVID-19 (cough or fever or loss of sense of smell) will rise from ~100,000/day in the summer to ~360,000/day in the winter (personal communication from Professor Andrew Hayward, Professor of Infectious Disease Epidemiology and Inclusion Health Research, University College London).

Physical distancing and hygiene interventions are expected to reduce the transmission of other pathogens that share modes of transmission with SARS-CoV-2.[228,229] The estimated R_0 for influenza is lower than for SARS-CoV-2, which also suggests that physical distancing or (increasingly) community infection control measures that prevent the spread of SARS-CoV-2 (including good hand hygiene and face coverings) would

prevent transmission of influenza as well. Recent data from Hong Kong suggest that non-pharmaceutical interventions (including border restrictions, quarantine and isolation, distancing, and changes in population behaviour) were associated with reduced transmission of COVID-19, and are likely to have substantially reduced influenza transmission in early February 2020.[230] Early indications from the beginning of the influenza season in Australia also indicate much lower numbers of laboratory-confirmed cases of influenza during lockdown in April and May than in previous years,[231] although surveillance figures need to be interpreted in light of possible changes in healthcare seeking behaviour and testing during the SARS-CoV-2 pandemic. Asthma exacerbation rates have also decreased in Australia since physical distancing has been implemented (personal communication to Expert Advisory Group member from Professor Helen Reddel, Research Leader at the University of Sydney and Chair of the Science Committee of the Global Initiative for Asthma) suggesting possible impacts of reduced seasonal viral infections, as well as air pollution.

4. Priorities for prevention and mitigation

In this section, we identify actions to mitigate the impact of COVID-19 on the expected seasonal surge in healthcare demand for the winter of 2020/21. This section explores strategies to minimise community SARS-CoV-2 transmission and impact; optimise the organisation of the NHS in partnership with social care; optimise public health surveillance, and outbreak investigation and management, for early identification of COVID-19 and influenza outbreaks; and minimise the transmission and impact of influenza.

Crucially, preparations for winter must start now. It is important to recognise the urgency of acting during July and August to enable the health and social care system to better cope with the COVID-19 pandemic and mounting winter pressures.

It is critical to work with the most at-risk communities to identify and mitigate factors contributing to the excess burden on the most vulnerable, including those with diseases that predispose to severe COVID-19, those in social deprivation and susceptible ethnic groups.

There are three main cross cutting themes:

- Mitigation strategies should not pose further disadvantage to the most vulnerable in society, or the highest risk patients or communities.
- To maximise their effectiveness (and to ensure they do not exacerbate inequalities), preparations for winter must be informed by engagement with patients, carers, the public and healthcare professionals (as we have benefitted from in this report); and whenever possible be developed through co-production.
- Implementation of prevention and mitigation strategies requires enhanced coordination, collaboration and data sharing between central and local initiatives.

4.1 Minimising community SARS-CoV-2 transmission and impact

4.1.1 Population-level mitigations - establishing the 'new normal'

4.1.1.1 Population-level mitigations

It is very unlikely that patterns of social interaction will return to previous levels; across the world, for countries that have exited lockdowns, Google mobility data suggest that movement patterns remain at least 20% lower than in January 2020, with a higher reduction in movement maintained in higher-income settings.[232] We are also starting to see a 'decoupling' of movement data and disease trends compared to the close coupling that was evident as countries went into lockdown.[233] This indicates that other factors (TTI, physical distancing outside of the household, face coverings/masks, etc.) can help to maintain reductions in transmission. It is not yet possible to disentangle the relative contribution of these, but all are likely to reduce the incidence of other respiratory diseases. Indoor celebrations held over autumn and winter, such as Diwali and Christmas, may reduce the publics' adherence to physical distancing and other measures, and this could lead to an increased number of infections. The wider impact of this will depend on R_t at that time. People need to be advised in a culturally appropriate manner of the risks of transmission, especially among the elderly. The impact of travel

on the 2020/21 winter is currently unknown: the decrease in international travel during lockdown is likely to have a substantial impact on reducing the international spread of influenza and other infectious diseases; however, international movement usually increases during the Christmas season.[234]

Active containment measures, including physical distancing, good hand hygiene and wearing of face coverings in shared indoor environments, are vital to preventing SARS-CoV-2 transmission as we approach winter. However, it should be recognised that the most effective strategies for implementing these measures are those that are structural.[235] For example: strategies to reduce the number of effective contacts that people have (e.g. working from home); mandating wearing of face-coverings in shared indoor environments where physical distancing at 2 metres is not possible; strategies to prevent an infectious person being present in an environment (e.g. rapid isolation when symptoms occur); and changes in physical and social environments that enable containment measures that reduce transmission (e.g. reducing the number of people using a shared space, providing facilities for hand washing or hand sanitizing, etc.). High rates of public engagement in containment measures are critical to the effectiveness of public health interventions at scale. The least effective strategies are those that rely on individual effort alone (e.g. encouragement rather than mandating the wearing a face covering). Public acceptability, clear guidance, communication and mandating where appropriate are key to achieving high rates of engagement in mitigation measures (e.g. mandating face coverings on public transport).

We support the Environmental and Modelling Group's review of the evidence to SAGE on 'Transmission of SARS-CoV-2 and Mitigating Measures', which noted that transmission of SARS-CoV-2 is most strongly associated with close and prolonged contact in indoor environments, and that physical distancing is an important mitigation measure.[236] It recommended that where physical distancing of 2 metres cannot be achieved, additional mitigation measures including (but not limited to) face coverings and minimising duration of exposure should be adopted. It advised that all the potential transmission routes should be considered when selecting prevention and mitigation measures and that they should be tailored to the setting and the activities carried out. Identification of the risk of transmission, and particularly large clusters/outbreaks, by setting is an urgent priority of contact tracing and outbreak investigation so that physical distancing and mitigation measures can be more accurately targeted.

Tailored guidance needs to be developed for commercial, public and domestic properties on the benefits of increased building ventilation to reduce virus transmission and improve indoor air quality in general, with a focus on planning for winter.[237] Ensuring good ventilation, increasing exposure to sunlight and maintaining higher temperatures and humidities are all strategies that are likely to reduce transmission risk for COVID-19 and other seasonal respiratory infections.[238,239,240,241] Specific guidance would be needed for high occupancy settings, such as hostels and universities. Organisations should explicitly consider plans for winter as part of their COVID-19 secure risk assessment. There is a need for an increased emphasis on control of COVID-19 in workplace settings. This includes improved surveillance of occupational outbreaks, clear guidance, co-production of prevention measures and inspection of workplace settings to ensure compliance. **Domestic environments should be a particular consideration as household transmission is**

one of the highest risks. In particular, this includes clear guidance on how to self-isolate within the home to prevent infection to household members. This should also include recognition of inequalities in housing where those who are most vulnerable to COVID-19 are also likely to be those with the poorest quality housing, highest levels of overcrowding and least able to heat their homes adequately in winter. Resources should be in place to support the most vulnerable (for example, winter fuel payments as discussed in 4.1.2).

Face coverings, including homemade cloth masks, offer an additional tool for reducing transmission of COVID-19.[242,243,244] Face coverings reduce droplet dispersal to varying degrees and the evidence for effectiveness of face coverings is variable and dependent on setting. However, the evidence suggests that, overall, face coverings could contribute to reducing viral transmission when population compliance is high.[245,246,247,248,249,250] If widely used in situations where there is a likelihood that physical distancing may not be possible (such as on public transport and in shops and workplaces), face coverings could reduce onward transmission.[251] Encouraging or mandating the wearing of face coverings where appropriate so that this becomes a social norm – as it has in parts of Asia (and as happened with condoms in response to the AIDS epidemic) – could increase their effectiveness in the public domain. Establishing standards for manufactured and guidance for homemade cloth face masks, to optimise quality fit and effectiveness based on available evidence, should also be considered. Equitable access to face coverings was a key concern for the Patient and Carer Reference Group, and the Government should give consideration to the distribution of cloth face masks to everyone as has been done in other countries. Further research is needed into: the value of face coverings in specific sub-groups (e.g. children); the effectiveness of face coverings in different settings (e.g. households in reducing transmission); and how face coverings could be encouraged as a social norm.

Modelling studies can help to estimate effects of interventions on COVID-19 and suggest that interventions aimed at reducing the spread of COVID-19 will be needed for a prolonged period of time to avoid overwhelming the healthcare system.[252] 'Lockdown' has been widely implemented globally to reduce transmission. **Given the large social and economic implications of lockdown, understanding which components are effective in reducing the effective reproduction number R_t is key.** A number of recent studies have begun to measure and model the efficacy of lockdown.[253,254] Estimates suggest that such interventions prevented or delayed ~62 million confirmed cases across six countries corresponding to averting ~530 million total infections (between January-April 2020, individual dates dependent on country).[255]

4.1.1.2 How do we establish and communicate the 'new normal'?

Clear and trustworthy communications about science and policy and the action that people can take is crucial to communicate the role of the public in mitigating the risk of COVID-19 transmission.[256,257]

Efforts must be made to maximise public engagement in control measures including: physical distancing; wearing face coverings in settings where physical distancing is not possible; regular hand and respiratory hygiene; levels of hygiene in the home; heating and ventilation of homes; and self-isolation and participation in the TTI programme when symptomatic, or following contact with a COVID-19 case. For example,

participants in our public dialogue sessions highlighted the need for clearer instructions around the use of face coverings (Annex 3). Those with chronic illnesses and older adults need to be aware of their increased risk and will need to be particularly careful to avoid infection. **An extensive public information campaign in the autumn, co-produced and optimised by members of the target communities working with professional organisations, could help improve understanding, motivation, skills and resources in relation to minimising transmission** (see Box 1).

Greater emphasis and guidance is needed on how to prevent household transmission, given the substantial risk of transmission to other household members.[258,259] Household transmission for respiratory infections can be reduced by physical distancing and other non-pharmaceutical interventions.[260,261] This is particularly important in intergenerational households where older adults are particularly at risk of severe consequences of infection.

There is evidence that, as lockdown is eased, society has become more divided.[262] When the UK went into lockdown the vast majority of the population understood and supported government action. Recent polling suggests that 38% of the population remain 'trusting'; an equal percentage are 'dissenting', have a higher perception of risk and are suspicious of measures to ease lockdown; and 24% are 'frustrated' and wish for a more rapid relaxation of regulations. This also emerged from our public dialogue sessions (see Annex 3). This implies that if new measures have to be taken in a potential resurgence of cases, it will be more difficult to gain consensus and adherence. Strong leadership and stewardship from those in positions of authority will be required to build and maintain public trust in control measures.

Willingness to name contacts in the TTI programme may be compromised by concerns of putting friends and family in quarantine for 14 days – with potentially substantial childcare, economic and social implications – and self-quarantine may be compromised by similar issues. Non-compliance might be mitigated through initiatives such as statutory pay for those required to quarantine.

Finally, timely, clear and easily understandable communication for those who are shielding is crucial, especially in light of updated guidelines. There may be an opportunity to learn from data collected to date to adjust future shielding criteria and guidance accordingly in co-production with patients, carers and the public. These points were strongly emphasised by the Patient and Carer Reference Group. Risk stratification should be considered for patient groups who may be able to take a more relaxed approach to shielding, for example children compared to adults with certain chronic diseases.[263]

The risks to children and families need to be balanced against the long-term consequences of social isolation and school closures on the emotional and mental health development of children. It has been argued that the evidence of the limited effectiveness of school closures on transmission means that this should be a last resort measure,[264,265] and that should school closures be deemed necessary in a future outbreak, consideration should be given to maintain provision for those in most disadvantaged groups and to mitigate the impact on children sent home (e.g. school meal vouchers and steps to support learning, including laptop loans).

Box 1: Public information campaigns and guidance should be co-produced, culturally sensitive and tailored with community ownership

Social and individual determinants, such as education, income and ethnicity, can affect exposure to public health messages and capacity to act upon them, as shown during the H1N1 pandemic.[266] Embedding co-production and shared decision-making throughout the policy cycle is crucial. Co-production involves working in equal partnership with service users, carers and communities at the earliest stages of design, development and evaluation. Public information campaigns and guidance should be co-developed and piloted with local community teams, such as patient participation groups, to design a range of engaging, tailored and targeted resources (e.g. infographics) suitable for a diverse range of people and settings. This includes culturally tailored resources translated into different languages. A number of resources on co-production are available.[267,268,269,270] This is particularly relevant to implementation of the national testing, contact tracing and isolation programme, and shielding guidance.

Concerns have been raised about a significant gap in culturally-tailored and appropriate public health information for individuals from BAME populations, including those who are not online and those for whom English is not their first language. Local communities have the understanding and respect for different cultural perspectives. It is essential that programmes are embedded within local structures and networks, and in collaboration with local government and public health teams. Programmes should be delivered by/with trusted local leaders (e.g. Directors of public health, healthcare practitioners, doctors, religious leaders) and community representatives. Implementation will need to be relevant to each individual community. Awareness should be raised through volunteer groups, religious and community leaders, local businesses groups, primary care, community pharmacies and social media.

These points were strongly emphasised by the Patient and Carer Reference Group.

4.1.2 Boosting resilience in and support for the population

A public campaign encouraging people to take positive action before winter to improve physical and mental health and boost resilience should be undertaken, linked with the campaign to reduce transmission advocated above. This could include: improving diet; encouraging exercise and increased movement (especially for those working at home); improving indoor environmental conditions, such as temperature, ventilation and environmental cleaning; and approaches to improve mental wellbeing and manage stress. Working in collaboration with those with expertise in this area, for example Sport England, could be helpful.[271] **Public messaging also needs to be strengthened to ensure communities know how to access health services and feel safe to do so.** Further efforts are required to mobilise better social, practical, financial and community support for those struggling to cope with the effects of the pandemic. It is important that any campaign is targeted, co-produced, and works with existing successful campaigns and local community networks and leaders (see Box 1).

Better communication of weather and health plans (such as the cold weather plan for England and the National Institute for Health and Care Excellence (NICE) indoor air quality guidance), and clear, unified and coordinated warnings and advice about the health impacts of the cold weather could mitigate the impacts of weather this winter and in future.[272,273] Numerous services already exist to help manage and mitigate the seasonal health burden due to weather, including the: seasonal outlook;[274] cold weather warning service;[275] and short duration severe weather and flood warnings.[276,277] The enhanced integration of these with wider health advisory, planning and response mechanisms would play a critical role in mitigating health impacts and managing the NHS logistical planning and response during the heightened winter period.

It has been suggested that low levels of vitamin D – endemic within the UK, exacerbated by lockdown and which worsen over winter – may contribute to susceptibility to COVID-19.[278] There is currently little evidence that vitamin D reduces the risk of SARS-CoV-2 infection.[279] However, vitamin D has been associated with a protective effect against acute respiratory tract infections and is known to be important to bone and muscle health.[280] The UK Government has advised that everyone should consider taking 10 micrograms of vitamin D daily during the COVID-19 pandemic due to the decrease in sunlight exposure as more time is spent indoors.[281,282] The UK Government also advises that people whose skin has little to no exposure to sunlight and ethnic minority groups with dark skin should consider taking a vitamin D supplement all year round.[283,284] **Given the protective effects of vitamin D against respiratory tract infections and wider health benefits, the Government should consider how to encourage the use of vitamin D this winter, particularly in vulnerable and low socio-economic groups.** The wider use of vitamin D was emphasised by the Patient and Carer Reference Group.

More should be done to provide appropriate support to those who are at an increased risk – for example older people and those with multiple long-term chronic conditions, including severe and enduring mental disorders. The mental and physical health rehabilitation needs of people who have had serious illness should be prioritised. Planning for a resurgence in cases of mental health disorders should include mental health service providers, who need to maintain responsive services and ensure that the needs of those for whom remote contact is not feasible (including inpatients and those in the community with most severe presentations) are adequately met.

It is known that multimorbidity is associated with lower socio-economic status.[285] Exploring how communities can work with local health and social care systems to become ‘resilient’, with consultations to manage long-term conditions, and build trust in appropriate watchful waiting will be important to mitigate some of these risks. Patients could be engaged in a similar system used by the Met Office that delivered forecasts to patients with COPD to prevent admissions.[286]

Support could also be financial. Many households have been negatively impacted financially from the COVID-19 pandemic and this is likely to have an impact on fuel poverty. Ten percent (up to 5,000) of excess winter deaths are directly attributable to fuel poverty and so tackling fuel poverty to ensure heating at home would be highly beneficial.[287] The Committee on Fuel Poverty has recommended widening immediate automatic entitlement for Warm Home Discount to include low income families in or at

risk of fuel poverty to mitigate against the immediate impact of COVID-19.[288] **Removing the many practical and financial disincentives/barriers to infection control measures** (e.g. loss of income/employment) **would improve adherence and mitigate wider health effects**.[289,290] Provision of alternative accommodation, food, medicine and essential amenities, and financial support (especially to increase adherence to isolation and quarantine measures) are likely to be important for socio-economically disadvantaged communities, including some BAME communities who are more likely to live in multigenerational households. Supporting people to enable them to comply with COVID-19 advice and guidance was strongly emphasised by the Patient and Carer Reference Group. Those who have been required to self-isolate for long periods due to underlying health conditions (shielding) and those with pre-existing poor mental health are likely to need additional support if further periods of prolonged isolation are required.

4.1.3 Test, trace and isolate

The strategy of TTI is a key part of the UK Government's next stage response to COVID-19. TTI (and equivalents in the devolved administrations) involves initial isolation and rapid testing of patients with symptoms consistent with SARS-CoV-2 infection, independent of their clinical management, and tracing their contacts (workplace and social, as well as household) who are then required to self-quarantine and advised to report their own symptoms. TTI is unlikely to prevent a winter resurgence in SARS-CoV-2 alone, but can play an important role as part of a wider package of effective non-pharmaceutical interventions, as highlighted by modelling exercises and experience in countries including South Korea, New Zealand and Iceland.[291,292,293] **TTI will only be effective if it is carried out quickly, accurately, is acceptable to the public, and encompasses a high proportion of symptomatic cases.** Ensuring a focused and efficient TTI programme was emphasised by the Patient and Carer Reference Group.

Speed is required to rapidly obtain test results, and to find and quarantine contacts before they become infectious. Rapid results require widespread, decentralised and accessible testing options. Separate quarantining should be considered for high risk populations (e.g. hostels for the homeless and student accommodation). While tracking apps have played a role in several TTI systems, traditional contact tracing is likely to be at the core of any successful implementation.[294]

In England, the restart of COVID-19 TTI on 28 May led to almost 21,000 index cases being referred into TTI in the first week; of whom 73% were reached and 89% of close contacts found.[295] Approximately 90% of contacts are managed through PHE's local health protection teams working with local public health departments, with a central contact tracing service managing non-complex cases.[296,297] Effective TTI will thus require strong links between national and local tracing teams and harness partnerships between the NHS, academia and industry.

There are substantial opportunities for TTI to act synergistically with a broader surveillance system, local outbreak investigation and management teams, and local public health teams along with the NHS for healthcare outbreaks. TTI can help identify community and institutional (e.g. health and social care settings, prisons) outbreaks, and are vital to outbreak investigations as infections spread beyond the initial outbreak site. Surveillance systems can also help identify key risk groups for TTI systems to prioritise tracking and tracing. Surveillance is discussed further in section 4.3.

