

# **COVID-19 Transmission in Prison Settings**

**March 2021**

**Report prepared on behalf of the SAGE EMG Transmission Group**

## Background and reason for commission

The Ministry of Justice have commissioned the SAGE EMG Transmission Group to produce a consensus statement addressing the following questions to inform longer term policy.

- **What are the social and epidemiological differences in prisons between the first and second wave in England & Wales?**

Prisons are highly dynamic, residential, crowded, communal settings. As such they are highly prone to outbreaks of COVID-19 and consequent raised risk of hospitalisations and deaths (**High confidence**). COVID-19 outbreaks have continued throughout wave 1 and 2. Highly restrictive control measures including substantial restrictions on prisoner mixing, reverse cohorting of new arrivals, shielding units, confining prisoners to their cells for up to 23 hours a day, reduced socialisation, training and exercise opportunities and stopping of visitors have been in place throughout the pandemic. Control measures have been strengthened in wave 2 with increased routine testing of staff, reception testing of prisoners, mass testing during outbreaks and a wastewater testing pilot. Despite this, the incidence of disease, number and size of outbreaks, hospitalisation and mortality rates have increased markedly in wave 2 compared to wave 1, as also observed in the community (**High confidence**). This may reflect increased transmissibility (B.1.1.7 strain), higher community incidence and potentially a degree of fatigue with control measures.

- **What is the epidemiological relationship between custody and the community? – To what extent does this differ based on social and geographical dynamics and prison?**

Prisons are highly connected with the community, primarily through prison staff who have close contact with prisoners and come in and out of prison on a daily basis (**High confidence**). Regular testing of staff helps to minimise risk but is limited by incomplete uptake (**High confidence**). During the pandemic, connections through other visiting staff have been minimised, but normally constitute an important link to the community (**High confidence**). Visits from families and friends have largely been stopped through the pandemic but normally constitute an important contact with the community (**High confidence**). Inflow of prisoners has decreased markedly during the pandemic due to postponement of decreased court activity (**High confidence**). Different prisons have different levels of turnover with local prisons having very high turnover and long-stay or high secure prisons having much lower turnover (**High confidence**). Prisoners often come from, and are released to, poorer communities with higher levels of COVID-19 (**High confidence**). Prisoners may be released to communal settings such as approved premises or end up in homeless hostels, where risk of outbreaks may continue (**High confidence**).

- **How will these findings apply in the context of increasing vaccine rollout and decreasing prevalence with consideration of future prison health security?**

Prisons will remain at high risk of outbreaks even when disease levels in the community are low because importation of a single case can lead to a large outbreak (**High confidence**). Without high levels of immunity or continued intensive control measures prisons could in future become amplifiers or reservoirs of infection, including variants of concern (**High confidence**). The flow of prisoners into prison is set to increase markedly as courts reopen and a large backlog of cases are addressed (**High confidence**). This will lead to increased occupancy levels and difficulty in maintaining current control measures (**High confidence**). The current severe restrictions employed have a highly negative effect on mental health of prisoners and their families and rehabilitation (**High confidence**). In the absence of universal vaccination of staff and prisoners it is likely that these measures will need to be continued for many more months (**High confidence**). Modelling suggests that universal vaccination of prisoners would have a similar impact to the current highly intensive control measures and that vaccination of staff would also decrease infection levels in residents (**High confidence**). This suggests that severe restrictions could be lifted much faster if vaccine is rolled out faster than currently planned under the current prioritisation criteria (**High confidence**).

This briefing presents evidence for committee consideration relating to: COVID-19 related health outcomes of prisoners and prison staff, information on current control measures employed in prisons and their perceived effectiveness, the potential effectiveness of wider/additional control measures such as increased vaccination, considerations and concerns relating to the onward risk of infections and outbreaks in prisons, and the potential for prisons to become infection amplifiers/reservoirs. The report aims to outline the scientific evidence to inform key policy decisions rather than make recommendations about specific actions.

The evidence presented here, and in the accompanying appendices, is the most comprehensive summary to date on the pandemic situation within the prison system. This includes newly derived information on hospitalisation and mortality rates (of prisoners) covering the most recent months (up to March 2021).

The evidence presented here could inform:

- a) Intensity of vaccination programme
- b) Intensity of infection control measures including social distancing, and testing policy.
- c) The epidemiological heterogeneity according to prison function, geography, and compliance

Definitions used throughout:

**Outbreak** – An outbreak is defined as 2 or more prisoners or detainees or staff in the PPD who meet the case definition for COVID-19 or have a positive test result and among whom transmission was likely to have occurred within a 14-day period. In practice the outbreaks described in this report are generally much larger than the definition implies.

**Amplifier** - The concept of amplifier refers to the ability of an institutional setting such as a prison, where there is a high risk of an outbreak, where importation of a single case can lead to many more cases as a result of outbreaks.

**Reservoir** – the concept of a reservoir of infection refers to the phenomenon that when infection rates decrease in the general population settings which are prone to outbreaks may continue to be affected and potentially lead to transmission into the broader community.

## **Background:**

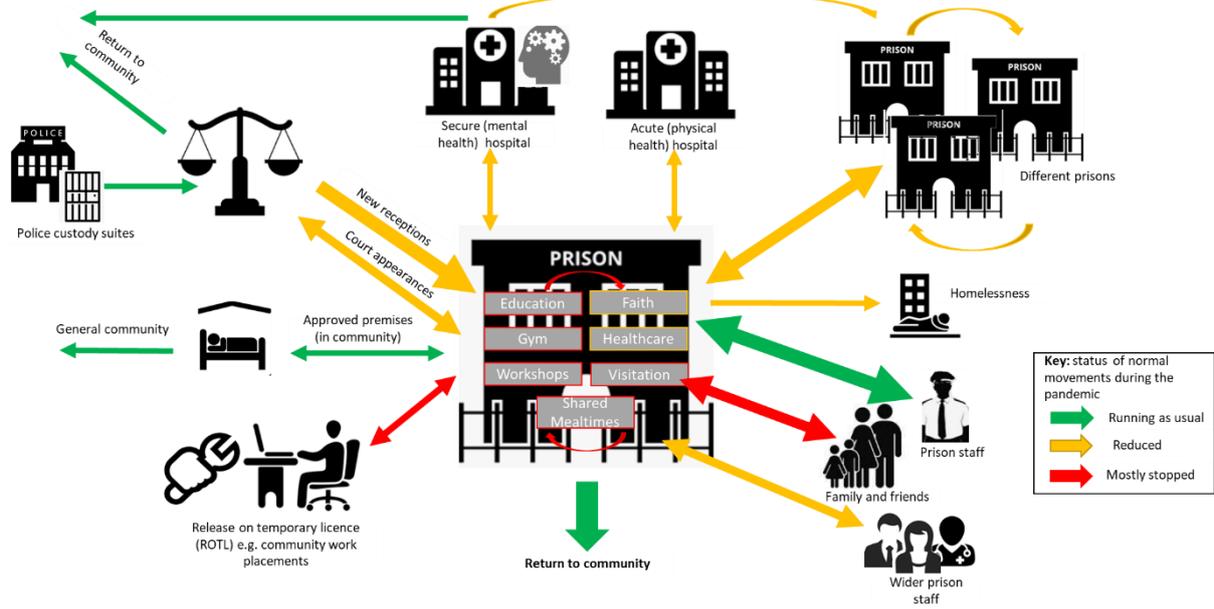
Despite stringent infection prevention and control measures in prisons for the last year there is ongoing evidence of frequent large-scale COVID-19 outbreaks across the prison sector, higher levels of infection in prison than in the general population, higher rates of hospitalisations and higher associated mortality (Braithwaite, 2021) in prisoners and prison officers. The intensity of transmission in the prison sector appears substantially higher in the second wave of the pandemic than in the first wave despite a similar intensity of control measures.

**Scientific advice and guidance is required to inform the development of an ongoing strategy for management of COVID-19 in the prison estate, as community prevalence decreases and society starts to lift restrictions.** The prison system is highly dynamic (Figure 1) and will see increases in movement over the coming months, increasing the flow of virus into and out of the prison system and between prisons. Prisons remain vulnerable to outbreaks even when community transmission is low given the amplification of infection that happens within an institutional setting due to its design and high contact rates.

Whilst community prevalence decreases, prisons will continue to remain at high risk of outbreaks, and may also act as **a potential reservoir and amplifier of infection for the community**, unless there are high levels of immunity and/or extensive restrictions and infection prevention and control (IPC) measures in place. There is a risk that variants of concern could amplify rapidly within a prison environment, compromising not only the health of those in prison, but also wider community health security.

Currently neither prisoners nor staff are prioritised for vaccination unless they fall into existing JCVI prioritisation categories. There is concern that failure to prioritise prisoners and prison staff will mean that large-scale outbreaks will continue and severe restrictions on prisoners will need to continue for many more months.