Awareness, access to and uptake of COVID-19 testing must be equitable across all social and economic groups and disparities must not be widened in the implementation of the national COVID-19 TTI programme.[298] UK BAME engagement with prior health screening programmes has been low – reasons for this include: i) lack of knowledge about health conditions, screening benefits and how to access them; ii) barriers to access, including language, low social support, time and financial constraints, anticipated discrimination and culturally insensitive messaging; and iii) beliefs and attitudes towards healthcare systems, fatalism and the usefulness of screening.[299,300] Several of these factors are compounded for BAME women. Avoiding such inequalities for COVID-19 TTI requires multifaceted approaches, including multidisciplinary researcher input and engagement with leaders of marginalised communities in programme development (see Box 1 for further information).[301,302] Key aspects in ensuring participation from all communities will include: the provision of support services (e.g. translation facilities) and the co-development and pilot-testing of all tools (e.g. an app) in populations most affected by COVID-19. Contact tracing teams will also need training to ensure conversations are culturally sensitive and can be delivered in appropriate languages. Barriers to compliance are further discussed in sections 4.1.1 and 4.1.2.

As explored in section 3.4, a generalised increase in respiratory infections over the winter could rapidly overwhelm test and trace capacity, with estimates suggesting that the expected number of people in England and Wales who will meet current case definitions for COVID-19 will increase by three to four fold in the winter (personal communication from Professor Andrew Hayward, Professor of Infectious Disease Epidemiology and Inclusion Health Research, University College London). **Testing and tracing capacity will need to be significantly expanded to cope with increasing demands over the winter**. Provisions should also be made for severe weather, which could significantly impact TTI logistics (e.g. transporting samples in heavy snow).

The use of multiplex influenza, SARS-CoV-2 and other respiratory virus testing within the rapid TTI programme, alongside point-of-care testing in healthcare settings, will be important to distinguish the cause of influenza-like illnesses and optimise appropriate clinical management. Considerations should be given to testing for all common respiratory viruses and giving virus specific isolation advice (e.g. isolation for COVID-19, prescription of antivirals for influenza – the latter is discussed further in section 4.4.2). Pinpointing those with COVID-19 for isolation and contact quarantine could also improve willingness to comply with TTI by lowering the probability that people are self-isolating unnecessarily.

4.1.4 COVID-19 treatments and vaccines

There are currently few treatment options for COVID-19 and it is unlikely that a vaccine will be available this winter. As such, it will be important to ensure high-levels of adherence to non-pharmaceutical interventions and to optimise the UK's approach to minimising influenza transmission (see section 4.4) **to mitigate the burden on the health and social care system this winter.**

4.1.4.1 COVID-19 treatments

There is emerging evidence on the treatment of COVID-19 for hospitalised patients. There is early evidence that the antiviral remdesivir may be of moderate benefit in

reducing the need for supportive measures and shortening time to recovery.[303,304,305] The Medicines and Healthcare products Regulatory Agency (MHRA) has granted a favourable review with an Early Access to Medicines Scheme (EAMS) in place.[306] Dexamethasone has shown efficacy against mortality as an endpoint in later stages of disease, for hospitalised patients requiring oxygen and/or mechanical ventilation and is now recommended for such patients in the UK.[307,308]

A number of other trials are in progress, and only when these are reported will it be known what the efficacy and thus the demand will be and in what stage of disease the medicines may be best used.[309] The long-term control of COVID-19 will require a pipeline of promising therapies. To support this, the Academy launched the COVID-19 preclinical drug development database to map ongoing activities and help researchers identify collaborations.[310]

The challenges for treatment and/or prevention of COVID-19 with respect to medicines will depend on the timely reporting of trials, licencing, evaluation and commissioning of medicines with accelerated access schemes, as well as mechanisms to deploy these nationally at pace. Part of this is in place with the Research to Access Pathway to Investigational Drugs – COVID-19 (RAPID-C19) led by the National Institute for Health Research (NIHR), NICE, MHRA, and NHS England; however, the manufacture and supply of drugs needs to be modelled in a global context, and with consideration of winter surges. In addition, a bottom up approach to operationalise commissioning decisions at pace is required, which will be more urgent in winter months with added pressures. Early signals should accelerate negotiations with pharmaceutical companies, including generic manufacturers. Schemes, such as the six-week rolling stock (in place for no-deal Brexit) and others, should be considered to help maintain supplies while avoiding stockpiling more than is required. This may be particularly applicable to the drugs currently in trial. Horizon scanning by bodies (e.g. RAPID-C19) can pick up on early signals to ensure a winter supply chain is in place given any modelling as described above. This needs to occur in tandem with early liaison with bodies that can facilitate expert review and ensure the operationalisation of commissioning policies (e.g. formulary committees).

4.1.4.2 COVID-19 vaccines

It is unlikely that there will be an effective vaccine against COVID-19 which would be available for use in the winter of 2020/21. There are over 100 vaccine candidates in development for COVID-19, but the vast majority are in the preclinical stage.[311,312] Of the handful that have reached clinical trials, only one has entered Phase III testing (in a combined Phase II/III trial design).[313] Given the decrease in cases of COVID-19, with anticipated lower numbers over the summer months, assessing efficacy in the UK will be challenging, and trial sites in countries with higher infection rates, including Brazil and South Africa, are planned.[314] It will also be important to assess whether co-administration with influenza vaccine impacts the immunogenicity of either vaccine, as combinations of viral vector and adjuvant vaccines may lead to immune interference, with reduced efficacy.[315]

If protective vaccines are available, it is not known how long the protection might last or if the immune response (induced either by natural infection or vaccination) might eventually cause disease enhancement during reinfection with SARS-CoV-2.[316]

In a best-case scenario, where a vaccine is effective as a single dose, the number of doses produced would be limited before winter and insufficient to vaccinate the population. Risk stratification will be needed to decide on which groups to vaccinate. Frontline health and social care workers and those at increased risk of serious disease and death from COVID-19 infection (stratified according to age and risk factors) should be considered a priority.[317]

4.2 Optimising the organisation of the health and social care system

4.2.1 Minimising hospital and healthcare acquired infection

Minimising the infections acquired in health and care settings is a priority for the coming winter. There is much publicly available guidance on specific infection prevention and control practices. We endorse the hospital infection control practices set out in the recent 'Data Evaluation and Learning for Viral Epidemics (DELVE) Scoping report on hospital and healthcare acquisition of COVID-19 and its control' as outlined in Box 2, which should be widely implemented and extended to care homes where relevant.[318] **In addition to the key areas outlined, a standardised, nationwide hospital surveillance system to track and analyse nosocomial infections and inform locally-led outbreak control as recommended by the DELVE report should be implemented.**[319] This report discusses public health surveillance further in section 4.3.

Box 2: Successful hospital infection control practices for COVID-19
(taken from 'DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control') [320]

1. *Minimise risk of importation into hospitals*
    a. Consistent and reasonable limits on visitors (varying by local epidemic state)
    b. Minimise agency/multi-site staffing and staff movements between sites (including hospitals, care homes and other institutions) as practical
    c. Entry screening, or self-certification, of staff, patients and visitors for signs and symptoms of COVID-19 infection
    d. Maximise use of telemedicine and remote consultations

2. *Minimise risk of transmission within hospitals*
    a. Aerosol/droplet transmission
        i. Requirements to wear surgical/cloth masking by staff, visitors and patients wherever feasible, for source control; in addition to staff masking for wearer-protection in specific high risk settings
        ii. Organise hospitals into COVID-19 stratified 'hot' and 'cold' zones, or entire hospitals into 'hot' and 'cold' hospitals if feasible
        iii. Cohort staff to limit physical overlap and movement between zones if possible (i.e. 'bubbling')
        iv. Limits on communal activities for healthcare workers (break rooms, cafeteria) and maintenance of physical distancing
        v. Move Multidisciplinary Team and other meetings online as much as possible
        vi. Maximise use of remote consultations for outpatients

vii. Maintain effective airflow handling systems (acknowledging building infrastructure limits)
viii. Physical distancing, especially in likely hotspots (e.g. waiting rooms, triage locations, A&E, corridors, lifts, staff lounges, canteens or cafeterias)

b. Contact transmission
i. Repeated frequent handwashing for everyone present in facility
ii. Ensuring access to appropriate personal protective equipment for all staff
iii. Training on donning and doffing of personal protective equipment (e.g. masks, gowns, gloves, visors), and mandating staff use as appropriate
iv. Reduced sharing of equipment (e.g. computer keyboards)
v. Expanded and improved environmental cleaning procedures (including exploring novel methods such as UV light, antiviral surfaces, optimum surfaces)

3. Minimise risk of outbreak occurrence and expansion within hospital

a. Active clinical surveillance of patients for the development of COVID-19 infection
b. Prompt isolation, testing, investigation and contact tracing of infected healthcare workers
c. Prompt quarantine of healthcare workers and patients with significant exposure to known cases, and self-monitoring for those with lesser exposure
d. Rapid and standardised outbreak investigations and reporting, including root-cause analysis
e. Provision of sick leave without penalty or prejudice based on symptoms (including contract staff)

4. Minimise risk of exportation from hospitals

a. Testing/quarantining of patients being discharged to own home or institutional care

Care homes were severely affected by the COVID-19 pandemic in many countries across the world, and in the UK an excess of 20,000 deaths in individuals living in care homes was reported during March and April 2020.[321] Many care homes are privately owned, and therefore oversight is challenging. However, **it is vital that the sector receives the appropriate level of support and expertise to prevent and manage outbreaks**. Where possible, admission to hospital should be minimised, and measures such as increasing influenza vaccination of health and social care workers can alleviate this (see section 4.4.1).

Hospital discharge procedures should be reviewed to ensure that infected patients are not discharged to care homes. Ensuring patients are COVID-19 negative prior to transfer from hospital or intermediate care facilities, such as 'step down' or 'isolation' facilities as discussed in section 4.2.2, will also reduce the risk to other residents and staff. Such processes for discharge into the community and care homes should be stress tested to ensure they can accommodate a greater number of patients with the virus and have sufficient isolation space for containing potential outbreaks.

Capacity and capability should be built into care home infection prevention and control measures, which should also be stress tested to ensure a greater number of patients can be accommodated safely while ensuring any outbreaks are contained. Many care home

residents have not been able to see family for several months, and measures to increase visiting whilst maintaining infection prevention and control precautions need to be carefully considered. While end of life care has not been considered in this report, managing care for individuals facing end of life due to COVID-19 is an important issue which should be addressed.[322,323] The Academy has a strand of work on death and dying.[324]

4.2.2 Interventions to optimise COVID-19 and non-COVID-19 care

Winter planning for the NHS and social care needs to be undertaken early, modelled on previous winters and likely COVID-19 levels, ensuring there is sufficient capacity in all parts of the system ahead of winter.

4.2.2.1 Separation of COVID-19 and non-COVID-19 care

As the healthcare system begins to restart core services, it will be vital to mitigate against further transmission of COVID-19. **Reducing COVID-19 transmission will require cohorting of patient groups following rapid accurate testing, such as point-of-care multiplex testing, potentially to the extent of segregating services across a whole healthcare system**. The Patient and Carer Reference Group highlighted reservations about high risk individuals attending hospital appointments, even with clear and effective separation of COVID-19 positive and negative work, due to residual concerns about transmission of COVID-19.

The health and care system must work together to minimise congestion of healthcare facilities and limit COVID-19 transmission. One potential initiative could be diverting COVID-19 infected patients to specialised 'fever' hospitals/wards. During non-epidemic periods, these facilities could be used for preparedness training and run by a skeleton crew.[325]

4.2.2.2 Increasing capacity in the event of a future COVID-19 surge

To ensure hospital capacity is available and avoid further delays to ongoing care, the NHS and social care will need to ensure there is sufficient capacity outside of hospital settings. The Nightingale hospitals, which were opened rapidly in the early phase of the pandemic to deal with an anticipated need for increased capacity, were under-used and required diverting staff from other areas, impacting on service and capacity elsewhere.[326] Given the significant vacancies in NHS posts, trying to staff additional hospitals to the levels experienced during the initial pandemic is likely to be unsuccessful. Instead, a strategic approach to the use of the Nightingale units and other facilities should be considered. For example, they could act as 'step down' or 'isolation' facilities for vulnerable populations, such as elderly care patients being transferred to social care settings or those in high occupancy settings (e.g. hostels).

The ability to increase additional physical critical care capacity, including critical care beds and non-invasive ventilation, ahead of winter will be vital to minimise the disruption of non-COVID-19 related care. The infrastructure in some hospitals may pose challenges to the expansion of critical care or non-invasive ventilation beds due to the availability of high flow oxygen supply, so the expansion should be conducted in conjunction with other hospitals to provide more flexibility for expansion and use – for example as part of an Integrated Care System in England. Guidance on acute admissions will also be necessary to enable the preservation and

prioritisation of ICU beds. To avoid overcrowding of accident and emergency (A&E) departments, as often seen in winter, and limit the risk of nosocomial transmission, it will be necessary to increase admission avoidance initiatives ahead of the winter period.

Unlike with the initial pandemic, paediatric ICUs, theatres and recovery units should not be relied on as substitutes for critical care capacity.[327] In addition, critical care workforce capacity drawn from across other NHS departments may be limited over the winter as elective and non-elective services increase, which should be accounted for in any future service planning. If this were to be repeated, rapid expansion of training to teach or refresh skills will be necessary.

4.2.2.3 Managing the backlog of care according to clinical priority

The NHS should look to limit the increase in the backlog of care as far as possible over the summer months ahead of any potential surge in COVID-19. Before increasing wider care services, organisations will require extensive recovery plans with a staged approach, and services should only be stepped up when safe to do so.

Clear and transparent communication with patients and communities should be established and maintained to explain the challenges that the NHS is facing and the processes in place to ensure their safety while prioritising those most in need.

When dealing with the backlog of elective care, **there should be robust processes in place to ensure full clinical prioritisation of elective procedures** (e.g. regular clinical reviews of waiting lists). Access to treatment should be prioritised by clinical need rather than by length of wait to ensure those most in need of care are prioritised. Returns to clinical care should consider the use of remote assessment (e.g. pre-assessments being delivered via online consultations). High acuity (e.g. ICU and High Dependency Unit capacity) may have the potential to absorb essential medical procedures (e.g. surgery, acute coronary and stroke care) in those who are also COVID-19 positive. Additional capacity can be provided through the continued use of private or independent sector settings, which would ensure sufficient flexibility to accommodate further spacing for lower risk COVID-19 areas throughout the winter.[328,329]

For high risk patient groups, there should be COVID-19 minimised pathways and services (e.g. renal, cancer, endoscopy). These services should separate elective and non-elective pathways and shield patients before, during and after surgery. Workforce management will be challenging as specialist staff groups able to provide these services should not move between patient cohorts on a shift by shift basis.[330,331,332] A 14 day period of isolation prior to elective surgery may be appropriate for adults, but for children and young people this could impact on their emotional well-being, social development and mental health; periods of isolation may also negatively impact working parents and carers and potentially exacerbate inequalities. Alternative, less stringent strategies should be considered. Screening patients for the SARS-CoV-2 virus through PCR testing in the 48-72 hours prior to surgery could also be considered.

4.2.2.4 Ensuring PPE supply

In all care settings, it will be vital to ensure an adequate and appropriate supply of PPE is provided in advance of any future surge of COVID-19.

Considerations must be made to ensure that the required levels of protection for different personnel in different settings (e.g. those in theatre and how this is affected by the nature of the surgery required, or those in primary care settings). This will have implications on the restarting and sustaining of many areas of surgical care over the coming months and beyond.[333] The need to provide protection that is fit-for-purpose, both in terms of its underlying functional performance and its fit to the individual, is crucial to ensure availability of staff for the full range of clinical and support functions. Furthermore, the PPE supply chains require thorough stress testing to ensure adequate provision. The recent improvements have occurred at a time of lower prevalence and therefore do not reflect worst-case scenario conditions.[334] Ensuring adequate PPE will be vital to mitigate against the risk of losing public and staff confidence, as well as to the transmission of COVID-19 itself. Risk assessments and PPE requirements will need careful consideration to protect at-risk groups, such as some BAME groups.[335,336]

4.2.2.5 Dealing with a post-COVID-19 morbidity surge

Addressing the needs of patients with long-term conditions arising from COVID-19 will be a critical issue for the upcoming winter.[337] **It will be important to ensure the appropriate services are available to support this group of high risk patients through sufficient rehabilitative support.** This can be planned for by:

- Establishing a co-ordinated national registry to systematically document post-COVID-19 complications and associated burden of disease.
- Expanding services for patients with post-COVID-19 sequelae, including those who were initially managed in the community, hospital or ICU, to cope with the expected increase in numbers and complexity of patients.
- Resuming early respiratory and other outpatient clinic services.
- Reviewing, urgently, personnel capacity for specialties that are coordinating the follow-up services, as well as preparing for future waves, with a need to expedite appointments and training.
- Concerted national effort to evaluate patients from the initial COVID-19 wave and initiate appropriate therapy through the summer, so that as much disease as possible is controlled and appropriately treated by winter or by the time of a resurgence of COVID-19.

4.2.3 Workforce management

All health and social care staff must feel valued and safe in their work; this can be improved through the co-production of relevant policies with the workforce. In winter 2020/21, wellbeing and resilience amongst health and social care staff may be affected, particularly in staff who have already dealt with high numbers of COVID-19 patients, and for whom annual leave was cancelled earlier in the year. **It will be necessary to ensure support is in place for the mental health and wellbeing of health and social care workers during any future pandemics and afterwards.** Consideration should be given to strategies which will improve the workforce's resilience (see section 4.1.2). These are likely to be collective measures to bolster morale within teams, as well as provision of support and treatment to those most significantly affected, the provision of adequate PPE, and comprehensive staff training in infection prevention and control to protect staff and patients. Long-term health surveillance of the NHS workforce should be a priority and is discussed in section 4.2.1 of this report.

Ensuring adequate numbers of staff to cover for sickness, post-contact isolation and necessary time off will be challenging, especially given the wide ranging 'rota gaps' reported before this crisis. While there have been challenges in obtaining workforce absence statistics, robust data on staff sickness (including agency staff) will be required in winter to assist in planning of services. Any adverse weather events (e.g. widespread flooding or a very cold or snowy period), will further compound challenges and should also be considered in planning.

Staff should not move between patient cohorts on a shift by shift basis, therefore the implications on workforce management are challenging.[338,339,340] Staff working in care homes may be temporary (e.g. agency workers) or may work multiple jobs, increasing the risk of contact with respiratory infections. Healthcare workers have been identified as the source of transmission in multiple outbreaks, and staff working at multiple facilities are a risk factor for large outbreaks.[341] There are wider issues of funding, wages and stability of the care sector that will need further consideration but that we do not address in this report.