Figure 1: Movement within the prison system during the pandemic



## KEY MESSAGES

1. Prisons are highly prone to large scale outbreaks leading to higher rates of infection and hospitalisation and much higher levels of COVID-19 mortality than seen in the general population after adjusting for age. Both the higher incidence of infection and the poorer underlying health of prisoners are likely to contribute to this increase in mortality
2. Prisons will remain at high risk of outbreaks even when infection levels in the community are low because the importation of a single case can lead to a large outbreak. Without high levels of immunity or continued intensive control measures, prisons could become reservoirs and amplifiers of infection, including variants of concern. This presents a risk to the wider community as well as to those in the prison.”
3. Prison outbreaks are frequent, large, long lasting (over a period of weeks) and difficult to control. The majority of prisons have had outbreaks involving over 50 people during the second wave, although the controls in place have significantly reduced rates of infection
4. Often infections introduced into a prison will not spread, and this be reduced further by control measures. However, experience has shown that even with control measures in place there remains a significant risk that a single strain can rapidly amplify to a large outbreak, which can be very difficult to control.
5. Prison outbreaks occur despite highly intensive control measures including: substantial restrictions on prisoner mixing, reverse cohorting of new arrivals, confining prisoners to their cells for up to 23 hours a day, reduced socialisation, training and exercise opportunities and stopping of visitors
6. Although the restrictions have saved lives qualitative surveys have indicated that spending up to 23 hours a day in a cell, stopping of visits from spouses, children and partners and cancellation of rehabilitative activities has had a substantial negative impact on mental health. Whilst this parallels mental health problems associated with pandemic restrictions in the wider community the extent of the restrictions has been greater in prison and the prison population is also already highly vulnerable to mental health problems
7. Control of infection coming into the prison will become increasingly challenging as numbers of prisoners increase to normal levels
8. Effective interventions to reduce transmission, outbreaks, spread of new variants and mortality include early vaccination of all prisoners and staff, intensified testing regimes (including sequencing for early identification of variants and surge capacity), social distancing and compartmentalisation
9. Increasing early vaccination of all prisoners and staff would allow faster lifting of severe restrictions, reduce outbreaks and decrease mortality, and benefit the wider control of Covid-19

## Overarching summary statements and probability ratings

(Numbers within text refer to evidence sections in Appendix D)

Prisons are high-density environments and prior to the pandemic c.22.5% of prisoners were held in crowded conditions. As of March 2021 there were c.78,000 prisoners spread across 120 establishments in England and Wales (map of prison establishments available in Appendix E). Prisons vary in size and purpose, with some experiencing a high churn of people given the frequent receptions from court, and others designed to hold prisoners on longer sentences and deliver rehabilitative programmes of work and education (1.2). Prison design also varies. Many people are housed in relatively modern facilities, and new prison builds are in progress; meanwhile some prisoners remain resident in Victorian facilities, occasionally without in-cell sanitation.

Prisoners suffer from health inequalities, experiencing poorer health access and outcomes than the general population (1.7). The pandemic has compounded these health inequalities, requiring prisoners to be held for the last year under one of the most stringent lockdown models in the country (3.1), yet remaining at high risk of infection and poorer health outcomes from COVID-19 (4.4).

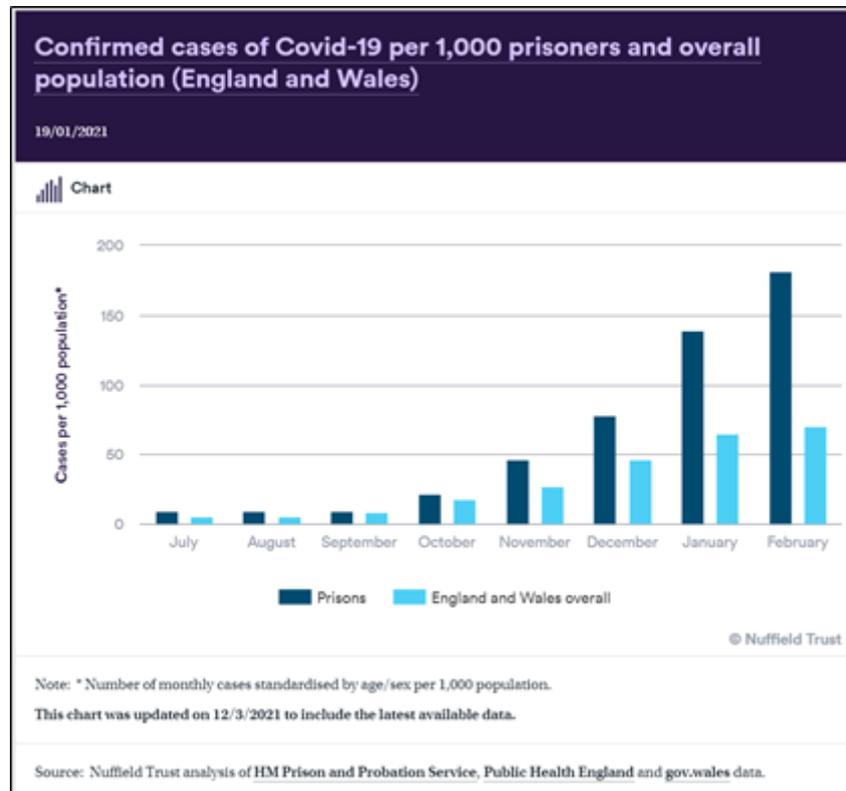
### Risk of poor outcomes

**Prisoners experience greater health inequalities than people in the community and have a higher risk of COVID-19 infection, a higher risk of mortality and a higher risk of hospitalisation than people in the general community**

Prisoners have a higher risk of infection with COVID-19 (Figure 2), recording 181.2 cases per 1,000 people in February 21 compared to a general population rate of 70.19 cases per 1000 (4.1).

Age Standardised Mortality Rates in prisoners are higher than those for the general population, increasing from 1.7 (95% CI 1.14-2.53) in the first wave to 4.54 (95% CI 3.67-5.56) in the second wave. Both the higher incidence of infection and the poorer underlying health of prisoners are likely to contribute to higher levels of COVID-19 mortality in prison populations compared to the general population. These SMRs are higher than the adjusted Hazard Ratios seen for many chronic diseases (calculated by the QCOVID tool used to inform vaccine prioritisation in younger adults e.g. Adjusted Hazard Ratios = 1.5 for COPD, 1.24 for cardiovascular disease).

Prisoners also experience a higher risk of hospitalisation (admissions per 100,000 people by age rate ratio 1.28-1.76) than people in the general community (4.4). **(High confidence)**



**Figure 2: Confirmed COVID-19 cases in prisoners versus overall population**

The prolonged restrictions imposed in prisons (substantial restrictions on prisoner mixing, confining prisoners to their cells for up to 23 hours a day, reduced socialisation, training and exercise opportunities and stopping of visitors) (3.1) have also increased the risk of mental health morbidity (3.1.11) **(High confidence)**.

## Environmental risk

**Prisoners are highly dynamic environments. Movements have been restricted but will increase, increasing transmission risks**

Prison environments have a high population density (1.1), turnover (1.8), sharing of facilities and accommodation (3.1.4) - as such they are likely to be highly conducive to transmission of COVID-19 unless there are high levels of immunity and/or extensive restrictions and IPC measures are in place **(High confidence)**.

The prison system is dynamic, with a high level of movement within and between prisons, and also between other community settings (e.g. courts). In a normal year there are c. 37k transfers between prisons, 55k releases, 100k hospital appointments, 53k people received

from courts, 99k people received from community/police and 65k court appearances (1.12). Movements within prisons are summarised in Table 1 at the end of this document.

The inflow of prisoners into prison has been at a reduced level through much of the pandemic but is likely to increase as the criminal justice system and wider society return to normal; movements across the wider prison estate have also been restricted (1.12). The continued outflow of prisoners but the reduced inflow has decreased the prison population compared to pre-pandemic levels. There is an expectation that the population will increase as court activity scales back up, potentially reducing opportunities for social distancing. This may also have the effect of putting pressure on the Reverse Cohorting parts of each establishment and create bottlenecks for onward prisoner movement through the estate.

**During the pandemic, whilst there have been restrictive lockdowns in prisons, prison staff are the most likely to bring the virus into prisons**

Despite lockdown conditions, prisoners maintain a high level of contact with prison officers especially when queuing for medication, meal times, use of force and for hygiene and exercise activities. Prison officers and other staff regularly working in prisons have daily connections with communities outside of prison and as such are the most likely group to bring the infection into prison. This is supported by evidence from genomic sequencing and modelling (4,5, 5.2) (**High confidence**). Prison officers also hold a role similar to that of social care staff, with many having contact with clinically vulnerable prisoners under the care of their institution (1.11).

Recent genomic investigations of prison outbreaks suggest prisons follow similar patterns to other closed environments. Investigations of outbreaks show that strains imported from the local community or from hospital settings or visiting health care staff can circulate widely within prisons. Prison staff are the most likely source of strains coming from the local community. Although many outbreaks are clonal, they can also involve multiple strains. (4.5).

**Ventilation is variable between prisons**

Ventilation is variable between prisons, with many documented as having poor ventilation, particularly in older 19<sup>th</sup> century local prisons (1.2). Information on the specific ventilation systems in use within different prisons is not available. Prisoner's cells vary widely in their access to natural ventilation from outside sources and cells do not ordinarily have air conditioning. Cell doors are mostly closed throughout except for the small amount of time in which prisoners are allowed out of their cells ). Windows may have additional bars or screens that further hinder the flow of air from outside. The size and position of a window in a cell will vary by establishment, with some older prisons having much smaller windows than newer prisons. Communal spaces will also vary in access to natural ventilation depending on age of construction and layout. This will again vary widely from one prison to another.