The various health and social care services pose different risks to the workforce. There has been considerable variation between and within service (e.g. some GP practices are not seeing any patients face to face due to unacceptable risk). **Local or national guidance is required to standardise how to balance the risk to staff with the duty of care for patients.** All health and social care staff will require risk assessment for work, which should take into account BAME staff groups that may have to be re-deployed as a result of risks identified.[342,343] The NHS currently employs around 1.2-1.5 million staff across the UK; in England approximately 21% (20% among nursing and support staff and 44% among medical staff) are BAME.[344] The Royal College of Psychiatry has created a Staff Impact assessment based on the Workforce Race Equality Standard (WRES) report with recommendations for individual-level and systemic mitigations.[345] Risk assessments and PPE requirements will need careful consideration to protect these at-risk groups.[346,347]

4.2.4 Primary care

Primary care saw 850,000 patients every day in England during 2019; 70,231 of these patients attended A&E departments, of which 13,400 were admitted to hospital.[348] These figures demonstrate the importance of primary care in preventing the NHS from being overwhelmed this winter.

GP practices and their services are changing as a result of COVID-19, with reduced face to face consultations, greater local autonomy through primary care networks (PCNs) and community involvement, and increased patient self-management all developing rapidly. The development of PCNs offers an excellent opportunity for patients and the wider community to participate in the co-production of future care with this winter being an important catalyst.

4.2.4.1 Creating safe surgeries

Telephone triage, online consultations, and electronic prescriptions and sick notes, which were increasingly used before COVID-19, have expanded rapidly during the pandemic and should continue through the winter.[349] However, there is a need to be mindful of exacerbating inequalities of care in more vulnerable patients where face to face

consultations may be more appropriate, or for those unable to access the technologies required for these initiatives.

Healthcare staff are a source of infection due to asymptomatic transmission combined with their multiple close-proximity contacts, including with the most vulnerable.[350] In addition to continued strict prioritisation of patient footfall within surgeries, **working practices should be adjusted to reduce cross infection amongst staff.** This includes actions such as one person/one room/one day and maintaining communication between staff by phone, text, screen message, or video conference. National guidance from the Royal College of General Practitioners (RCGP) or the NHS based on evidence-based best practice would be helpful.

The use of local 'hot' sites/hubs worked well in some areas, allowing GP practices to safely continue to manage other conditions.[351] In some instances, GP practices had 'hot' and 'cold' areas. However, this has to be a local decision with patient involvement through the PCN. The ability of practices to continue to safely manage other conditions, including in the most vulnerable, is critical. Evidenced criteria to select patients going to the 'hot hub' is required to prevent them being overwhelmed if there is a concurrent RSV and influenza outbreak, particularly as staffing these clinics has been a major issue during the initial COVID-19 wave in spring 2020.

4.2.4.2 Proactive approaches for the most vulnerable

We have highlighted in section 4.1.2 the need to boost resilience in the population. **Primary care should target acute care, prevention and screening at those most at risk**, learning from cases, severity and mortality from the initial wave of COVID-19 using emerging criteria such as those from the Oxford RCGP Surveillance or OpenSafely.[352,353] High risk patients should be given more information (possibly a checklist) about things they should do before, during and after winter. This could be localised but could also integrate with the five national levels for COVID-19 infection and the four levels in the Cold Weather Plan to make communication more streamlined and practical in these high risk patients.[354,355] Those who have additional known risk factors should be prioritised including: men, who have a lower propensity to consult than women; people with long-term conditions; people from ethnic minorities; people who are more deprived; and those in crowded accommodation. Primary care needs to continue to deliver remote consultations and care to the most vulnerable people and plan for once restrictions have been lifted.[356]

4.2.4.3 Resourcing

Appropriate resourcing of primary care can protect the rest of the health and social care system. Many GP practices will struggle with resources over the winter; financial pressures will impact due to missing Quality of Outcomes Framework indicators and item of service targets because of the pandemic. Staff resourcing will also be impacted through absences of staff at higher risk of illness from COVID-19, who will need to be safeguarded. **Careful consideration must be given to primary care resourcing to ensure GP practices remain well-resourced throughout the winter.**

4.3 Optimise public health surveillance, outbreak investigation and management for early identification and suppression of COVID-19 (and influenza) outbreaks

Granular, population-wide, near-real-time health surveillance is central to early detection of new waves of COVID-19 infection; the changes in its socio-demographic and distribution across the country; and the understanding of how any new outbreak affects other infections (notably influenza).

All surveillance systems require regular data delivery and rapid dissemination to decision makers. Passive COVID-19 surveillance systems, such as those developed by PHE and the Department of Health and Social Care (DHSC) for weekly reporting, provide data on diagnosed cases with input from a number of sources, including the NHS and the Office for National Statistics (ONS).[357,358] **To inform these existing surveillance systems and understand COVID-19 transmission dynamics, it is important to sustain and improve the quality and completeness of near real-time, granular data collection with more detailed reporting in time, place and person.** Such location data will enable rapid identification of local outbreaks and likely transmission routes (e.g. the extent and modes of transmission in patients and staff in hospitals and care homes). Collection of additional data on occupation will facilitate detection of workplace outbreaks. Data on hospital admissions (provided by NHS statistics), and mortality (from ONS) are also critical to understanding epidemic course.[359,360] Obtaining granular data requires standardised reporting on the epidemiological characteristics of positive tests across both hospital and community testing programmes, including the TTI programme.

Other key forms of surveillance include large-scale population surveys to inform estimates of current infection prevalence and incidence to inform measures of R_t and are essential to developing policy on population control and non-pharmaceutical intervention measures. These surveys should include both current infection rates (through PCR testing) and past infection (via antibody testing).[361] **Targeted surveys of populations where COVID-19 incidence is high or unknown** – those experiencing homelessness, BAME individuals, and those in key client-facing jobs (e.g. in hospitals and care homes) and educational settings such as schools, nurseries and universities – **will be vital and winter surveillance should be stratified to ensure such groups are carefully monitored for early evidence of a resurgence in cases.** Regular screening of staff and improved access to diagnostics is required to support surveillance in staff and residents in care homes. This should allow regular reporting of care home acquired infections alongside the infection and sickness absence in health and social care workers. Further priorities for the surveillance needs of hospitals and care homes are summarised in the 'DELVE Scoping report on hospital and healthcare acquisition of COVID-19 and its control'.[362]

Agile early warning systems are essential and there is potential for data dashboards to be developed based on data from local areas or crowd sources (e.g. the COVID Symptom Study app).[363] These dashboards could be centrally based and provide processed results back to local operators. Maintaining virological and syndromic surveillance for influenza, for example through PCNs and other influenza surveillance systems such as FluSurvey, is also essential to detect upsurges in COVID-19 symptoms and fully understand the relative contribution of influenza (and other respiratory viruses)

to these symptoms.[364] The forthcoming Oxford RCGP Clinical Informatics Digital (ORCHID) Hub aims to provide COVID-19 primary care data linked to hospital and ONS data.[365] GP practices should be encouraged to share their data, and consider joining networks to collate information such as the RCGP Research and Surveillance Centre.[366]

Strong links between the data sets provided by the NHS, public health bodies and ONS are essential. These central surveillance systems and data sets must have clear communication mechanisms to support better-resourced local public health and health protection teams, and the NHS. Outbreak investigation teams should have the authority to access areas and sites with identified case clusters, and to require remedial actions to reduce transmission.

All collated data need to be made available to local public health and NHS providers in order to rapidly implement outbreak investigation and control. This data must also be made accessible to researchers with the linking of routine surveillance data and research platforms.

Given the complexity of all the data collection, processing and distribution involved in effective public health management of a winter COVID-19 outbreak, a single central authority overseeing and coordinating efforts would increase the likelihood of success. The Joint Biosecurity Centre or a similar body may be able to play this overarching role, although clarity on how this fits with existing NHS and UK public health bodies is required, and it would be important to avoid creating additional bureaucracy in the implementation of measures.[367]

4.4 Minimise influenza transmission and impact

4.4.1 Optimising the UK influenza vaccine strategy

This winter, it will be a priority to increase the uptake of the influenza vaccination programme for eligible groups, including high risk groups who are vulnerable to influenza, such as the elderly and clinically vulnerable; young children, who can amplify community spread; and health and social care workers. There will be challenges to this, including limited supplies and the need for physical distancing when delivering the vaccination programme. Supply and access to influenza vaccines was highly important to the Patient and Carer Reference group and also discussed in our public dialogue sessions (Annex 3).

In this section, we refer to vaccination uptake data as a range from all countries of the UK; however, there are some differences between the criteria for data extraction and comparisons should be made cautiously.[368]

Increasing uptake of influenza vaccination in elderly and high risk populations will be crucial for this winter. Uptake in those over 65 year in 2019/20 was 69.4-74.8% within the UK. [369] In recent years, uptake of the influenza vaccine in high risk populations under 65 years of age has been lower than in other elements of the programme (42.3-58.9% in 2019/20 within the UK) so increasing coverage in this population will be important for this winter.[370] Current vaccination programmes are led by primary care, as it is best able to undertake active call-recall using its patient register

– the main intervention associated with improving uptake.[371] For working age populations, pharmacy provision can offer an accessible service, and close working between these providers in local areas can facilitate higher coverage. Most high risk patients access multiple health services. For some risk groups, local commissioners should investigate provision in specialist care, which may be important for some patients who are regularly attending secondary care settings, such as those receiving dialysis. A model whereby the first health worker to see a patient in a high risk group ahead of the influenza season administers the vaccination could help provide earlier and potentially greater coverage, although data linkage mechanisms are required to ensure communication between providers and to measure uptake. In addition, disparities in influenza vaccine uptake have been associated with ethnicity and social deprivation, and specific targeting should be considered.[372]

Children are a key group for influenza vaccination as they amplify community spread.[373] Influenza vaccinations in schools have been suspended and if attendance at primary schools continues to be impacted after September 2020, this will make delivery of the schools based influenza programme more challenging. The same workforce will also be required to deliver catch up for other school based programmes that were suspended in secondary schools in the 2019/20 academic year, so **the immunisation workforce may need to be strengthened**. **There needs to be consideration of how to implement a 'catch-up' programme for vaccinations that have been missed both in schools and general practice to avoid outbreaks of vaccine preventable disease.**

Influenza vaccination is currently opt-in for healthcare workers, and uptake of 41.2-74.3% was achieved in 2019/20 across the UK.[374] **Increasing vaccination coverage of healthcare workers, including care home workers, social care and agency staff, to close to universal uptake will help to reduce transmission to vulnerable patients and reduce sickness absence, and should be a priority.**[375] Influenza vaccination of care home staff has been shown to reduce mortality, morbidity and admission rates of residents, but there is limited occupational health provision to this sector.[376,377] Staff in these settings are eligible for vaccination in the NHS, through general practice and pharmacies, but uptake is not well monitored, and is considered to be low.[378] Early findings from a 2014 survey found around 30% of care home staff reported being vaccinated (personal communication to a member of the Expert Advisory Group from Professor Jackie Cassell, Deputy Dean and Honorary Consultant in Public Health, Brighton and Sussex Medical School).[379] Employers of health and social care staff are responsible for providing occupational influenza vaccinations. NICE guidance recommends a **multi-component approach to increase vaccine uptake in health and social care staff, including providing on-site vaccination, and doing this in the evenings/at handover** to also capture staff on night shift.[380]

There are other settings where those at risk are likely to be over-represented but the population struggles to access mainstream vaccination services. Local commissioners should consider offering vaccines in novel settings to target those at risk such as homeless services, detained settings, Roma, Gypsy and Traveller encampments, and schools for those with learning disabilities.

To support this, the information system for influenza vaccinations needs further improvement.[381] **The information flows between pharmacy and GP computerised medical records on the administration of influenza vaccine should be widened to include other non-GP settings such as maternity units and hospitals**, possibly using NHS numbers (and equivalents in the devolved administrations). These approaches will also require better coordination of vaccination programmes between key agencies: PHE, NHS England, local authorities and primary care (and their equivalents in the devolved administrations).

4.4.2 Harnessing multiplex testing for improved clinical management

Routine joint testing for SARS-CoV-2, influenza and other respiratory viruses will be important for surveillance, treatment decisions and reducing rates of transmission. The management of the COVID-19 pandemic was previously severely hampered by limited availability and long delays associated with laboratory PCR testing. If patients of unknown SARS-CoV-2 status are cohorted together in assessment areas until results are returned, this leads to poor patient flow, reduced operational capacity and most importantly, nosocomial transmission to patients and staff (see section 4.2.1).

Rapid testing within the TTI system and/or point-of-care testing (POCT) for SARS-CoV-2 and influenza would distinguish the cause of influenza-like illness and optimise appropriate clinical management, including the possible widespread use of oseltamivir for influenza. Currently, the use of antivirals for influenza is low in primary care.[382] For antivirals to be effective, they need to be taken ideally within 48 hours of the onset of influenza symptoms, but can reduce recovery time in primary care patients and reduce complications of influenza in high risk adults in the community.[383,384]

PHE recommends treatment with neuraminidase inhibitors, such as oseltamivir, in high risk community patients within 48 hours of symptom onset (or later at physician discretion); all hospitalised patients irrespective of duration off illness; and recommends consideration of prophylactic use in care homes during outbreaks (irrespective of vaccination status).[385] **To reduce severe complications of influenza that impact the health service and reduce influenza transmission, PHE guidance on treatment with neuraminidase inhibitors should be widely implemented.**

The upscaling and rolling out of POCT for SARS-CoV-2 and influenza across the NHS will be essential in enabling it to respond successfully to the next phase of the pandemic during the coming winter months. Resources should be made available for hospitals, care homes and GP practices to create the infrastructure to support this. There will need to be consideration of supply chain and logistics regarding antivirals, beyond the scope of this report.

We strongly support multiplex testing; however, if this is not feasible, existing evidence supports the routine use of POCT for influenza in hospitals. The ResPOC study demonstrated that routine POCT was associated with increased detection of influenza and improvements in antibiotic, antiviral and isolation facility use, compared to laboratory PCR.[386] Testing 'syndromically' for a range of different viruses (influenza, RSV, rhinovirus, etc.) may also have benefits above testing for influenza alone.[387] In addition, observational studies show the benefits of POCT for influenza compared with laboratory testing, in primary care settings.[388] Community pharmacy based POCT for

influenza, linked to antiviral prescription, is also a potential strategy to enable widespread community POCT without overwhelming GP surgeries.[389]

Annex 1 People's Perspective – Nothing about us, without us

"*Only when patients can influence do they have power. When patients hold influence, services are designed for their experience...*"[390]

Dr Jessica Drinkwater, General Practitioner

This is our perspective

Our words accompany an Academy of Medical Sciences report 'Preparing for a challenging winter 2020/21'. The report describes the scientific perspective on factors that could make winter 2020/21 difficult for everyone in the UK, and see the NHS stretched beyond its capacity. We* all live with, or care for someone who lives with, one or more long-term conditions.[391] These conditions make us uniquely vulnerable to the coming UK winter and the challenges it brings. Between us, we have lifetimes of experience of living with long-term conditions. It has never been more important to involve us in the decisions made about our lives. We have rarely experienced more meaningful and genuine involvement than we have with this project. This is our perspective.

"*I was wary before COVID-19. Every cold, tummy bug, every child with chickenpox was a threat. Now, any contact with anyone might be fatal. I don't play Russian roulette.*"

Colin Wilkinson

We are all used to being vigilant about infections. For one reason or another, we are all at greater risk from every kind of infection. We've all learned to live with that. When this pandemic struck, it took away our control of our lives, our care and our futures. Our support networks vanished overnight. At best, the partnerships we had built with the NHS workers who care for us were put on hold. At worst, we were forgotten, some missed off shielding lists when we knew we should be on them, unable to access supermarket online shopping slots or council food boxes, feeling we didn't matter. Now, like many, we're exhausted. We recognised the feelings of those interviewed by Ipsos MORI,[392] but we all felt the stakes were higher for us.

"For those in vulnerable groups the prospect of going outside, near people who may not abide by social distancing rules, was a major source of concern. Some wondered whether they might ever take public transport or visit town centres again."

Ipsos MORI workshop participant

Many vital processes came to a sudden halt – not just our care. This was understandable, given the life or death struggle in which the whole of the UK was engaged at the time. As that struggle subsides, we feel that the most crucial, pervasive and fundamental need is to involve people in determining which health services are needed most, and how they should be delivered. Where such involvement did not exist before the pandemic, it must be put in place now. **Building back better doesn't just apply to our economy or our environment. It has to apply to our care.** Disparities between people and places have to be addressed.[394,395,396,397,398,399]

"*The pandemic has not landed evenly across the population: it has taken a greater toll on older people, on men, on poorer communities, and on Black, Asian and Minority Ethnic groups.*"[400]

We can find the best way forward together

Involving people in service design must not be a continuing casualty of COVID-19. If the people's stake in the redesign of services to cope with the challenges of winter continues to be ignored, poorer physical and mental health and a greater strain on the NHS will be the result.

"The only way to get quality, meaningful healthcare is to involve the disenfranchised patients. Theirs is the biggest need."
Carol Liddle

Facing the challenges of winter, we must have the option to make shared decisions about what matters to us, and what will enable us to cope with the challenges ahead. Designing options to access the support we want will empower us to manage our own health, working towards the life we choose for ourselves, not the treatment outcomes clinicians think we need. The only way that can happen is if we are involved in deciding which services are offered and how.[401] Working with clinicians, we can find the best way forward – together.

"When decisions are made without the people affected – they are usually the wrong decisions."
Mandy Rudczenko

Of course, our lives and our care are also shaped by guidance our Government produces, and we need a greater role in this as well. The evolving guidance from Government has become much more complex as lockdown starts to be lifted. While the risk of contracting the virus may be lower, the consequences of doing so remain unchanged for us. Those consequences vary widely, even among people who are classified as extremely clinically vulnerable. For those of us who received them, the shielding letters were complicated, long and difficult to understand. We understand that involving people in developing guidance can seem difficult. Living with guidance developed without us is much more so.

"*Decisions must reflect realities. The only way to achieve this is through true collaboration."*
Carol Liddle

There is now a window of opportunity in which Government, the NHS and social care providers can work with the people they support to design a set of services, guidelines and communications that will work for the whole person – not individual conditions – and will give people options.

Involve us now

We support National Voices' five principles[402] for the next phase of the COVID-19 response. However, we recognise that co-production processes[403,404,405,406] will be difficult to undertake remotely. Healthcare organisations must do everything they can to use involvement processes which embody the values[407] of co-production.[408]

"You can't have equality without power being shared. We are a long way from that."
Lynn Laidlaw

Any involvement and shared decision-making process has to be real, not a tokenistic effort. From experience, we feel this will not happen without Government leading by example and compelling health and other local bodies to share decision making. There is one test we would apply to any involvement process. If the decisions are not made by all the groups involved, at the same time, in the same virtual or real room, it is not real involvement. **Nothing about us should be decided without us.**

"Don't assume you know what I need unless you ask me."
Kimberlee Cole

We make one simple, heartfelt request. **Involve us now** in preparing for the challenges this winter will present – or create a burden of health problems which may last for decades. The members of this reference group, and we are sure, many like us, stand ready to assist.

"Government must listen to the voices of communities now, especially vulnerable people, and work with us to tackle the prospect of a challenging winter."
Sudhir Shah

** A full list of the members of the Patient and Carer Reference Group is available in Annex 2. This group provided information and advice on the issues most important to those who would be most affected by a bad winter. The two co-Chairs of this group sat on the Academy's Expert Advisory Group to feed patient and carer perspectives into their discussions.*

Annex 2 Report preparation

This report represents the considered input of the following Expert Advisory Group members. Members participated in a personal capacity, not as representatives of the organisations listed. The report does not necessarily represent the position of the Academy of Medical Sciences or of any of the individuals involved in its development, as listed below.