## Changes during wave 1 and 2

### Transmission, mortality and outbreaks have got worse during wave 2

As in the community the intensity of transmission in the prison sector and the subsequent risk of outbreaks and mortality were substantially higher in the second wave of the pandemic than in the first wave (4.1, 4.2, 4.4) (**High confidence**) despite a similar intensity of control measures (**High confidence**) - this has become particularly apparent as B.1.1.7 (with increased transmissibility) has become dominant across the UK. However, the fact that standardised mortality rates were 1.7 fold higher than the general population in the first wave and 4.5 fold higher in the second wave suggests that the increased transmissibility had a disproportionately greater impact on infection levels and subsequent mortality in prisons than in the general population. The majority of prisons have experienced large outbreaks (4.2) despite intensive control measures (3.1, 3.2) (**High confidence**). Prison establishments vary in size and can hold numbers of residents from the low hundreds to the thousands. In the second wave more than 79% of prisons (n=102) have had outbreaks where at least 50 prisoners and staff have been infected, many outbreaks have been far larger (4.2).

### Current control measures have reduced transmission and mortality, but alone cannot prevent all transmission, and will likely become less effective as prison population numbers increase

There have been intensive infection control measures throughout, implemented early in the first wave, with substantial restrictions on prisoner mixing, reverse cohorting of new arrivals, shielding units, confining prisoners to their cells for up to 23 hours a day, reduced socialisation, training and exercise opportunities and stopping of visitors. (3.1.1-3.1.6) Regular staff testing was added to this regime from November 2020 (3.2.5). Reception testing of prisoners was introduced from September 2020. The roll-out of transfer testing continues nationally and wastewater testing pilots are ongoing (3.1.7- 3.1.8). A timeline covering some of the key activities related to management of the pandemic is available in Appendix C. Mass testing of prisons has been attempted during outbreaks but achieving high uptake remains challenging. Reverse cohorting procedures may become more difficult if the number of new prison receptions rise but capacity remains limited.

The restrictions on mixing have prevented much larger scale transmission of COVID-19 and associated mortality than would otherwise have occurred (**High confidence**). Modelling suggests that, in the absence of vaccination, the severe restrictions on social mixing and the reverse cohorting approaches introduced by prisons were warranted (5.1, 5.2) (Figure 4).

## Prisons as an amplifier

As with other closed settings, the prison environment amplifies infections

Prisons may in future act as a potential reservoir and amplifier of infection, including new variants (6.1) (**Medium confidence**). The risk of infection and outbreaks in prisons has increased markedly in the second wave of COVID-19 (4.2) as new highly transmissible variants have emerged.

Most prison outbreaks are initially seeded from the community but these outbreaks can then act as an amplifier of infection with subsequent risk of transmission back into the community.

The risk of amplification is larger than that for other groups. If prisoners remain at higher risk of infection, then they will potentially select for variants that are able to escape pre-existing immunity and/or able to transmit more effectively. The high prevalence and frequent exposure also creates a possibility for generation of de novo variants including recombination events, which have been observed in non-prison settings (4.5).

Prison outbreaks are some of the largest outbreaks in any setting in the country. 79% of prisons in wave 2 (n=102) have had outbreaks that involved more than 50 people (4.2).

Outbreaks are difficult to control and are often clonal (4.5). This suggests that outbreaks are more often a rapid expansion of a small number of infections rather than a continual expansion of all viruses, however this poses a high risk should the expansion be related to a more transmissible strain.

Failure to protect prisoners from increased transmission levels will leave a window of opportunity for new variants to amplify, potentially leading to prisons as a reservoir of infection for the community

Prison outbreaks are challenging to manage due to the following reasons:

- a) **Nature of the environment**- although a standard recommendation by Health Protection Teams in response to outbreaks, prisons cannot simply cease all movements of people (into, around and between prisons) due to the need to serve courts, manage population pressures and deal with security issues so this risks population inter-mixing and disease transmission
- b) **Mass testing issues** - although recommended by PHE, the ability to deliver mass testing of all residents and staff is not readily available currently in most prisons resulting in often prolonged outbreaks recruiting large numbers of cases driven by asymptotically infected people- this is being addressed currently at national level but in many outbreaks OCTs (outbreak control teams) have been limited by testing constraints focussing testing on specific parts of prisons with higher identified attack rates and clinically symptomatic cases which is a strategy likely to miss many cases
- c) **Behavioural issues** – Although not unique to prisons, many perverse incentives operate in prisons for both staff and prisoners to not get tested, even if symptomatic- the former due

to financial impacts e.g. availability for additional work, and the latter due to impact on self and others in terms of further isolation/restrictions to regime which can result in reluctance to come forward for testing or possible coercion not to do so by others

**d) Limited staff** - prisons have limited primary healthcare teams delivering testing, vaccination and other infection control interventions in outbreaks as well as trying to deliver primary healthcare services, with teams often depleted due to staff cases or isolating contacts- this impacts on ability to manage outbreaks operationally.

Together these factors mean that early seeding of outbreaks may stay hidden and spread effectively in prisons, leading to outbreak situations, unless high levels of prison population immunity are present and maintained as the resident population changes.

During wave 2 there have been several instances where large prison outbreaks have been associated with the local area recording some of the overall [highest infection rates](#) in England, despite low levels of local community transmission. Robust evidence confirming this association is currently lacking, however reports to date give some support to the suggestion that prison infections can escalate quickly, despite far lower community prevalence.

People who fall within the prison cohort are traditionally less likely to engage with healthcare services in the community. It is likely that many new entrants to prison will be un-vaccinated, even when community vaccination has been offered to all age groups.

In addition, it can be hard to follow up people once they have left prison; many people do not know their onward destination, leave homeless (1.10) or may not wish to stay in contact with the justice system after release. This poses difficulties in contact tracing people within the community. It is not legally possible to keep someone in prison when their sentence has been completed.

## Further considerations

**Whilst lockdown restrictions remain in prison this is likely to continue to affect mental health and reduce activities that support rehabilitation**

Prison movements have been severely restricted during the pandemic lockdown (1.12). Although prisons were able to reduce some restrictions last summer, they were re-imposed in most prisons as risk levels increased. Whilst restrictions remain, prisoner mental health and wellbeing will suffer from the psychological effect of watching the country unlock whilst their regime stays persistently severely restricted (3.1.11). This will become harder to explain to people in prison, and to maintain over time, alongside feelings of fatigue from mass testing. Research from a prison service user led organisation reported that around half of all respondents said their mental health had deteriorated since the start of the pandemic (3.1.11). Respondents expressed frustration that they were unable to complete planned rehabilitative activities and also reported a lost sense of purpose. Both prisoners and their

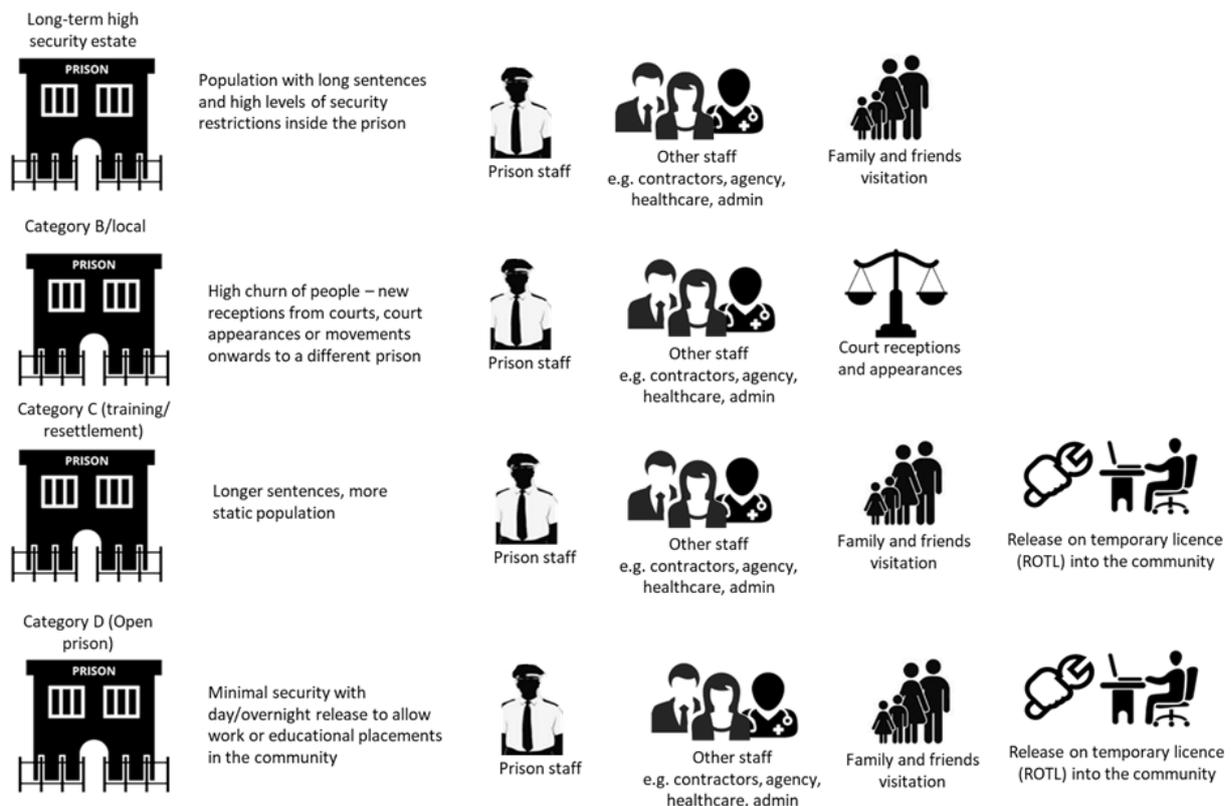
families have reported high levels of pain and anxiety related to the prolonged separation from their immediate family, including children (3.1.11).

Prison officers have been responsible for much of the delivery and control of frontline public health measures despite no formal healthcare training. Ideally the prison service should be able to 'unlock' in parallel with community settings to mitigate these concerns and allow delivery of a rehabilitative regime, including social visits, meaning movements will increase over the coming months (1.12).