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We are grateful to the following early to mid-career researchers, who supported the development of the report by working closely with Expert Advisory Group members and the Secretariat.

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Patient and Carer Reference Group

We are grateful to the members of the Patient and Carer Reference Group for their insight into the health challenges, opportunities and priorities for this coming winter.

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Kimberlee Cole
Lynn Laidlaw
Carol Liddle
Nira Malde-Shah
Mandy Rudczenko, Co-Chair, Patient and Carer Reference Group (also sat on the Expert Advisory Group)
Sudhir Shah, Co-Chair, Patient and Carer Reference Group (also sat on the Expert Advisory Group)
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Annex 3 Covid-19 winter preparedness workshops – topline note

This note summarises the key findings from three three-hour online workshops conducted with members of the public to understand their views and priorities for the UK in coping with a possible resurgence of Covid-19 infections over the winter of 2020-2021. Between 30 June and 2 July we spoke to 36 people in the groups covering the general public, vulnerable people required to "shield" and those from Black and minority ethnic backgrounds.

A full report will be provided shortly.

Current interest in the pandemic

Overall awareness of the pandemic was high across the groups, with some having highly detailed knowledge about the virus in the UK and worldwide. However fatigue was also strongly felt: those who had been watching the daily briefings stopped doing so some time before they ended, and some participants said they didn't look for news about the pandemic any more as it was too depressing.

Interest tended to hinge on personal factors with those more directly affected showing greater levels of interest. For instance, vulnerable participants (who had received letters telling them to shield during the pandemic) tended to be more knowledgeable and interested as their health is a more important topic of their daily life than it is for the general public.

Those from BAME backgrounds (especially younger people) tended not to be aware of the disproportionate impact the disease has on these groups. As a whole, this group were less interested in talking about the disease as having an ethnicity-based element – they would rather think about socio-economic drivers, for instance the high numbers of people from ethnic minorities working as lower-paid frontline workers such as taxi drivers, bus drivers and nurses.

Life under lockdown

Views of life under lockdown were generally positive but there were also significant negatives for some. Among the positives were the ability to spend more time with children and family, being on furlough or being able to work from home and having more time for hobbies and remote socialising were all spontaneously mentioned. Older people tended to have the most positive views of lockdown.

These were also interpreted as negatives by others in the group – uncertainty over future employment (either the prospect of unemployment or an unknown return date), the stress of looking after children full time, being unable to visit friends and family and the closure of gyms and leisure facilities made lockdown hard. The uncertainty of the pandemic was a source of anxiety generally, while for those in vulnerable groups the prospect of going outside, near people who may not abide by social distancing rules, was a major source of concern. Some wondered whether they might ever take public transport or visit town centres again.

There was a general perception that "other people" were not abiding by the rules of social distancing, evidenced for many by the scenes of crowds on Bournemouth beach and also typified for some by the conduct of high-profile individuals they felt should be setting better examples. This fed a general demand among the groups that the social distancing rules be made clearer and that they should be demonstrably

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enforced, including through fines and arrests. This feeling was particularly strong among the shielding groups.

Expectations for winter

Few in the groups had any expectations of what this winter might look like. Life under the pandemic appears to have curtailed participants' time horizons with few having plans beyond August, let alone later in the year. Yet there is a generalised expectation that things might get worse: when shown stimulus suggesting that a second peak was likely over winter, the common reaction was one of unsurprised resignation. This extended to the prospect of a second lockdown, although there were strong concerns about the impact of a second lockdown on the economy.

There is also a strong association between winter and the Christmas/New Year period, meaning that participants weren't typically thinking about a winter period that can stretch until the end of March 2021. With widespread fatigue from the past few months of summer lockdown it seems likely that a similar feeling might occur and be more intense over the winter.

Concerns about a second wave were tied to life stage – those in school and Sixth Form were worried about what it would do to their exams and college/university applications, while those in employment were primarily worried that their employers might not survive a second peak and there would be mass unemployment. Those from shielding groups and the retired had fewer direct concerns and were also most comfortable with the prospect of a second lockdown.

Trust and communications

Scientists were considered a trustworthy source of information but there was a tendency to associate leading scientists with politicians. There was a common perception that a single scientific truth exists around the pandemic and that scientists are the ones promoting and defending it, while politicians are more focussed on protecting the economy. But those who were more interested in the pandemic and knew more about it were also more likely to question the mortality and infection figures, wondering whether they are being massaged or underreported. Among this group, those who distrusted the government transferred this distrust to the scientists leading the response, whose position was seen to be politicised.

Conversely, trust in politicians was lower. Some acknowledged a difficult trade-off between protecting people and the economy (and were unable to suggest an answer) but there was criticism of the government's handling of the outbreak and its communications, which were felt to have become more complicated since the early days of the pandemic. Those who had been following the pandemic more closely were able to name multiple instances where they felt the government had manipulated figures or not been straightforward in talking to the public.

The groups expressed confusion about the current guidelines, being unsure about how to act under many of the new, less absolute, social distancing measures. Coming shortly ahead of the planned opening of many shops and restaurants in England on the 4th July, there was also a view that many of the newly-opening places would not follow the rules. Some demanded greater clarity on the scientific rationale behind each of the steps that have been taken in the opening up – what the impact of each step was expected to be and the thought process behind permitting it.

Those who are shielding had more personal experience of communications during the pandemic, with a wider range of authorities and people. It is clear that their experiences have varied widely within the nations, dependent on the Local Authority and hospital catchments they live in.

Those living in Scotland and Wales were more positive about the performance of their national leaders, contrasting this against what they saw as the poor performance of the UK government.

Preparing for winter

The workshops explored public views on four areas of preparation for the winter: minimising Covid-19 transmission; minimising the spread of other winter diseases such as flu; optimising healthcare organisation to deal with the backlog of non-Covid care and optimising public health surveillance systems. The groups found it harder to engage with areas of planning beyond immediately dealing with Covid-19 – key messages are below:

Minimising Covid

There was widespread support for all hygiene measures minimising transmission of Covid-19 including social distancing and hand washing – and concern about how these measures would be maintained as lockdown is eased. There was demand that the position on facemasks be clarified and clearer instructions given.

Public views of the test, track and isolate system are closely tied with the “failed app” trialled on the Isle of Wight – few realise the importance of email and telephone calls to the system. As a result the groups were dismissive of how useful this system could be and questioned whether people would comply if the service told them to self-isolate. In the groups, some individuals said they would not comply themselves if they had already made plans for the period.

The government app was also tied to the Covid tracking apps which have been rolled out automatically into all Apple and Android smart phones – participants described an unpleasant surprise of finding this had been downloaded and was using their Bluetooth and GPS systems (leading one participant to turn off her Bluetooth for the first time). The groups talked of this being “creepy”, and it was not clear whether people separated this from the government-run app.

Minimising flu

Older participants and those in shielding groups were clearer on the importance of ensuring flu vaccinations for those at risk this winter, although for some the mixed effectiveness of the vaccine meant that they didn’t feel it should be mandatory. Although it was felt that front line workers and older people should be prioritised for vaccinations, the groups were not able to provide a clearer hierarchy of need.

Optimising health care organisation

Participants were aware that many regular health check-ups and appointments have been cancelled due to the Covid response. Many, including those from shielding groups, had personal experience of this through missed blood tests, antenatal check-ups, optician and dentistry appointments.

However this combination of local experiences did not translate in the group into a picture of a national backlog, and the general view was that treating Covid should be the priority. Cancer check ups were the only type of non-Covid healthcare which cut through as having equal priority to treating the pandemic.

Among younger groups there was a feeling that many smaller issues they had – chipped teeth, overdue eye tests and so on – were of secondary importance and they were resigned to waiting some time before these would be seen to. Others had experience of online alternatives – physio over Zoom for one participant – which were not felt to be as effective as in-person treatment.

Optimising health surveillance

There was a general feeling that the government has a lot of data about the pandemic and is able to pinpoint local areas – the lockdown in Leicester was announced during fieldwork and used as an evidence point in the groups. However, questions remained over how effectively the government was using this data.

Using the Leicester lockdown as an example, it remains the case that the groups see dealing with the pandemic as a national, rather than local, issue – the expectation is that the central Government (whether UK, Scottish or Welsh) would be monitoring all regions and declaring local lockdowns, rather than this being decided at a County or Local Authority level.

Key steps

The workshops were asked what they felt to be the key steps for different groups as we approach winter:

- **Individuals**: Use “common sense” and take the personal hygiene measures recommended
- **Businesses**: The groups expected business to focus on staying afloat during a challenging time – there wasn’t an expectation of leadership from the business sector during the pandemic
- **Government**: Clearer guidelines and demonstrable punishment for those who break the rules. Some also wanted acknowledgement that early stages of the pandemic had been mishandled as a signal from the government that it is learning and listening to scientists and the people.

Annex 4 UK winter forecasts

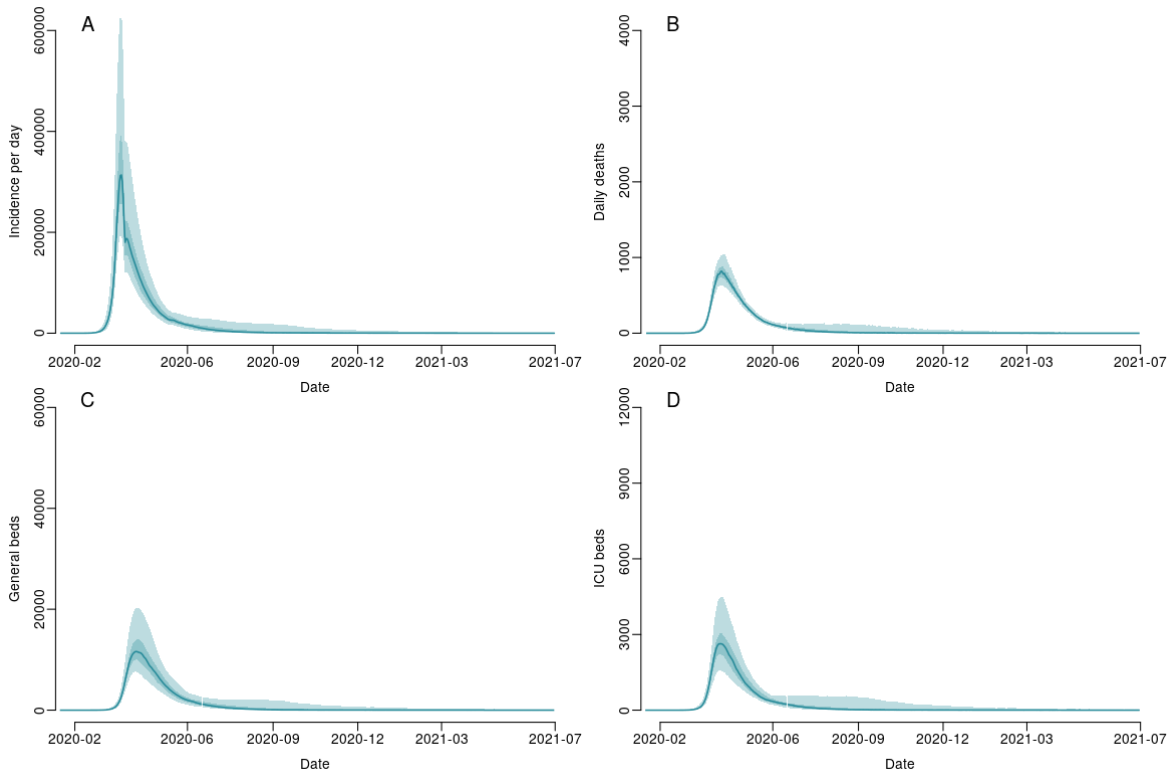

Figure A. *This model assumes that R_t = 1.1 from September 2020 through to July 2021. (A) daily infections, (B) COVID-19-attributable deaths in hospital (i.e. excluding care homes and excess deaths in the community), (C) general beds occupied and (D) critical care beds occupied. The solid line shows the median, dark band the interquartile range, and pale band the 95% credible interval (CrI).*

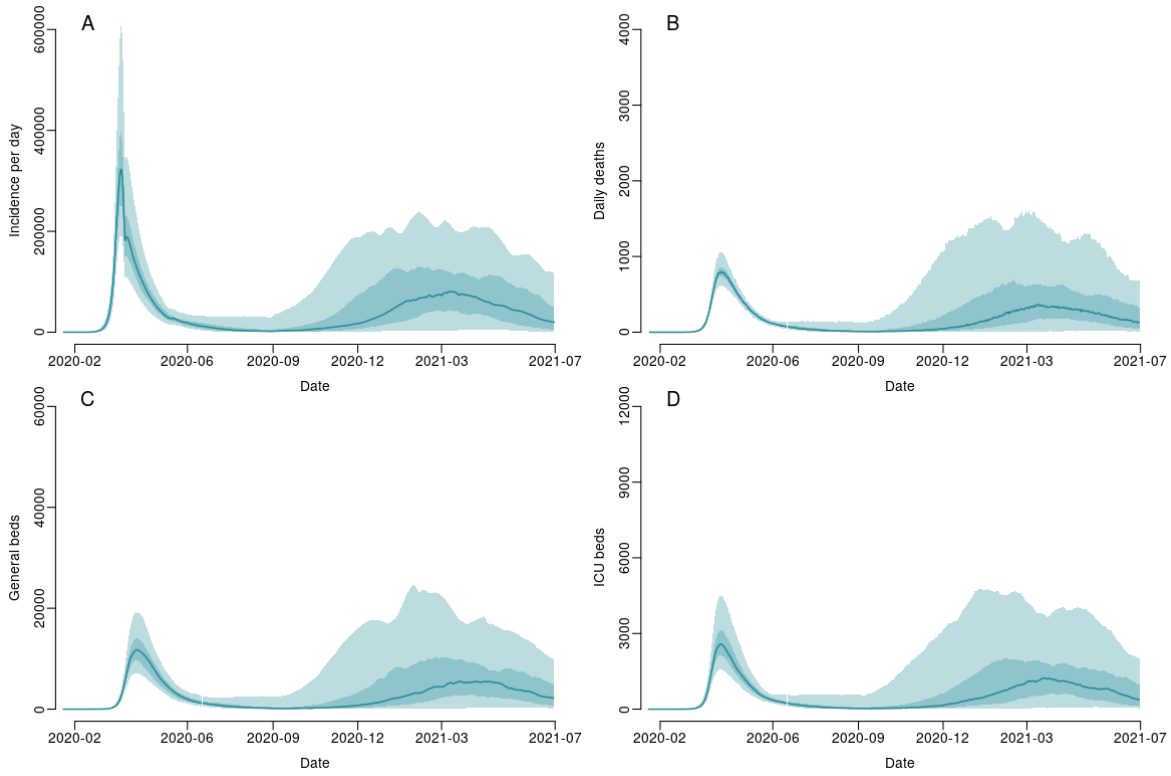

Figure B. *This model assumes that R_t = 1.5 from September 2020 through to July 2021. (A) daily infections, (B) COVID-19-attributable deaths in hospital (i.e. excluding care homes and excess deaths in the community), (C) general beds occupied and (D) critical care beds occupied. The solid line shows the median, dark band the interquartile range, and pale band the 95% credible interval (CrI).*

References

[1] The King's Fund (2020). *NHS hospital bed numbers: past, present, future*. https://www.kingsfund.org.uk/publications/nhs-hospital-bed-numbers
[2] Defined as deaths above the annual mean between December and March.
[3] Office for National Statistics (2019). *Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2018to2019provisionaland2017to2018final#:~:text=1.-,Main%20points,and%202017%20to%202018%20winters.
[4] Pebody RG, *et al*. (2018). *Significant Spike in Excess Mortality in England in Winter 2014/15 - Influenza the Likely Culprit*. Epidemiology and Infection **146(9)**, 1106-1113.
[5] *National Records of Scotland. (2018) Winter Mortality in Scotland 2017/18 https://www.nrscotland.gov.uk/files/statistics/winter-mortality/2018/winter-mortality-17-18-pub.pdf*
[6] Northern Ireland Statistics and Research Agency. (2018). *Excess Winter Mortality 2017/18* https://www.nisra.gov.uk/publications/excess-winter-mortality-201718
[7] NHS Confederation (2020). *Public reassurance needed over slow road to recovery for the NHS*. https://www.nhsconfed.org/news/2020/06/road-to-recovery
[8] Defined as deaths above the annual mean between December and March.
[9] Office for National Statistics (2019). *Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2018to2019provisionaland2017to2018final#:~:text=1.-,Main%20points,and%202017%20to%202018%20winters.
[10] Pebody RG, *et al*. (2018). *Significant Spike in Excess Mortality in England in Winter 2014/15 - Influenza the Likely Culprit*. Epidemiology and Infection **146(9)**, 1106-1113.
[11] Office for National Statistics (2018). *Excess winter mortality in England and Wales: 2017 to 2018 (provisional) and 2016 to 2017 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2017to2018provisionaland2016to2017final
[12] NHS England (2018). *Deferred elective in January 2018*. https://www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2018/03/Deferred-elective-activity-in-January-2018-FINAL.pdf
[13] Extra winter mortality is defined as deaths above the annual mean between December and March.
[14] Office for National Statistics (2019). *Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2018to2019provisionaland2017to2018final#:~:text=1.-,Main%20points,and%202017%20to%202018%20winters.
[15] Pebody RG, *et al*. (2018). *Significant Spike in Excess Mortality in England in Winter 2014/15 - Influenza the Likely Culprit*. Epidemiology and Infection **146(9)**, 1106-1113.
[16] *National Records of Scotland. (2018) Winter Mortality in Scotland 2017/18* https://www.nrscotland.gov.uk/files/statistics/winter-mortality/2018/winter-mortality-17-18-pub.pdf
[17] Northern Ireland Statistics and Research Agency. (2018). *Excess Winter Mortality 2017/18* https://www.nisra.gov.uk/publications/excess-winter-mortality-201718
[18] **[pre-print]** Wang J, *et al*. (2020). *High Temperature and High Humidity Reduce the Transmission of COVID-19*. Social Science Research Network, 3351767. https://dx.doi.org/10.2139/ssrn.3551767
[19] Wu Y, *et al*. (2020). *Effects of temperature and humidity on the daily new cases and new deaths of COVID-19 in 166 countries*. Science of the Total Environment **729**, 139051.
[20] Price RHM, Graham C & Ramalingam S (2019). *Association between viral seasonality and factors*. Scientific Reports **9**, 929.
[21] Hajat S, Bird W & Haines A (2004). *Cold Weather and GP Consultations for Respiratory Conditions by Elderly People in 16 Locations in the UK*. European Journal of Epidemiology **19(10)**, 959-968.
[22] Nuffield Trust (2018). *Snowed under: understanding the effects of winter on the NHS*. https://www.nuffieldtrust.org.uk/files/2018-12/1544789063_effects-of-winter-on-the-nhs-web.pdf
[23] Hajat S, *et al*. (2016). *Public health vulnerability to wintertime weather: time-series regression and episode analyses of national mortality and morbidity databases to inform the Cold Weather Plan for England*. Public Health **137**, 26-34.
[24] Patterson S (2018). *Do hospital admission rates increase in colder winters? A decadal analysis from an eastern county in England*. Journal of Public Health **40(2)**, 221-228.
[25] Public Health England (2017). *Cold Weather Plan For England; Making the Case: Why long-term strategic planning for cold weather is essential to health and wellbeing*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652568/Cold_Weather_Plan_Making_the_Case_2017.pdf
[26] Hajat S (2017). *Health effects of milder winters: a review of evidence from the United Kingdom*. Environmental Health **16(Suppl 1)**, 109.
[27] The King's Fund (2020). *NHS hospital bed numbers: past, present, future*. https://www.kingsfund.org.uk/publications/nhs-hospital-bed-numbers

[28] National Institute for Health and Care Excellence (2018). *Chapter 39 Bed occupancy; Emergency and acute medical care in over 16s: service delivery and organisation*. https://www.nice.org.uk/guidance/ng94/evidence/39.bed-occupancy-pdf-172397464704
[29] Office for National Statistics (2019). *Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2018to2019provisionaland2017to2018final#:~:text=1.-,Main%20points,and%202017%20to%202018%20winters.
[30] NHS (2019). *The NHS Long Term Plan*. https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf
[31] The Health Foundation (2017). *Winter is coming: How much would it cost to keep the pressure down?* https://www.health.org.uk/blogs/winter-is-coming-how-much-would-it-cost-to-keep-the-pressure-down
[32] Hajat S (2017). *Health effects of milder winters: a review of evidence from the United Kingdom*. Environmental Health **16(Suppl 1)**, 109. https://doi.org/10.1186/s12940-017-0323-4
[33] Charlton-Perez AJ, *et al*. (2019). *Winter pressures on the UK health system dominated by the Greenland Blocking weather regime*. Winter and Climate Extremes **25**, 100218.
[34] Public Health England (2018). *Estimation of costs to the NHS and social care due to the health impacts of air pollution: summary report*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/708855/Estimation_of_costs_to_the_NHS_and_social_care_due_to_the_health_impacts_of_air_pollution_-_summary_report.pdf
[35] Beynon C, *et al*. (2011). *The cost of emergency hospital admissions for falls on snow and ice in England during winter 2009/10: a cross sectional analysis*. Environmental Health **10**, 60.
[36] Parsons N, *et al*. (2011). *Modelling the Effects of the Weather on Admissions to UK Trauma Units: A Cross-Sectional Study*. Emergency Medicine Journal **28(10)**, 851-855.
[37] Okell LC, *et al*. (2020). *Have deaths from COVID-19 in Europe plateaued due to herd immunity?* The Lancet **395(10241)**, E110-111.
[38] Birrel P, *et al*. (2020). *COVID-19:nowcast and forecast*. https://www.mrc-bsu.cam.ac.uk/now-casting/
[39] Verity R, *et al*. (2020). *Estimates of the severity of coronavirus disease 2019: a model-based analysis*. The Lancet Infectious Diseases **20(6)**, 669-677.
[40] Docherty AB, *et al*. (2020). *Features of 20 133 UK patients in hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: prospective observational cohort study*. British Medical Journal **369**, m.1985.
[41] Birrel P, *et al*. (2020). *COVID-19:nowcast and forecast*. https://www.mrc-bsu.cam.ac.uk/now-casting/
[42] Flaxman S, *et al*. (2020). *Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe*. Nature, https://doi.org/10.1038/s41586-020-2405-7 [unedited manuscript]
[43] Birrel P, *et al*. (2020). *COVID-19:nowcast and forecast*. https://www.mrc-bsu.cam.ac.uk/now-casting/
[44] Public Health England (2020). *Weekly Coronavirus Disease 2019 (COVID-19) Surveillance Report; Summary of COVID-19 surveillance systems*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/888254/COVID19_Epidemiological_Summary_w22_Final.pdf
[45] Okell LC, *et al*. (2020). *Have deaths from COVID-19 in Europe plateaued due to herd immunity?* The Lancet **395(10241)**, E110-111.
[46] Flaxman S, *et al*. (2020). *Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe*. Nature, https://doi.org/10.1038/s41586-020-2405-7 [unedited manuscript]
[47] Baker RE, *et al*. (2020). *Susceptible supply limits the role of climate in the early SARS-CoV-2 pandemic*. Science, science.abc2535.
[48] **[pre-print]** Horby P, *et al.* (2020). *Effect of dexamethasone in hospitalized patients with COVID-19: preliminary report.* medRxiv, 20137273. https://doi.org/10.1101/2020.06.22.20137273
[49] de Lusignan S, *et al*. (2020). *Risk Factors for SARS-CoV-2 Among Patients in the Oxford Royal College of General Practitioners Research and Surveillance Centre Primary Care Network: A Cross-Sectional Study*. The Lancet Infectious Diseases, https://doi.org/10.1016/S1473-3099(20)30371-6 [published online ahead of print, 2020 May 15].
[50] The Guardian (2020). *Three food factories in England and Wales close over coronavirus*. https://www.theguardian.com/business/2020/jun/19/three-meat-factories-in-england-and-wales-closed-over-coronavirus
[51] Welsh Government (2020). *Written statement: Coronavirus (COVID-19) - Update on Outbreaks and Incident at meat and food processing sites in Wales*. https://gov.wales/written-statement-coronavirus-covid-19-update-outbreaks-and-incident-meat-and-food-processing-sites
[52] Ministry of Housing, Communities & Local Government (2020). *COVID-19: Guidance for the safe use of places of worship from 4 July*. https://www.gov.uk/government/publications/covid-19-guidance-for-the-safe-use-of-places-of-worship-from-4-july/covid-19-guidance-for-the-safe-use-of-places-of-worship-from-4-july
[53] **[pre-print]** Le Bert N, *et al.* (2020). *Different pattern of pre-existing SARS-COV-2 specific T cell immunity in SARS-recovered and uninfected individuals*. bioRxiv, 115832. https://doi.org/10.1101/2020.05.26.115832
[54] **[pre-print]** Peng Y, *et al*. (2020). *Broad and strong memory CD4^{+} and CD8^{+}T cells induced by SARS-CoV-2 in UK convalescent COVID-19 patients*. bioRxiv, 134551. https://doi.org/10.1101/2020.06.05.134551
[55] **[pre-print]** Sekine T, *et al*. (2020). *Robust T cell immunity in convalescent individuals with asymptomatic or mild COVID-19*. bioRxiv, 174888. https://www.biorxiv.org/content/10.1101/2020.06.29.174888v1
[56] Nickbakhsh S, *et al*. (2019). *Virus-virus Interactions Impact the Population Dynamics of Influenza and the Common Cold*. Proceedings of the National Academy of Sciences of the United States of America, **116(52)**, 27142-27150.

[57] Nickbakhsh S, *et al*. (2020). *Epidemiology of Seasonal Coronaviruses: Establishing the Context for the Emergence of Coronavirus Disease 2019*. The Journal of Infectious Diseases **222(1)**, 17-25.
[58] Gorse GJ, Patel GB & Fan X (2017). *Interpatient mutational spectrum of human coronavirus-OC43 revealed by illumina sequencing*. Journal of Medical Virology **89(8)**, 1330-1338.
[59] Kiyuka PK, *et al*. (2018). *Human Coronavirus NL63 Molecular Epidemiology and Evolutionary Patterns in Rural Coastal Kenya*. The Journal of Infectious Diseases **217(11)**, 1728-1739.
[60] Bikle DD (2014). *Vitamin D metabolism, mechanism of action, and clinical applications*. Chemistry and Biology **21(3)**, 319-329.
[61] Abolins S, *et al*. (2017). *The Comparative Immunology of Wild and Laboratory Mice, Mus Musculus Domesticus*. Nature Communications **8**, 14811.
[62] Martineau AR, *et al*. (2017). *Vitamin D Supplementation to Prevent Acute Respiratory Tract Infections: Systematic Review and Meta-Analysis of Individual Participant Data*. British Medical Journal **356**, i6583.
[63] Altizer S, *et al*. (2006). *Seasonality and the Dynamics of Infectious Diseases*. Ecology Letters **9(4)**, 467-484.
[64] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[65] The Centre for Evidence-Based Medicine (2020). *BAME COVID-19 Deaths - What do we know? Rapid Data and Evidence Review*. https://www.cebm.net/covid-19/bame-covid-19-deaths-what-do-we-know-rapid-data-evidence-review
[66] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[67] The Centre for Evidence-Based Medicine (2020). *BAME COVID-19 Deaths - What do we know? Rapid Data and Evidence Review*. https://www.cebm.net/covid-19/bame-covid-19-deaths-what-do-we-know-rapid-data-evidence-review
[68] Office for National Statistics (2020). *Coronavirus (COVID-19) related deaths by ethnic group, England and Wales: 2 March 2020 to 10 April 2020*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/coronavirusrelateddeathsbyethnicgroupenglandandwales/2march2020to10april2020
[69] Institute for Fiscal Studies (2020). Are some ethnic groups more vulnerable to COVID-19 than others? https://www.ifs.org.uk/inequality/chapter/are-some-ethnic-groups-more-vulnerable-to-covid-19-than-others/
[70] **[pre-print]** The OpenSAFELY Collaborative, *et al*. (2020). *OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients*. medRxiv, 20092999. https://doi.org/10.1101/2020.05.06.20092999
[71] Aldridge RW, *et al*. (2020). *Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data [version 2; peer review: 2 approved, 1 approved with reservations]*. Wellcome Open Research **5(88)**, 15922.2.
[72] **[pre-print]** Sapey E, *et al*. (2020). *Ethnicity and risk of death in patients hospitalised for COVID-19 infection: an observational cohort study in an urban catchment area*. medRxiv, 20092296. https://doi.org/10.1101/2020.05.05.20092296
[73] **[pre-print]** The OpenSAFELY Collaborative, *et al*. (2020). *OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients*. medRxiv, 20092999. https://doi.org/10.1101/2020.05.06.20092999
[74] Aldridge RW, *et al*. (2020). *Black, Asian and Minority Ethnic groups in England are at increased risk of death from COVID-19: indirect standardisation of NHS mortality data [version 2; peer review: 2 approved, 1 approved with reservations]*. Wellcome Open Research **5(88)**, 15922.2.
[75] Office for National Statistics (2020). *Coronavirus (COVID-19) related deaths by ethnic group, England and Wales: 2 March 2020 to 10 April 2020*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/articles/coronavirusrelateddeathsbyethnicgroupenglandandwales/2march2020to10april2020
[76] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[77] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[78]Baker CJ (2011). *Help Make Your School a Flu-Free Zone.* NASN School Nurse **26(6)**, 364-7.
[79] **[pre-print]** Viner RM, *et al*. (2020). *Susceptibility to and transmission of COVID-19 amongst children and adolescents compared with adults: a systematic review and meta-analysis*. medRxiv, 20108126. https://doi.org/10.1101/2020.05.20.20108126
[80] Davies NG, *et al*. (2020). *Age-dependent effects in the transmission and control of COVID-19 epidemics*. Nature Medicine, https://www.nature.com/articles/s41591-020-0962-9 [published ahead of print, 2020 Jun 16].
[81] **[pre-print]** Panovska-Griffiths J, *et al*. (2020). *Determining the optimal strategy for reopening schools, work and society in the UK: balancing earlier opening and the impact of test and trace strategies with the risk of occurrence of a secondary COVID-19 pandemic wave*. medRxiv, 20100461. https://doi.org/10.1101/2020.06.01.20100461
[82] **[pre-print]** Keeling MJ, *et al*. (2020). *The impact of school reopening on the spread of COVID-19 in England*. medRxiv, 20121434. https://doi.org/10.1101/2020.06.04.20121434

[83] Bressan S, *et al*. (2020). *Lockdown: more domestic accidents than COVID-19 in children.* Archives of Disease in Childhood, http://dx.doi.org/10.1136/archdischild-2020-319547 [published online ahead of print, 2020 Jun 02] [internally peer reviewed].
[84]National Society for the Prevention of Cruelty to Children (2020). *Calls about domestic abuse highest on record following lockdown increase*. https://www.nspcc.org.uk/about-us/news-opinion/2020/Calls-about-domestic-abuse-highest-on-record-following-lockdown-increase/
[85] Bhopal S, *et al.* (2020). *Who has been missed? Dramatic decrease in numbers of children seen for child protection assessments during the pandemic.* Archives of Disease in Childhood, http://dx.doi.org/10.1136/archdischild-2020-319783 [published online ahead of print, 2020 Jun 18] [internally peer reviewed].
[86] Fujiwara D, *et al.* (2020). *The Wellbeing Costs of COVID-19 in the UK*. https://www.jacobs.com/sites/default/files/2020-05/jacobs-wellbeing-costs-of-covid-19-uk.pdf
[87] NHS Digital (2018). *Mental health of children and young people in England: Summary of key findings.* https://files.digital.nhs.uk/A6/EA7D58/MHCYP%202017%20Summary.pdf
[88] Co-SPACE study (2020). *Report 04: Changes in children and young people's emotional and behavioural difficulties through lockdown*. https://emergingminds.org.uk/wp-content/uploads/2020/06/CoSPACE-Report-4-June-2020.pdf
[89] COVID-19 Psychological Research Consortium (2020). *Initial research findings on the impact of COVID-19 on the well-being of young people aged 13 to 24 in the UK.* https://drive.google.com/file/d/1AOc0wCPqv2gfFSQ_DVmw12vrgQK01z0V/view
[90] **[pre-print]** Panovska-Griffiths J, *et al*. (2020). *Determining the optimal strategy for reopening schools, work and society in the UK: balancing earlier opening and the impact of test and trace strategies with the risk of occurrence of a secondary COVID-19 pandemic wave*. medRxiv, 20100461. https://doi.org/10.1101/2020.06.01.20100461
[91] Johns Hopkins University & Medicine (2020). *COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)*. https://coronavirus.jhu.edu/map.html
[92] Martineau AR, *et al*. (2017). *Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data*. British Medical Journal **356**, i6583.
[93] **[pre-print]** Wang J, *et al*. (2020). *High Temperature and High Humidity Reduce the Transmission of COVID-19*. Social Science Research Network Electronic Journal, 3551767. http://dx.doi.org/10.2139/ssrn.3551767
[94] Wu Y, *et al*. (2020). *Effects of Temperature and Humidity on the Daily New Cases and New Deaths of COVID-19 in 166 Countries*. The Science of the Total Environment **729**, 139051.
[95] Price RHM, Graham C & Ramalingam R (2019). *Association between viral seasonality and meteorological factors*. Scientific Reports **9**, 929.
[96] Baker RE, *et al*. (2020). *Susceptible supply limits the role of climate in the early SARS-CoV-2 pandemic*. Science, science.abc2535.
[97] Zhu Y, *et al*. (2020). *Association between short-term exposure to air pollution and COVID-19 infection: Evidence from China*. Science of the Total Environment **727**, 138704.
[98] Fattorini D & Regoli F (2020). *Role of the chronic air pollution levels in the Covid-19 outbreak risk in Italy*. Environmental Pollution **264**, 114732.
[99] Frontera A, *et al*. (2020). *Severe air pollution links to higher mortality in COVID-19 patients: The "double-hit" hypothesis*. Journal of Infection, https://doi.org/10.1016/j.jinf.2020.05.031 [Article in press]
[100] **[pre-print]** Wu X, *et al*. (2020). *Exposure to air pollution and COVID-19 mortality in the United States: A nationwide cross-sectional study*. medRxiv, 20054502. https://doi.org/10.1101/2020.04.05.20054502
[101] **[pre-print]** Venter ZS, *et al*. (2020). *COVID-19 lockdowns cause global air pollution declines with implications for public health risk*. medRxiv, 20060673. https://doi.org/10.1101/2020.04.10.20060673
[102] Chen W, *et al*. (2020). *Short-range airborne route dominates exposure of respiratory infection during close contact*. Building and Environment **176**, 106859.
[103] Chao CYH, *et al.*, (2008). *Characterization of expiration air jets and droplet size distributions immediately at the mouth opening.* J Aerosol Sci **40(2)**, 122–133.
[104] SAGE – Environmental and Modelling Group (2020). *Evidence of environmental dispersion for different mechanisms, and the risks and potential mitigations/measures of control within different environments from what we know about COVID-19.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/887556/SAGE_paper_Apr_2020_Final-redacted.pdf
[105] Nazaroff WW (2016). *Indoor Bioaerosol Dynamics*. Indoor Air **26(1)**, 61-78.
[106] Sharpe T, *et al*. (2015). *Occupant Interactions and Effectiveness of Natural Ventilation Strategies in Contemporary New Housing in Scotland, UK*. International Journal of Environmental Research and Public Health **12(7)**, 8480-8497.
[107] Dimitroulopoulou C (2012). *Ventilation in European dwellings: A review*. Building and Environment **47**, 109-125.
[108] Ministry of Housing, Communities & Local Government (2019). *Ventilation and Indoor Air Quality in New Homes*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835208/Research_-_ventilation_and_indoor_air_quality.pdf
[109] Nicas M, Nazaroff WW & Hubbard A (2010). *Toward Understanding the Risk of Secondary Airborne Infection: Emission of Respirable Pathogens*. Journal of Occupational and Environmental Hygiene **2(3)**, 143-154.
[110] SAGE – Environmental and Modelling Group (2020). *Environmental Influence on Transmission.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/887618/EMG_Environmental_transmission-_02052020__1_.pdf