There is currently no evidence on the economic cost of NPIs or those associated with the potential for continued outbreaks in prisons, however this is likely to be substantial, including: direct costs of testing for prisoners and staff, hospitalisation, prison escorts (for hospitalised patients), mass testing/sequencing, and also opportunity costs relating to prisoner and staff time lost, for example, delays to rehabilitation programmes, education or work related opportunities due to continued isolation and restrictions or implications to the prison regime of low staffing levels caused by staff absence/illness. Consideration of the most cost effective long-term strategy for infection control in prisons may be warranted. Assuming vaccination is of similar effectiveness to NPIs (5.1.2) it is likely to be much more cost effective than extensive use of NPIs (**High Confidence**).

**Assuming prison movements will need to resume at some point in the future, the impact of this will depend on the role and function of the prison**

Increased movements will increase the risk of introduction of infection and subsequently of associated outbreaks, hospitalisations and deaths (**High confidence**). Changes in movement will not be equal across the prison estate, around 50% of the prison population is transient; prisons that receive the majority of new receptions (local prisons) are likely to see the highest churn in numbers. Differing emphasis on different control measures may be required for different prison types and populations (Figure 3).



\* NOTE: This is an indicative picture and does not necessarily reflect the overlap between prisons, such as legal visits, ROTL & prison staff who work in multiple sites

Figure 3: Examples of key contact points in different types of prisons

**Decreasing community prevalence will not remove the risks of outbreaks within the prison environment**

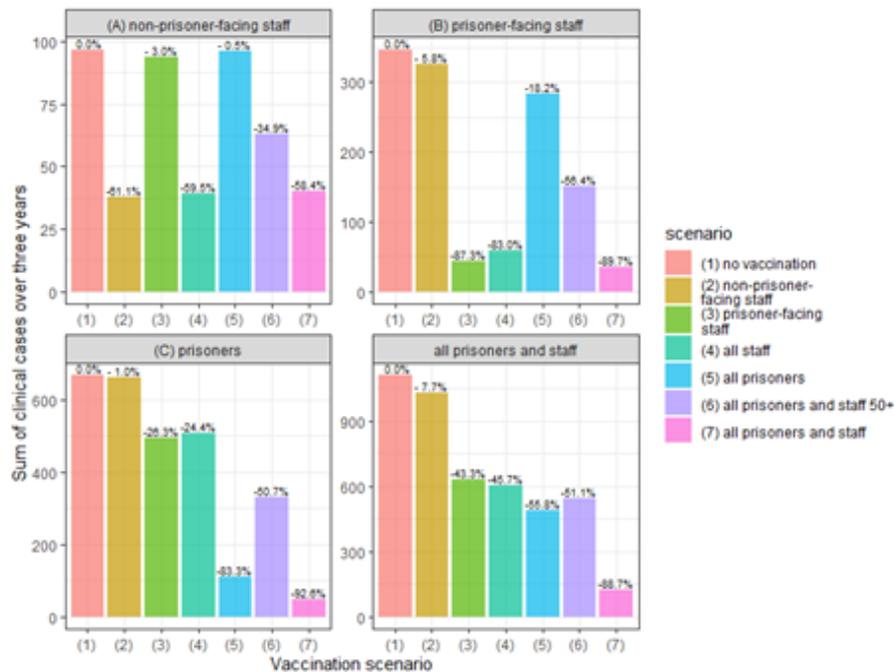
Decreasing community prevalence may lessen the chance of introduction of infection, however it does not change the likelihood of explosive outbreaks after infection enters the closed institutional environment (**High confidence**). A University of Manchester model shows that prison staff are the most likely to introduce COVID-19 into prisons and that visitors are 10-15 times less likely to bring the infection into prison than staff (5.2). Winter 2021 also poses a new risk of dual infection with COVID-19 and influenza (6.3).

Although advice to the community is that shielding can stop as of 1<sup>st</sup> April 2021, consideration is needed for how this advice should be interpreted in prisons if outbreaks continue to occur (3.1.3).

**Modelling shows vaccination of all prisoners and staff is the best strategy to reduce risk**

One prison vaccination model from LSHTM (5.1.1) has evidenced that vaccinating all prisoners and staff is the only vaccination strategy that prevents a further large wave of cases within two years. (**High confidence**) This strategy was predicted to reduce cases by

89%. Restricting vaccination to all prisoners and staff over the age of 50 was considerably less effective at preventing outbreaks. Vaccinating all staff would reduce rates in prisoners by 24%.



**Figure 4: Percentage reduction in clinical cases related to different vaccination strategies (LSHTM modelling)**

New modelling from the University of Manchester shows that universal vaccination of prisoners would be broadly as effective as NPIs employed in prison settings (5.1.2). The LSHTM modelling shows that staff vaccination also reduces infections. Taken together this suggests that widespread vaccination of staff and prisoners would offer an equivalent level of protection as the highly restrictive NPIs currently in place, offering the possibility to withdraw restrictive measures if vaccination was rolled out.