[111] van Doremalen N, *et al*. (2020). *Aerosol and Surface Stability of SARS-CoV-2 as Compared with SARS-CoV-1*. The New England Journal of Medicine **382**, 1564-1567.
[112] Ratnesar-Shumate S, *et al*. (2020). *Simulated Sunlight Rapidly Inactivates SARS-CoV-2 on Surfaces*. The Journal of Infectious Diseases **222(2)**, 214-222.
[113] Chin AWH, *et al*. (2020). *Stability of SARS-CoV-2 in different environmental conditions*. The Lancet Microbe, https://doi.org/10.1016/S2666-5247(20)30003-3 [published online, 2020 Apr 02].
[114] World Health Organisation (2018). *WHO Housing and Health Guidelines 4; Low indoor temperatures and insulation*. World Health Organisation, Geneva. https://www.ncbi.nlm.nih.gov/books/NBK535294/
[115] Jevons R, *et al*. (2016). *Minimum Indoor Temperature Threshold Recommendations for English Homes in Winter - A Systematic Review*. Public Health **136**, 4-12.
[116] Shiue I (2016). *Cold homes are associated with poor biomarkers and less blood pressure check-up: English Longitudinal Study of Ageing, 2012-2013*. Environmental Science and Pollution Research International **23(7)**, 7055-7059.
[117] Lauc G, *et al*. (2020). *Fighting COVID-19 with water*. Journal of Global Health **10(1)**, 010344.
[118] Ministry of Housing, Communities & Local Government (2019). *Ventilation and Indoor Air Quality in New Homes*.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835208/Research_-_ventilation_and_indoor_air_quality.pdf
[119] Randhawa G (2007). *Tackling health inequalities for minority ethnic groups: challenges and opportunities*.
https://raceequalityfoundation.org.uk/wp-content/uploads/2018/03/health-brief6.pdf
[120] Equality and Human Rights Commission (2018). *Healing a divided Britain: the need for a comprehensive race equality strategy*. https://www.equalityhumanrights.com/sites/default/files/healing_a_divided_britain_-_the_need_for_a_comprehensive_race_equality_strategy_final.pdf
[121] UK Government (2018). *Overcrowded households*. https://www.ethnicity-facts-figures.service.gov.uk/housing/housing-conditions/overcrowded-households/latest#by-ethnicity
[122] UK Government (2019). *Families and households*. https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/families-and-households/latest#ethnic-groups-by-household-type
[123] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[124] Public Health England (2020). *Disparities in the risk and outcomes of COVID-19*.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892085/disparities_review.pdf
[125] The King's Fund (2020). *NHS hospital bed numbers: past, present, future*.
https://www.kingsfund.org.uk/publications/nhs-hospital-bed-numbers
[126] The King's Fund (2019). *Brexit: the implications for health and social care*.
https://www.kingsfund.org.uk/publications/articles/brexit-implications-health-social-care
[127] Health Service Journal (2019). *Brexit and the NHS workforce: A guide for healthcare leaders*.
https://www.hsj.co.uk/workforce/brexit-and-the-nhs-workforce-a-guide-for-healthcare-leaders/7024658.article
[128] National Health Service Digital (2020). *NHS Sickness Absence Rates*. https://digital.nhs.uk/data-and-information/publications/statistical/nhs-sickness-absence-rates
[129] Brooks SK, *et al*. (2018). *A Systematic, Thematic Review of Social and Occupational Factors Associated With Psychological Outcomes in Healthcare Employees During an Infectious Disease Outbreak*. Journal of Occupational and Environmental Medicine **60(3)**, 248-257.
[130] The British Medical Association (2020). *Stress and burnout warning over COVID-19.*
https://www.bma.org.uk/news-and-opinion/stress-and-burnout-warning-over-covid-19
[131] UK Government (2020). *NHS workforce*. https://www.ethnicity-facts-figures.service.gov.uk/workforce-and-business/workforce-diversity/nhs-workforce/latest#by-ethnicity
[132] Skills for Care (2019). *The state of the adult social care sector and workforce in England, 2019.*
https://www.skillsforcare.org.uk/adult-social-care-workforce-data/Workforce-intelligence/documents/State-of-the-adult-social-care-sector/State-of-Report-2019.pdf
[133] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.*
https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[134] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.*
https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[135] Office for National Statistics (2020). *Coronavirus (COVID-19) Infection Survey pilot: 5 June 2020*.
https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/coronaviruscovid19infectionsurveypilot/5june2020/pdf
[136] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.*
https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[137] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.*
https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[138] NHS (2020). *Minimising nosocomial infections in the NHS*. https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/06/C0586-minimising-nosocomial-infections-in-the-nhs.pdf
[139] **[pre-print]** Docherty AB, *et al*. (2020). *Features of 16,749 hospitalised UK patients with COVID-19 using the ISARIC WHO Clinical Characterisation Protocol*. medRxiv, 20076042.
https://doi.org/10.1101/2020.04.23.20076042
[140] European Centre for Disease Prevention and Control (2020). *Surveillance of COVID-19 at long-term care facilities in the EU/EEA*. https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-long-term-care-facilities-surveillance-guidance.pdf

[141] Northern Ireland Statistics and Research Agency. (2020). *Weekly Deaths in Northern Ireland. Death Registration Statistics including COVID-19 by Date of Death. Week ending 12th June 2020 (Week 23)* https://www.nisra.gov.uk/sites/nisra.gov.uk/files/publications/Historial%20Weekly%20Deaths%20Bulletin%20-%20Week%20ending%2012th%20June%202020.pdf
[142] European Centre for Disease Prevention and Control (2020). *Surveillance of COVID-19 at long-term care facilities in the EU/EEA*. https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-long-term-care-facilities-surveillance-guidance.pdf
[143] Gordon AL, *et al*. (2020). *Commentary: COVID in care homes - challenges and dilemmas in healthcare delivery*. Age and Ageing, https://doi.org/10.1093/ageing/afaa113 [published online, 2020 May 13].
[144] Holroyd-Leduc J & Laupacis A (2020). *Continuing care and COVID-19: a Canadian tragedy that must not be allowed to happen again*. Canadian Medical Association Journal **192(23)**, E632-E633.
[145] Ayliffe GAJ, *et al.* (1998). *Revised guidelines for the control of methicillin-resistant Staphylococcus aureus infection in hospitals; Report of a combined working party of the British Society for Antimicrobial Chemotherapy, the Hospital Infection Society and the Infection Control Nurses Association*. The Journal of Hospital Infection **39(4)**, 253-290.
[146] Coia JE, *et al.* (2006). *Guidelines for the Control and Prevention of Meticillin-Resistant Staphylococcus Aureus (MRSA) in Healthcare Facilities*. The Journal of Hospital Infection, **63(Suppl 1)**, S1-44.
[147] International Standard Randomised Controlled Trial Number Registry (2020). *COVID-19 in care homes (VIVALDI)*. http://www.isrctn.com/ISRCTN14447421
[148] Department of Health and Social Care (2020). *Face masks and coverings to be worn by all NHS hospital staff and visitors*. https://www.gov.uk/government/news/face-masks-and-coverings-to-be-worn-by-all-nhs-hospital-staff-and-visitors
[149] Scottish Government (2020). *Enhanced safety for health and social care staff.* https://www.gov.scot/news/enhanced-safety-for-health-and-social-care-staff/
[150] Scottish Government (2020). *Enhanced safety for health and social care staff.* https://www.gov.scot/news/enhanced-safety-for-health-and-social-care-staff/
[151] NHS (2020). *Healthcare associated COVID-19 infections - further action*. https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/06/Healthcare-associated-COVID-19-infections--further-action-24-June-2020.pdf
[152] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[153] NHS Confederation (2020). *Public reassurance needed over slow road to recovery for the NHS*. https://www.nhsconfed.org/news/2020/06/road-to-recovery
[154] NHS Confederation (2020). *Getting the NHS back on track planning for the next phase of COVID-19*. https://www.nhsconfed.org/-/media/Confederation/Files/Publications/Documents/REPORT_NHS-Reset_Getting-NHS-back-on-track_FNL.pdf
[155] Holmes JL, *et al*. (2020). *Emergency Ambulance Services for Heart Attack and Stroke During UK's COVID-19 Lockdown*. The Lancet **395(10237)**, e93-e94.
[156] De Vincentiis L, *et al*. (2020). *Cancer diagnostic rates during the 2020 'lockdown', due to COVID-19 pandemic, compared with the 2018–2019: an audit study from cellular pathology*. Journal of Clinical Pathology, http://dx.doi.org/10.1136/jclinpath-2020-206833 [published online, 2020 June 19].
[157] The Royal College of Emergency Medicine (2020). *COVID-19: Resetting Emergency Department Care*. https://www.rcem.ac.uk/docs/Policy/RCEM_Position_statement_Resetting_Emergency_Care_20200506.pdf
[158] NHS (n.d.). *A&E Attendances and Emergency Admissions*. https://www.england.nhs.uk/statistics/statistical-work-areas/ae-waiting-times-and-activity/
[159] NHS (2020). *Provider-based Cancer Waiting Times for April 2020 (Provisional)*. https://www.england.nhs.uk/statistics/statistical-work-areas/cancer-waiting-times/monthly-prov-cwt/2020-21-monthly-provider-cancer-waiting-times-statistics/provider-based-cancer-waiting-times-for-april-2020-provisional/
[160] Scottish Government. (2020). Urgent medical help still available https://www.gov.scot/news/urgent-medical-help-still-available/
[161] Health and Social Care Board. (2020). *COVID-19 (coronavirus) – Don't delay in seeking help* http://www.hscboard.hscni.net/dont_delay_help/
[162] Welsh Government. (2020) *NHS activity and performance summary: April and May 2020*. https://gov.wales/nhs-activity-and-performance-summary-april-and-may-2020-html
[163] Abdelaziz HK, *et al*. (2020). *Impact of COVID-19 pandemic on patients with ST-segment elevation myocardial infarction: Insights from a British cardiac center*. American Heart Journal **226**, 45-48.
[164] Hammad TA, *et al*. (2020). *Impact of COVID-19 pandemic on ST-elevation myocardial infarction in a non-COVID-19 epicenter*. Catheterization and Cardiovascular Interventions, https://doi.org/10.1002/ccd.28997 [published online ahead of print, 2020 June 01].
[165] Nagi D, *et al*. 2020. *Supporting people with diabetes during the COVID-19 pandemic without face-to-face appointments.* British Journal of Diabetes **20**, 1-4.
[166] Dixon WG, *et al*. (2019). *How the weather affects the pain of citizen scientists using a smartphone app*. Nature Partner Journal Digital Medicine **2**, 105.
[167] Mohammad MA, *et al*. (2018). *Association of Weather With Day-to-Day Incidence of Myocardial Infarction: A SWEDEHEART Nationwide Observational Study*. Journal of the American Medical Association Cardiology **3(11)**, 1081-1089.
[168] Mohammad MA, *et al*. (2018). *Christmas, national holidays, sports events, and time factors as triggers of acute myocardial infarction: SWEDEHEART observational study 1998-2013*. British Medical Journal **363**, k4811.

[169] Wang X, *et al*. (2020). *Comorbid Chronic Diseases and Acute Organ Injuries Are Strongly Correlated with Disease Severity and Mortality among COVID-19 Patients: A Systematic Review and Meta-Analysis*. Research, 2020, 2402961 https://doi.org/10.34133/2020/2402961 [published online, 2020 Apr 19].
[170] Goff LM (2019). *Ethnicity and Type 2 Diabetes in the UK*. Diabetes Medicine: A Journal of the British Diabetic Association **36(8)**, 927-938.
[171] Tillin T, *et al*. (2012). *Southall And Brent REvisited: Cohort Profile of SABRE, a UK Population-Based Comparison of Cardiovascular Disease and Diabetes in People of European, Indian Asian and African Caribbean Origins*. International Journal of Epidemiology **41(1)**, 33-42.
[172] Wang X, *et al*. (2020). *Comorbid Chronic Diseases and Acute Organ Injuries Are Strongly Correlated with Disease Severity and Mortality among COVID-19 Patients: A Systematic Review and Meta-Analysis*. Research, 2020, 2402961 https://doi.org/10.34133/2020/2402961 [published online, 2020 Apr 19].
[173] Chaturvedi N (2003). *Ethnic differences in cardiovascular disease*. Heart **89(6)**, 681-686.
[174] Cainzos-Achirica M, *et al*. (2019). *Epidemiology, risk factors, and opportunities for prevention of cardiovascular disease in individuals of South Asian ethnicity living in Europe*. Atherosclerosis **286**, 105-113.
[175] Mathur R, *et al*. (2011). *Cardiovascular multimorbidity: the effect of ethnicity on prevalence and risk factor management*. British Journal of General Practice **61(586)**, e262-e270.
[176] **[pre-print]** Xu H, *et al*. (2020). *Acute Myocardial Injury of Patients with Coronavirus Disease 2019*. medRxiv, 20031591. https://doi.org/10.1101/2020.03.05.20031591
[177] Bansal M (2020). *Cardiovascular disease and COVID-19*. Diabetes and Metabolic Syndrome: Clinical Research and Reviews **14(3)**, 247-250.
[178] Mathur R, *et al*. (2018). *Ethnic differences in the progression of chronic kidney disease and risk of death in a UK diabetic population: an observational cohort study*. British Medical Journal Open **8(3)**, 020145.
[179] Hull S, *et al*. (2011). *The relationship of ethnicity to the prevalence and management of hypertension and associated chronic kidney disease*. BioMed Central Nephrology **12**, 1471-2369-12-41.
[180] **[pre-print]** Xu S, *et al*. (2020). *Acute kidney injury at early stage as a negative prognostic indicator of patients with COVID-19: a hospital based retrospective analysis*. medRxiv, 20042408. https://doi.org/10.1101/2020.03.24.20042408
[181] Lippi G, Wong J & Henry BM (2020). *Hypertension in Patients With Coronavirus Disease 2019 (COVID-19): A Pooled Analysis*. Polish Archives of Internal Medicine **130(4)**, 304-309.
[182] Comegna S (2017). *Prevalence of Obesity in the UK According to Sex, Age and Ethnicity: A Literature Review*. Sports Nutrition and Therapy **2(1)**, 1000121.
[183] Kass D, Duggal P & Cingolani O (2020). *Obesity Could Shift Severe COVID-19 Disease to Younger Ages*. The Lancet **395(10236)**, 1544-1545.
[184] Simpson CR, *et al*. (2015). *Ethnic variations in morbidity and mortality from lower respiratory tract infections: a retrospective cohort study*. Journal of the Royal Society of Medicine **108(10)**, 406-417.
[185] Johnson NA, *et al*. (2020). *The relationship between temperature and hip and wrist fracture incidence*. Annals Royal College of Surgeons of England **102(5)**, 348-354.
[186] Al-Azzani, *et al*. (2016). *Epidemic of fractures during a period of snow and ice: has anything changed 33 years on?* British Medical Journal Open **6(9)**, 010582.
[187] Hajat S, *et al*. (2016). *Public Health Vulnerability to Wintertime Weather: Time-Series Regression and Episode Analyses of National Mortality and Morbidity Databases to Inform the Cold Weather Plan for England*. Public Health **137**, 26-34.
[188] Intelligent Health [unpublished] 1146 people surveyed in June 2020 from Chesterfield Swindon, East Kilbride, Barnsley, East Renfrewshire, Gloucester, Blaby, Kettering, East Lothian, Leicester and Glasgow
[189] Sport England (n.d.). *Coronavirus*. https://www.sportengland.org/know-your-audience/demographic-knowledge/coronavirus#the_story_so_far
[190] Wright L, Steptoe A & Fancourt D (2020). *Are we all in this together? Longitudinal assessment of cumulative adversities by socioeconomic position in the first 3 weeks of lockdown in the UK*. Journal of Epidemiology and Community Health, https://doi.org/10.1136/jech-2020-214475 [published online ahead of print, 2020 June 05].
[191] Gray M & Bird W (2020). *COVID-19 will be followed by a deconditioning pandemic*. https://blogs.bmj.com/bmj/2020/06/15/covid-19-will-be-followed-by-a-deconditioning-pandemic/
[192] Moldofsky H & Patcai J (2011). *Chronic widespread musculoskeletal pain, fatigue, depression and disordered sleep in chronic post-SARS syndrome; a case-controlled study.* BMC Neurology **11**, 37.
[193] Win MK, *et al.* (2010). *Chikungunya fever in Singapore: acute clinical and laboratory features, and factors associated with persistent arthralgia.* Journal of Clinical Virology **49(2)**, 111-114.
[194] Etard JF, *et al.* (2017). *Multidisciplinary assessment of post-Ebola sequelae in Guinea (Postebogui): an observational cohort study.* Lancet Infectious Disease **17**, 545–552.
[195] Scott JT, *et al.* (2016). *Post-Ebola Syndrome, Sierra Leone.* Emerging Infectious Diseases. **22(4)**, 641–646.
[196] Jagadesh S, *et al.* (2018). *Disability Among Ebola Survivors and Their Close Contacts in Sierra Leone: A Retrospective Case-Controlled Cohort Study.* Clinical Infectious Disease **66(1)**, 131-133.
[197] Scott JT & Semple MG (2017). *Ebola virus disease sequelae: a challenge that is not going away.* The Lancet Infectious Diseases **17(5)**, 470-471.
[198] COVID Symptom Study app (2020). *COVID Symptom Study*. https://covid.joinzoe.com/
[199] COVID Symptom Study (2020). *How long does COVID last?* https://covid.joinzoe.com/post/covid-long-term
[200] Herridge MS, *et al*. (2011). *Functional Disability 5 Years after Acute Respiratory Distress Syndrome*. The New England Journal of Medicine **364**, 1293-1304.
[201] Whittaker E, *et al*. (2020). *Clinical Characteristics of 58 Children With a Pediatric Inflammatory Multisystem Syndrome Temporally Associated With SARS-Cov-2*. Journal of the American Medical Association, https://doi.org/10.1001/jama.2020.10369 [published ahead of print, 2020 Jun 08].

[202] Holmes EA, *et al*. (2020). *Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science*. The Lancet Psychiatry **7(6)**, 547-560.
[203] Rogers JP, *et al*. (2020). *Psychiatric and neuropsychiatric presentations associated with severe coronavirus infections: a systematic review and meta-analysis with comparison to the COVID-19 pandemic*. The Lancet Psychiatry **7(7)**, 611-627.
[204] **[pre-print]** Varatharaj A, *et al*. (2020). *UK-Wide Surveillance of Neurological and Neuropsychiatric Complications of COVID-19: The First 153 Patients*. Social Science Research Network, 3601761. https://dx.doi.org/10.2139/ssrn.3601761
[205] **[pre-print]** Pierce M, *et al*. (2020). *Mental Health Before and During the COVID-19 Pandemic: A Longitudinal Probability Sample Survey of the UK Population*. The Lancet or Social Science Research Network, 3624264. https://dx.doi.org/10.2139/ssrn.3624264
[206] **[pre-print]** Kwong ASF, *et al*. (2020). *Mental health during the COVID-19 pandemic in two longitudinal UK population cohorts*. medRxiv, 20133116. https://doi.org/10.1101/2020.06.16.20133116
[207] **[pre-print]** Pierce M, *et al*. (2020). *Mental Health Before and During the COVID-19 Pandemic: A Longitudinal Probability Sample Survey of the UK Population*. The Lancet or Social Science Research Network, 3624264. https://dx.doi.org/10.2139/ssrn.3624264
[208] Office for National Statistics (2020). *Coronavirus and anxiety, Great Britain: 3 April 2020 to 10 May 2020*. https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/articles/coronavirusandanxietygreatbritain/3april2020to10may2020
[209] Emerging Minds (n.d.). *Co-SPACE study*. https://emergingminds.org.uk/co-space-study-news/
[210] Brooks SK, *et al*. (2018). *A Systematic, Thematic Review of Social and Occupational Factors Associated With Psychological Outcomes in Healthcare Employees During an Infectious Disease Outbreak*. Journal of Occupational and Environmental Medicine **60(3)**, 248-257.
[211] Chang CK, *et al*. (2011). *Life Expectancy at Birth for People With Serious Mental Illness and Other Major Disorders From a Secondary Mental Health Care Case Register in London*. PLoS One **6(5)**, 0019590.
[212] **[pre-print]** Johnson S, *et al*. (2020). *Impact on mental health care and on mental health service users of the COVID-19 pandemic: a mixed methods survey of UK mental health care staff*. medRxiv, 20129494. https://doi.org/10.1101/2020.06.12.20129494
[213] National Health Service (2018). *Seasonal affective disorder (SAD)*. https://www.nhs.uk/conditions/seasonal-affective-disorder-sad/
[214] Graham H, *et al*. (2019). *Flood-And Weather-Damaged Homes and Mental Health: An Analysis Using England's Mental Health Survey*. International Journal of Environmental Research and Public Health **16(18)**, 3256.
[215] Price RHM, Graham C & Ramalingam S (2019). *Association between viral seasonality and meteorological factors*. Scientific Reports **9**, 929.
[216] Royal College of General Practitioners (n.d.). *RCGP Research and Surveillance Centre*. https://www.rcgp.org.uk/rsc
[217] Aldridge RW, *et al*. (2020). *Seasonality and immunity to laboratory-confirmed seasonal coronaviruses (HCoV-NL63, HCoV-OC43, and HCoV-229E): results from the Flu Watch cohort study [version 1; peer review: 2 approved with reservations]*. Wellcome Open Research **5**, 52.
[218] Public Health England (2020). *Surveillance of influenza and other respiratory viruses in the UK: Winter 2019 to 2020*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895233/Surveillance_Influenza_and_other_respiratory_viruses_in_the_UK_2019_to_2020_FINAL.pdf
[219] Defined as deaths above the annual mean between December and March.
[220] Office for National Statistics (2019). *Excess winter mortality in England and Wales: 2018 to 2019 (provisional) and 2017 to 2018 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2018to2019provisionaland2017to2018final#:~:text=1.-,Main%20points,and%202017%20to%202018%20winters.
[221] Pebody RG, *et al*. (2018). *Significant Spike in Excess Mortality in England in Winter 2014/15 - Influenza the Likely Culprit*. Epidemiology and Infection **146(9)**, 1106-1113.
[222] Office for National Statistics (2018). *Excess winter mortality in England and Wales: 2017 to 2018 (provisional) and 2016 to 2017 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2017to2018provisionaland2016to2017final
[223] Office for National Statistics (2018). *Excess winter mortality in England and Wales: 2017 to 2018 (provisional) and 2016 to 2017 (final)*. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2017to2018provisionaland2016to2017final
[224] NHS England (n.d.). *Deferred elective activity in January 2018*. https://www.england.nhs.uk/statistics/wp-content/uploads/sites/2/2018/03/Deferred-elective-activity-in-January-2018-FINAL.pdf
[225] Public Health England (2018). *Surveillance of influenza and other respiratory viruses in the UK: Winter 2017 to 2018*. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740606/Surveillance_of_influenza_and_other_respiratory_viruses_in_the_UK_2017_to_2018.pdf
[226] Nuffield Trust (2018). *Snowed under: understanding the effects of winter on the NHS*. https://www.nuffieldtrust.org.uk/files/2018-12/1544789063_effects-of-winter-on-the-nhs-web.pdf
[227] Public Health England (2020). *Weekly national flu reports: 2019 to 2020 season*. https://www.gov.uk/government/statistics/weekly-national-flu-reports-2019-to-2020-season

[228] Jefferson T, *et al*. (2009). *Physical interventions to interrupt or reduce the spread of respiratory viruses: systematic review*. British Medical Journal **339**, b3675.
[229] Hayward AC, *et al*. (2020). *Public activities preceding the onset of acute respiratory infection syndromes in adults in England - implications for the use of social distancing to control pandemic respiratory infections. [version 1; peer review: 2 approved]*. Wellcome Open Research **5**, 54.
[230] Cowling BJ, *et al*. (2020). *Impact assessment of non-pharmaceutical interventions against coronavirus disease 2019 and influenza in Hong Kong: an observational study*. The Lancet Public Health **5(5)**, E279-E288.
[231] Australian Government Department of Health (2020). *National Notifiable Diseases Surveillance System*. http://www9.health.gov.au/cda/source/rpt_3.cfm
[232] Drake TM, *et al.* (2020). *The effects of physical distancing on population mobility during the COVID-19 pandemic in the UK.* The Lancet Digital Health, https://doi.org/10.1016/S2589-7500(20)30134-5 [published online ahead of print, 2020 Jun 12].
[233] Ainslie KEC, et al. (2020). Evidence of initial success for China exiting COVID-19 social distancing policy after achieving containment [version 1; peer review: 2 approved]. Wellcome Open Research **5**, 81
[234] Browne A, *et al.* (2016). *The roles of transportation and transportation hubs in the propagation of influenza and coronaviruses: a systematic review.* Journal of Travel Medicine **23(1),** tav002.
[235] Centers for Disease Control and Prevention (2015). *Hierarchy of controls.* https://www.cdc.gov/niosh/topics/hierarchy/default.html
[236] Environmental and Modelling Group (2020). *Transmission of SARS-CoV-2 and mitigating measures.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/892043/S0484_Transmission_of_SARS-CoV-2_and_Mitigating_Measures.pdf
[237] Dietz L, *et al*. (2020). *2019 novel coronavirus (COVID-19) pandemic: built environment considerations to reduce transmission*. mSystems **5(2)**, e00245-20. [published correction appears in mSystems **5(3)**, e00375-20].
[238] Escombe AR, *et al.* (2007). *Natural ventilation for the prevention of airborne contagion.* Public Library of Science Medicine **4(2),** e68.
[239] Casanova LM, *et al.* (2010). *Effects of air temperature and relative humidity on coronavirus survival on surfaces*. Applied and Environmental Microbiology **76(9),** 2712–2717.
[240] Luongo JC, *et al.* (2016). *Role of mechanical ventilation in the airborne transmission of infectious agents in buildings*. Indoor Air **26(5),** 666–678.
[241] Hobday RA & Dancer SJ (2013). *Roles of Sunlight and Natural Ventilation for Controlling Infection: Historical and Current Perspectives*. The Journal of Hospital Infection **84(4)**, 271-82.
[242] Royal Society DELVE Initiative. (2020). *Face Masks for the General Public*. https://rs-delve.github.io/reports/2020/05/04/face-masks-for-the-general-public.html
[243] Chu DK, *et al*. (2020). *Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis*. The Lancet **395**, 1973–87
[244] **[pre-print]** Royal Society & British Academy. (2020). *Face masks and coverings for the general public: Behavioural knowledge, effectiveness of cloth coverings and public messaging*. https://royalsociety.org/-/media/policy/projects/set-c/set-c-facemasks.pdf?la=en-GB&hash=A22A87CB28F7D6AD9BD93BBCBFC2BB24
[245] Zhang R, *et al.* (2020). *Identifying airborne transmission as the dominant route for the spread of COVID-19.* Proceedings of the National Academy of Sciences **117(26),** 14857-14863.
[246] Leung NHL, *et al.* (2020). *Respiratory virus shedding in exhaled breath and efficacy of face masks*. Nature Medicine **26(5),** 676–680. [published correction appears in Nature Medicine **26(6),** 981].
[247] IZA Institute of Labor Economics (2020). *IZA DP No. 13319: Face masks considerably reduce COVID-19 cases in Germany: a synthetic control method approach.* http://ftp.iza.org/dp13319.pdf
[248] Payne DC, *et al.* (2020). *SARS-CoV-2 infections and serologic responses from a sample of U.S. Navy service members — USS Theodore Roosevelt, April 2020.* Morbidity and Mortality Weekly Report **69(23),** 714–721.
[249] Lyu W & Wehby GL (2020). *Community use of face masks and COVID-19: evidence from a natural experiment of state mandates in the US.* Health Affairs, https://doi.org/10.1377/hlthaff.2020.00818 [published online ahead of print, 2020 Jun 16].
[250] MacIntyre CR, *et al.* (2009). *Face mask use and control of respiratory virus transmission in households*. Emerging infectious diseases **15(2),** 233-241.
[251] Royal Society DELVE Initiative. (2020). *Face Masks for the General Public*. https://rs-delve.github.io/reports/2020/05/04/face-masks-for-the-general-public.html
[252] Davies NG, *et al*. (2020). *Effects of non-pharmaceutical interventions on COVID-19 cases, deaths, and demand for hospital services in the UK: a modelling study.* The Lancet Public Health, 5, e375–85
[253] Flaxman S, *et al*. (2020). *Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe*. Nature, https://doi.org/10.1038/s41586-020-2405-7 [unedited manuscript]
[254] Stutt ROJH, *et al.* (2020). *A modelling framework to assess the likely effectiveness of facemasks in combination with 'lock-down' in managing the COVID-19 pandemic.* Proceedings of the Royal Society A **476**, 20200376.
[255] Hsiang S, *et al.* (2020). *The effect of large-scale anti-contagion policies on the COVID-19 pandemic.* Nature, https://doi.org/10.1038/s41586-020-2404-8. [unedited manuscript]
[256] Bonell C, *et al.* (2020). *Harnessing behavioural science in public health campaigns to maintain 'social distancing' in response to the COVID-19 pandemic: key principles*. Journal of epidemiology and community health **74(8),** 617–619.
[257] Reynolds B & Crouse SQ (2008). *Effective communication during an influenza pandemic: the value of using a crisis and emergency risk communication framework.* Health promotion practice **9(4 Suppl),** 13S–17S.
[258] Kucharski AJ, *et al.* (2020). *Effectiveness of isolation, testing, contact tracing, and physical distancing on reducing transmission of SARS-CoV-2 in different settings: a mathematical modelling study.* The Lancet

Infectious Diseases, https://doi.org/10.1016/S1473-3099(20)30457-6 [published online ahead of print, 2020 Jun 16].
[259] Public Health England (2020). *COVID-19: guidance for households with possible coronavirus infection.* https://www.gov.uk/government/publications/covid-19-stay-at-home-guidance
[260] Suess T, *et al.* (2012). *The role of facemasks and hand hygiene in the prevention of influenza transmission in households: results from a cluster randomised trial; Berlin, Germany, 2009-2011.* BioMed Central Infectious Diseases **12,** 26.
[261] Wang Y, *et al.* (2020). *Reduction of secondary transmission of SARS-CoV-2 in households by face mask use, disinfection and social distancing: a cohort study in Beijing, China.* British Medical Journal Global Health **5**, e002794.
[262] The Policy Institute at King's College London (2020). *The Trusting, the Dissenting and the Frustrated: how the UK is dividing as lockdown is eased.* https://www.kcl.ac.uk/policy-institute/assets/how-the-uk-is-dividing-as-the-lockdown-is-eased.pdf
[263] Smith GD & Spiegelhalter D (2020). *Shielding from covid-19 should be stratified by risk.* British Medical Journal **369,** m2063.
[264] Viner RM, *et al.* (2020). *School closure and management practices during coronavirus outbreaks including COVID-19: a rapid systematic review.* The Lancet Child and Adolescent Health **4**, 397–404.
[265] Lee, J (2020). *Mental health effects of school closures during COVID-19*. The Lancet Child and Adolescent Health, **4(6)**, 421.
[266] Lin L, *et al.* (2014). *What have we learned about communication inequalities during the H1N1 pandemic: a systematic review of the literature.* BioMed Central Public Health **14,** 484.
[267] Social Care Institute for Excellence (2015). *Co-production in social care: what it is and how to do it.* https://www.scie.org.uk/publications/guides/guide51/
[268] Department of Health Northern Ireland (2018). *Co-production Guide; Connecting and Realising Value Through People.* https://www.health-ni.gov.uk/sites/default/files/publications/health/HSCB-Co-Production-Guide.pdf
[269] Scottish Co-production Network (n.d.). *Guides on co-production.* http://www.coproductionscotland.org.uk/learning/section/guides/
[270] Co-production Network for Wales (n.d). *Co-production knowledge base.* https://info.copronet.wales/
[271] We Are Undefeatable (n.d). *We Are Undefeatable*. https://www.weareundefeatable.co.uk/
[272] Public Health England (2018). *The Cold Weather Plan for England; Protecting health and reducing harm from cold weather.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/748492/the_cold_weather_plan_for_england_2018.pdf
[273] National Institute for Health and Care Excellence (2020). *Indoor air quality at home; NICE guideline [NG149].* https://www.nice.org.uk/guidance/ng149
[274] Scaife AA, *et al*. (2014). *Skillful long-range prediction of European and North American winters*. Geophysical Research Letters **41(7)**, 2514-2519.
[275] Met Office (n.d.). *Cold Weather Alerts*. https://www.metoffice.gov.uk/weather/warnings-and-advice/seasonal-advice/cold-weather-alerts
[276] Met Office (n.d.). *Weather warnings guide*. https://www.metoffice.gov.uk/weather/guides/warnings [Accessed July 2020]
[277] Met Office (n.d.). *Flood warnings guide [for UK]*. https://www.metoffice.gov.uk/weather/guides/flood-warnings [Accessed July 2020]
[278] Mitchell F (2020). *Vitamin-D and COVID-19: do deficient risk a poorer outcome?* The Lancet Diabetes & Endocrinology **8,** 570.
[279] National Institute for Health and Care Excellence (2020). *COVID-19 rapid evidence summary: vitamin D for COVID-19; Evidence summary [ES28]*. https://www.nice.org.uk/advice/es28/chapter/Key-messages
[280] Martineau AR, *et al*. (2017). *Vitamin D supplementation to prevent acute respiratory tract infections: systematic review and meta-analysis of individual participant data.* British Medical Journal **356,** i6583.
[281] NHS (n.d.). *Vitamins and minerals; Vitamin D.* https://www.nhs.uk/conditions/vitamins-and-minerals/vitamin-d/
[282] National Institute for Health and Care Excellence (2020). *COVID-19 rapid evidence summary: vitamin D for COVID-19; Evidence summary [ES28]*. https://www.nice.org.uk/advice/es28/chapter/Key-messages
[283] Public Health England (2016). *PHE publishes new advice on vitamin D.* https://www.gov.uk/government/news/phe-publishes-new-advice-on-vitamin-d
[284] National Institute for Health and Care Excellence (2020). *COVID-19 rapid evidence summary: vitamin D for COVID-19; Evidence summary [ES28]*. https://www.nice.org.uk/advice/es28/chapter/Key-messages
[285] Kivimäki M, *et al.* (2020). *Association between socioeconomic status and the development of mental and physical health conditions in adulthood: a multi-cohort study.* The Lancet Public Health **5(3),** e140-e149.
[286] Marno P, *et al.* (2010). *Can a health forecasting service offer COPD patients a novel way to manage their condition?* Journal of Health Services Research & Policy **15(3),** 150-155.
[287] Public Health England (2014). *Local action on health inequalities: Fuel poverty and cold home-related health problems.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/357409/Review7_Fuel_poverty_health_inequalities.pdf
[288] Committee on Fuel Poverty (2020). *Committee on Fuel Poverty; Fourth Annual Report 2020.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/894502/CFP_Annual_Report_June_2020.pdf
[289] West R, *et al*. (2020). *Applying principles of behaviour change to reduce SARS-CoV-2 transmission*. Nature Human Behaviour **4(5),** 451–459.

[290] Douglas M, *et al.* (2020). *Mitigating the wider health effects of covid-19 pandemic response*. British Medical Journal **369,** m1557.
[291] **[pre-print]** Panovska-Griffiths J, et al. (2020). *Determining the optimal strategy for reopening schools, work and society in the UK: balancing earlier opening and the impact of test and trace strategies with the risk of occurrence of a secondary COVID-19 pandemic wave.* medRxiv, 20100461. https://doi.org/10.1101/2020.06.01.20100461
[292] **[pre-print]** Colbourn T, *et al.* (2020). *Modelling the health and economic impacts of population-wide testing, contact tracing and isolation (PTTI) strategies for COVID-19 in the UK.* Preprints with The Lancet, 3627273. http://dx.doi.org/10.2139/ssrn.3627273.
[293] Royal Society DELVE Initiative (2020). *Test, Trace, Isolate.* https://rs-delve.github.io/reports/2020/05/27/test-trace-isolate.html
[294] Royal Society DELVE Initiative (2020). *Test, Trace, Isolate.* https://rs-delve.github.io/reports/2020/05/27/test-trace-isolate.html
[295] Department of Health and Social Care (2020). *Weekly NHS Test and Trace bulletin, England: 11 to 17 June 2020.* https://www.gov.uk/government/publications/nhs-test-and-trace-statistics-england-11-june-to-17-june-2020/weekly-nhs-test-and-trace-bulletin-england-11-to-17-june-2020
[296] Department of Health and Social Care (2020). *Weekly NHS Test and Trace bulletin, England: 11 to 17 June 2020.* https://www.gov.uk/government/publications/nhs-test-and-trace-statistics-england-11-june-to-17-june-2020/weekly-nhs-test-and-trace-bulletin-england-11-to-17-june-2020
[297] Mahase E (2020). *Covid-19: local health teams trace eight times more contacts than national service.* British Medical Journal **369,** m2486.
[298] Dodds C & Fakoya I (2020). *Covid-19: ensuring equality of access to testing for ethnic minorities.* British Medical Journal **369,** m2122.
[299] Crawford J, *et al.* (2016). *Cancer screening behaviours among South Asian immigrants in the UK, US and Canada: a scoping study.* Health & Social Care in the Community **24(2)**, 123-153.
[300] Bamidele O, *et al.* (2017). *Exploring factors contributing to low uptake of the NHS breast cancer screening programme among Black African women in the UK.* Diversity and Equality in Health and Care **14(4)**, 212-219.
[301] Dodds C & Fakoya I (2020). *Covid-19: ensuring equality of access to testing for ethnic minorities.* BMJ **369**, m2122.
[302] Kelly C, *et al.* (2020). *Interventions to improve the uptake of screening across a range of conditions in ethnic minority groups: a systematic review. International Journal of Clinical Practice*, https://doi.org/10.1111/ijcp.13202 [published online, 2018 Jun 19].
[303] Beigel JH, *et al.* (2020). *Remdesivir for the treatment of Covid-19 — preliminary report.* The New England Journal of Medicine, https://doi.org/10.1056/NEJMoa2007764 [published online ahead of print, 2020 May 22].
[304] COVID-19 Living Data (n.d.). *Pharmacologic Treatments for COVID-19 Patients*. https://covid-nma.com/living_data/index.php
[305] National Institute for Health and Care Excellence. (2020). *COVID 19 rapid evidence summary: Remdesivir for treating hospitalised patients with suspected or confirmed COVID-19*. https://www.nice.org.uk/advice/es27/chapter/Key-messages
[306] Medicines and Healthcare products Regulatory Agency (2020). *Early access to medicines scheme (EAMS) scientific opinion: Remdesivir in the treatment of patients hospitalised with suspected or laboratory-confirmed SARS-CoV-2 infection who meet the clinical criteria.* https://www.gov.uk/government/publications/early-access-to-medicines-scheme-eams-scientific-opinion-remdesivir-in-the-treatment-of-patients-hospitalised-with-suspected-or-laboratory-confirme
[307] **[pre-print]** Horby P, *et al.* (2020). *Effect of dexamethasone in hospitalized patients with COVID-19: preliminary report.* medRxiv, 20137273. https://doi.org/10.1101/2020.06.22.20137273
[308] Medicines and Healthcare products Regulatory Agency (2020). *Dexamethasone in the treatment of COVID-19: implementation and management of supply for treatment in hospitals.* https://www.cas.mhra.gov.uk/ViewandAcknowledgment/ViewAlert.aspx?AlertID=103054
[309] UK Collaborative on Development Research. (2020). *COVID-19 Research Project Tracker by UKCDR & GloPID-R* https://www.ukcdr.org.uk/funding-landscape/covid-19-research-project-tracker/
[310] The Academy of Medical Sciences (2020). *COVID-19 pre-clinical drug development database*. https://covidpipeline.acmedsci.ac.uk/
[311] Vaccine Centre at the London School of Hygiene & Tropical Medicine (2020). *COVID-19 vaccine development pipeline.* https://vac-lshtm.shinyapps.io/ncov_vaccine_landscape/
[312] World Health Organization (2020). *Draft landscape of COVID-19 candidate vaccines.* https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines
[313] Vaccine Centre at the London School of Hygiene & Tropical Medicine (2020). *COVID-19 vaccine development pipeline.* https://vac-lshtm.shinyapps.io/ncov_vaccine_landscape/
[314] Clinical Trials Arena (2020). *Oxford Covid-19 vaccine trials start in South Africa and Brazil.* https://www.clinicaltrialsarena.com/news/oxford-covid-19-vaccine-trials/
[315] Rampling T, *et al.* (2018). *Safety and efficacy of novel malaria vaccine regimens of RTS,S/AS01B alone, or with concomitant ChAd63-MVA-vectored vaccines expressing ME-TRAP.* Nature Partner Journals Vaccines **3,** 49.
[316] Hotez PJ, Corry DB & Bottazzi ME (2020). *COVID-19 vaccine design: the Janus face of immune enhancement.* Nature Reviews Immunology **20(6),** 347–348.
[317] Department of Health and Social Care (2020). *Joint Committee on Vaccination and Immunisation: Interim advice on priority groups for COVID-19 vaccination*. https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi/interim-advice-on-priority-groups-for-covid-19-vaccination
[318] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html

[319] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[320] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html
[321] Burki T (2020). *England and Wales see 20 000 excess deaths in care homes.* The Lancet **395(10237),** 1602.
[322] Association for Palliative Medicine of Great Britain and Ireland (2020). *COVID-19 and Palliative, End of Life and Bereavement Care in Secondary Care; Role of the specialty and guidance to aid care.* https://apmonline.org/wp-content/uploads/2020/04/COVID-19-and-Palliative-End-of-Life-and-Bereavement-Care-20-April-2020-2.pdf
[323] London School of Economics Anthropology (2020). *'A Good Death' During the Covid-19 Pandemic in the UK; A Report of Key Findings and Recommendations.* http://eprints.lse.ac.uk/104143/4/GoodDeath_Report_FINAL.pdf
[324] The Academy of Medical Sciences (2019). *The Departure Lounge.* https://acmedsci.ac.uk/policy/policy-projects/the-departure-lounge
[325] The Centre for Evidence-Based Medicine (2020). *COVID-19: 'Fever Hospitals'.* https://www.cebm.net/covid-19/covid-19-reestablishing-fever-hospitals
[326] Day M (2020). *Covid-19: Nightingale hospitals set to shut down after seeing few patients.* British Medical Journal **369,** m1860.
[327] National Audit Office (2020). *Readying the NHS and adult social care in England for COVID-19.* https://www.nao.org.uk/wp-content/uploads/2020/06/Readying-the-NHS-and-adult-social-care-in-England-for-COVID-19.pdf
[328] The King's Fund (2020). *Critical care services in the English NHS.* https://www.kingsfund.org.uk/publications/critical-care-services-nhs
[329] National Audit Office (2020). *Readying the NHS and adult social care in England for COVID-19.* https://www.nao.org.uk/wp-content/uploads/2020/06/Readying-the-NHS-and-adult-social-care-in-England-for-COVID-19.pdf
[330] Public Health England (2020). *Reducing the risk of transmission of COVID-19 in the hospital setting.* https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/reducing-the-risk-of-transmission-of-covid-19-in-the-hospital-setting
[331] NHS England and NHS Improvement (2020). *Clinical guide for the management of essential cancer surgery for adults during the coronavirus pandemic.* https://www.asgbi.org.uk/userfiles/file/covid19/c0239-specialty-guide-essential-cancer-surgery-coronavirus-v1-70420.pdf
[332] NHS England (2020). *Specialty guides.* https://www.england.nhs.uk/coronavirus/secondary-care/other-resources/specialty-guides/
[333] Royal College of Surgeons of England (2020). *Recovery of surgical services during and after COVID-19.* https://www.rcseng.ac.uk/coronavirus/recovery-of-surgical-services/
[334] National Audit Office (2020). *Readying the NHS and adult social care in England for COVID-19.* https://www.nao.org.uk/wp-content/uploads/2020/06/Readying-the-NHS-and-adult-social-care-in-England-for-COVID-19.pdf
[335] Public Health England (2020). *COVID-19: management of staff and exposed patients and residents in health and social care settings.* https://www.gov.uk/government/publications/covid-19-management-of-exposed-healthcare-workers-and-patients-in-hospital-settings
[336] Faculty of Occupational Medicine (2020). *Risk Reduction Framework for NHS Staff at risk of COVID-19 infection.* https://www.fom.ac.uk/wp-content/uploads/Risk-Reduction-Framework-for-NHS-staff-at-risk-of-COVID-19-infection-12-05-20.pdf
[337] NHS England (2020). *After-care needs of inpatients recovering from COVID-19.* https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/06/C0388-after-care-needs-of-inpatients-recovering-from-covid-19-5-june-2020-1.pdf
[338] Public Health England (2020). *Reducing the risk of transmission of COVID-19 in the hospital setting.* https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/reducing-the-risk-of-transmission-of-covid-19-in-the-hospital-setting
[339] NHS England and NHS Improvement (2020). *Clinical guide for the management of essential cancer surgery for adults during the coronavirus pandemic.* https://www.asgbi.org.uk/userfiles/file/covid19/c0239-specialty-guide-essential-cancer-surgery-coronavirus-v1-70420.pdf
[340] NHS England (2020). *Specialty guides.* https://www.england.nhs.uk/coronavirus/secondary-care/other-resources/specialty-guides/
[341] Lee MH, *et al.* (2020). *A systematic review on the causes of the transmission and control measures of outbreaks in long-term care facilities: back to basics of infection control.* Public Library of Science One **15(3),** e0229911.
[342] Faculty of Occupational Medicine (2020). *Risk Reduction Framework for NHS Staff at risk of COVID-19 infection.* https://www.fom.ac.uk/wp-content/uploads/Risk-Reduction-Framework-for-NHS-staff-at-risk-of-COVID-19-infection-12-05-20.pdf
[343] Public Health England (2020). *COVID-19: management of staff and exposed patients and residents in health and social care settings.* https://www.gov.uk/government/publications/covid-19-management-of-exposed-healthcare-workers-and-patients-in-hospital-settings
[344] UK Government (2020). *Ethnicity facts and figures: NHS Workforce.* https://www.ethnicity-facts-figures.service.gov.uk/workforce-and-business/workforce-diversity/nhs-workforce/latest
[345] Royal College of Psychiatrists (2020). *Impact of COVID-19 on Black, Asian and Minority Ethnic (BAME) staff in mental healthcare settings | assessment and management of risk.*

https://www.rcpsych.ac.uk/docs/default-source/about-us/covid-19/impact-of-covid19-on-bame-staff-in-mental-healthcare-settings-report-2020.pdf?sfvrsn=22a9083a_2

[346] Public Health England (2020). *COVID-19: management of staff and exposed patients and residents in health and social care settings.* https://www.gov.uk/government/publications/covid-19-management-of-exposed-healthcare-workers-and-patients-in-hospital-settings

[347] Faculty of Occupational Medicine (2020). *Risk Reduction Framework for NHS Staff at risk of COVID-19 infection.* https://www.fom.ac.uk/wp-content/uploads/Risk-Reduction-Framework-for-NHS-staff-at-risk-of-COVID-19-infection-12-05-20.pdf

[348] House of Commons Library (2020). *NHS Key Statistics: England, February 2020.* https://commonslibrary.parliament.uk/research-briefings/cbp-7281/

[349] Greenhalgh T, et al. (2020). *Video consultations for covid-19.* British Medical Journal **368,** m998

[350] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html

[351] NHS England and NHS Improvement (2020). *GP preparedness update letter 27 March 2020.* https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/gp-preparedness-update-letter-27-march-2020-.pdf

[352] Nuffield Department of Primary Care Health Sciences (2020). Oxford RCGP Research and Surveillance Centre. https://www.phc.ox.ac.uk/covid-19/projects/oxford-rcgp-research-and-surveillance-centre

[353] **[pre-print]** The OpenSAFELY Collaborative, *et al.* (2020). *OpenSAFELY: factors associated with COVID-19-related hospital death in the linked electronic health records of 17 million adult NHS patients.* medRxiv, 20092999. https://doi.org/10.1101/2020.05.06.20092999

[354] Public Health England (2019). *Cold weather plan for England.* https://www.gov.uk/government/collections/cold-weather-plan-for-england

[355] Gordon D, *et al.* (2017). *The GP's role in promoting winter wellness.* British Journal of General Practice **67(655),** 53.

[356] Hartmann-Boyce J & Mahtani KR (2020). *Supporting people with long-term conditions (LTCs) during national emergencies.* https://www.cebm.net/covid-19/supporting-people-with-long-term-conditions-ltcs-during-national-emergencies/

[357] Public Health England (2020). *Weekly COVID-19 surveillance report published.* https://www.gov.uk/government/news/weekly-covid-19-surveillance-report-published

[358] Department of Health and Social Care (2020). *NHS test and trace statistics (England): weekly reports.* https://www.gov.uk/government/collections/nhs-test-and-trace-statistics-england-weekly-reports

[359]NHS England (2020). *COVID-19 Daily Deaths.* https://www.england.nhs.uk/statistics/statistical-work-areas/covid-19-daily-deaths/

[360] Beeching NJ, Fletcher TE & Beadsworth MBJ (2020). *Covid-19: testing times.* British Medical Journal **369**, m1403.

[361] Petherick A (2020). *Developing antibody tests for SARS-CoV-2.* The Lancet **395(10230)**, 1101-1102.

[362] DELVE (2020). *DELVE Scoping report on hospital and health care acquisition of COVID-19 and its control.* https://rs-delve.github.io/reports/2020/07/06/nosocomial-scoping-report.html

[363] COVID-19 Symptom Study app (2020). *COVID Symptom Study.* https://covid.joinzoe.com/

[364] Public Health England (2020). *Sources of UK flu data: influenza surveillance in the UK* https://www.gov.uk/guidance/sources-of-uk-flu-data-influenza-surveillance-in-the-uk

[365] de Lusignan S, *et al.* (2020). *The Oxford Royal College of General Practitioners Clinical Informatics Digital Hub: Protocol to Develop Extended COVID-19 Surveillance and Trial Platforms.* Journal of Medical Internet Research Public Health Surveillance **6(3),** e19773.

[366] Royal College of General Practitioners (n.d.). *RCGP Research and Surveillance Centre.* https://www.rcgp.org.uk/clinical-and-research/our-programmes/research-and-surveillance-centre.aspx

[367] Institute for Government (2020). *Joint Biosecurity Centre.* https://www.instituteforgovernment.org.uk/explainers/joint-biosecurity-centre

[368] Public Health England (2020). *Surveillance of influenza and other respiratory viruses in the UK; Winter 2019 to 2020.* *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895233/Surveillance_Influenza_and_other_respiratory_viruses_in_the_UK_2019_to_2020_FINAL.pdf*

[369] Public Health England (2020). *Surveillance of influenza and other respiratory viruses in the UK; Winter 2019 to 2020.* *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895233/Surveillance_Influenza_and_other_respiratory_viruses_in_the_UK_2019_to_2020_FINAL.pdf*

[370] Public Health England (2020). *Surveillance of influenza and other respiratory viruses in the UK; Winter 2019 to 2020.* *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895233/Surveillance_Influenza_and_other_respiratory_viruses_in_the_UK_2019_to_2020_FINAL.pdf*

[371] National Institute for Health and Care Excellence (2017). *Vaccine uptake in under 19s; Quality standard [QS145].* https://www.nice.org.uk/guidance/qs145/chapter/Quality-statement-1-Recall-invitations

[372] Loiacono MM, *et al.* (2020). *Patient and practice level factors associated with seasonal influenza vaccine uptake among at-risk adults in England, 2011 to 2016: an age-stratified retrospective cohort study*. Vaccine: X **4,** 100054.

[373] Baker CJ (2011). *Help Make Your School a Flu-Free Zone.* NASN School Nurse **26(6)**, 364-7.

[374] Public Health England (2020). *Surveillance of influenza and other respiratory viruses in the UK; Winter 2019 to 2020.*

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/895233/Surveillance_Influenza_and_other_respiratory_viruses_in_the_UK_2019_to_2020_FINAL.pdf

[375] Hayward AC, *et al.* (2006). *Effectiveness of an influenza vaccine programme for care home staff to prevent death, morbidity, and health service use among residents: cluster randomised controlled trial.* British Medical Journal **333(7581),** 1241.

[376] Hayward AC, *et al.* (2006). *Effectiveness of an influenza vaccine programme for care home staff to prevent death, morbidity, and health service use among residents: cluster randomised controlled trial.* British Medical Journal **333(7581),** 1241.

[377] Lietz J, *et al.* (2016). *The occupational risk of influenza A (H1N1) infection among healthcare personnel during the 2009 pandemic: a systematic review and meta-analysis of observational studies.* Public Library of Science One **11(8),** e0162061.

[378] Burki TK (2018). *Concerns over low uptake of flu vaccination in social care.* The Lancet Respiratory Medicine **6(12),** 898.

[379] Unpublished data (2014 survey: 235/796 care home staff reported being vaccinated, n=45 care homes). Courtesy of Professor Jackie Cassell, Brighton and Sussex Medical School.

[380] National Institute for Health and Care Excellence (2018). *Flu vaccination: increasing uptake; NICE guideline [NG103].* https://www.nice.org.uk/guidance/ng103/chapter/Recommendations#employers-of-health-and-social-care-staff

[381] de Lusignan S, Hoghton M & Rafi I (2017). *Flu vaccination by pharmacists leads to suboptimal medical records*. British Medical Journal **359,** j5084.

[382] Adriaenssens N, *et al.* (2011). *European Surveillance of Antimicrobial Consumption (ESAC): systemic antiviral use in Europe.* The Journal of Antimicrobial Chemotherapy **66(8),** 1897–1905.

[383] Butler CC, *et al.* (2020). *Oseltamivir plus usual care versus usual care for influenza-like illness in primary care: an open-label, pragmatic, randomised controlled trial.* The Lancet **395(10217),** 42–52.

[384] Ison MG, *et al.* (2018). *LB16; Phase 3 trial of baloxavir marboxil in high-risk influenza patients (CAPSTONE-2 study).* Open Forum Infectious Diseases **5(Suppl 1),** S764–S765.

[385] Public Health England (2019). *PHE guidance on use of antiviral agents for the treatment and prophylaxis of seasonal influenza.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/833572/PHE_guidance_antivirals_influenza_201920.pdf

[386] Brendish NJ, Malachira AK & Clark TW (2017). *Routine molecular point-of-care testing for respiratory viruses in adults presenting to hospital with acute respiratory illness (ResPOC): a pragmatic, open-label, randomised controlled trial.* The Lancet Respiratory Medicine **5(5),** 401-411.

[387] Brendish NJ, et al. (2019). *Impact of point-of-care testing for respiratory viruses on antibiotic use in adults with exacerbation of airways disease.* The Journal of Infection **79(4),** 357–362.

[388] de Lusignan S, *et al.* (2019). *Feasibility of point-of-care testing for influenza within a national primary care sentinel surveillance network in England: protocol for a mixed methods study.* Journal of Medical Internet Research Research Protocols **8(11),** e14186.

[389] Klepser DG, *et al.* (2003). *Evaluation of a community pharmacy-based influenza and group A streptococcal pharyngitis disease management program using polymerase chain reaction point-of-care testing.* Journal of the American Pharmacists Association **59(6),** 872–879.

[390] Drinkwater J (2020). *Back to the future? Patient participation in general practice during covid-19*. https://blogs.bmj.com/bmj/2020/06/04/jessica-drinkwater-back-to-the-future-patient-participation-in-general-practice-during-covid-19/

[391] Aiden H for the Richmond Group of Charities (2018). *Multimorbidity: Understanding the challenge.* https://richmondgroupofcharities.org.uk/sites/default/files/multimorbidity_-_understanding_the_challenge.pdf

[392] The Ipsos MORI 'COVID-19 winter preparedness workshops – top line note' can be found in Annex 3.

[393] The King's Fund, Health Foundation & Nuffield Trust (2020). *Delivering core NHS and care services during the Covid-19 pandemic and beyond: Letter to the Commons Health and Social Care Select Committee.* https://www.kingsfund.org.uk/publications/letter-to-health-and-social-care-select-committee-covid-19

[394] The King's Fund (2020). *What are health inequalities?* https://www.kingsfund.org.uk/publications/what-are-health-inequalities

[395] The Health Foundation (2020). *Inequalities.* https://www.health.org.uk/topics/inequalities

[396] Public Health England (2019). *Health inequalities: place-based approaches to reduce inequalities.* https://www.gov.uk/government/publications/health-inequalities-place-based-approaches-to-reduce-inequalities

[397] Public Health England (2020). *COVID-19: review of disparities in risks and outcomes.* https://www.gov.uk/government/publications/covid-19-review-of-disparities-in-risks-and-outcomes

[398] Public Health England (2020). *COVID-19: understanding the impact on BAME communities*. https://www.gov.uk/government/publications/covid-19-understanding-the-impact-on-bame-communities

[399] Niedzwiedz, CL, *et al.* (2020). *Ethnic and socioeconomic differences in SARS-CoV-2 infection: prospective cohort study using UK Biobank.* BMC Med **18**, 160. https://doi.org/10.1186/s12916-020-01640-8

[400] The King's Fund, Health Foundation & Nuffield Trust (2020). *Delivering core NHS and care services during the Covid-19 pandemic and beyond: Letter to the Commons Health and Social Care Select Committee.* https://www.kingsfund.org.uk/publications/letter-to-health-and-social-care-select-committee-covid-19

[401] The King's Fund (2020). *Delivering better services for people with long-term conditions: Building the house of care.* https://www.kingsfund.org.uk/publications/delivering-better-services-people-long-term-conditions

[402] National Voices (2020). *Five principles for the next phase of the Covid-19 response.* https://www.nationalvoices.org.uk/sites/default/files/public/publications/5_principles_statement_250620.pdf

[403] Social Care Institute for Excellence (2015). *Co-production in social care: What it is and how to do it. SCIE Guide 51.* https://www.scie.org.uk/publications/guides/guide51/

[404] Wilton C, *et al.* (2016). *A Co-production Model: five values and seven steps to make this happen in reality.* http://coalitionforcollaborativecare.org.uk/features/a-co-production-model-five-values-and-seven-steps-to-make-this-happen-in-reality/
[405] The King's Fund (2016). *Patients as partners: Building collaborative relationships among professionals, patients, carers and communities.* https://www.kingsfund.org.uk/publications/patients-partners
[406] Turakhia P & Combs B (2017). *Using Principles of Co-Production to Improve Patient Care and Enhance Value.* AMA J Ethics **19(11)**, 1125-1131. https://doi.org/10.1001/journalofethics.2017.19.11.pfor1-1711
[407] Wilton C, *et al.* (2016). *A Co-production Model: five values and seven steps to make this happen in reality.* http://coalitionforcollaborativecare.org.uk/features/a-co-production-model-five-values-and-seven-steps-to-make-this-happen-in-reality/
[408] Wilton C, *et al.* (2016). *A Co-production Model: five values and seven steps to make this happen in reality.* http://coalitionforcollaborativecare.org.uk/features/a-co-production-model-five-values-and-seven-steps-to-make-this-happen-in-reality/

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