Currently neither prisoners or staff are prioritised for vaccination unless they fall into existing JCVI prioritisation categories (3.1.10, 3.2.6).

In addition to vaccination a range of testing and other NPIs may still be needed to enable more out of cell activities, faster lifting of prison restrictions and a staged return to the normal regime.(likely) New or existing control measures need to take into account the welfare of prisoners and their families, and also security in prisons. Considerations may include:

- Consideration of the role of asymptomatic testing and additional control measures to support the re-introduction of prison visitation for families and friends e.g. PCR test 48hrs prior to arrival of LFD on arrival if travel to the prison takes >48hrs

- Reverse cohorting may continue to be necessary but there may be capacity constraints so it may be appropriate to restrict this to unvaccinated new prisoners (who could also be considered for vaccination). More intense initial testing regimes among vaccinated new prisoners who are not subject to reverse cohorting might be used to further reduce risk of introduction from vaccinated prisoners.
- Strategies to improve uptake of routine staff testing to prevent importation . This will remain most important for unvaccinated staff.
- Consideration of testing in other areas of the criminal justice system (e.g. asymptomatic testing in police custody and of court attendees)
- Phased reestablishment of communal activities but utilising bubbles, social distancing and masks.
- Measures to spot early warning signs of infection (e.g. wastewater-based surveillance)
- Measures to allow rapid testing/control of prison outbreaks and rapidly identify variants of concern (e.g. dedicated mass testing resources including genomic sequencing of isolates)
- Measures to understand further transmission dynamics (e.g. genomics, air & surface sampling, modelling)

Further detailed information on this summarised evidence can be found in the accompanying appendices.

Table 1 (overleaf) summarises types of movements in prisons, the differences between wave 1, 2 and the future scenario, and the volume and transmission risk they may pose.

Table 1 – Summary of different types of prison movements

Type of contact between community and custody or within the prison environment	Wave 1	Wave 2	Potential future scenario	Volume, risk of transmission related to contact point
<p><b>New receptions from courts (HM Courts and Tribunals Service, 2021, Prison Reform Trust, 2021, MoJ 2021)</b></p>	<p>Courts operating at sub-optimal capacity, volume of new prison receptions reduced compared to pre-pandemic. Larger proportion of prison population is on remand due to delays in court hearings.</p> <p>Before Covid-19 restrictions were introduced, there was a backlog of around 40,000 cases in the Crown Courts and over 400,000 cases in the magistrates' courts</p>	<p>Courts operating at increased capacity compared to wave 1, volume of new prison receptions starting to increase.</p> <p>Court backlogs had increased by around a quarter by September 2020</p>	<p>Court activity increases to normal levels. Combination of case backlog and increased activity will lead to large numbers of new receptions to prisons. Likely that the proportion of sentenced cases will rise in line with pre-pandemic figures.</p>	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> ~53k people received from courts and ~99k people received from community/police settings in a year</p> <p><b>Risk of transmission: HIGH</b></p> <p><b>Rationale:</b> Prisoners arriving direct from community untested for COVID, potentially unvaccinated cohort, pressure on reverse cohorting systems due to high receptions reduces effectiveness</p> <p><b>Issues/unknowns within this setting:</b> Court holding cells can be small and social distancing may not be possible in all settings.</p> <p>Frequency of cleaning unknown</p>

				<p>Difficulties and unknown consistency of the 'chain of custody' for another prisoner being positive and contact tracing</p> <p>There is little or no record-keeping and it is not easy to share information relating to screening questions being used or case identification</p> <p>Numerous unknowns related to court transport services (PECS) –in regard to cleaning, social distancing with staff and chain of custody for contacts if a staff member were to be identified as positive</p>
<p><b>Court appearances (MoJ, 2021)</b></p>	<p>Court appearances reduced due to decreased overall activity. Many appearances done via video link.</p>	<p>Court appearances remain slightly reduced due to decreased overall activity. Many appearances done via video link.</p>	<p>Court appearances will increase as courts resume activity. Video activity will remain as an option. Numbers of jury trials and Crown court hearings will increase, which will likely take place face to face.</p>	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> ~65k people sent out to court in a normal year</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> courts are installing stringent IPC measures, contact with a smaller pool of people than in some other community settings</p> <p><b>Issues/unknowns within this setting:</b></p>

				<p>There is little or no record-keeping and it is not easy to share information relating to screening questions being used or case identification.</p> <p>There is a backlog of court cases and a new programme of <a href="#">Nightingale</a> Courts</p>
<b>Hospital appointments</b>	<p>Off-site hospital appointments reduced due to reduced hospital outpatient activity/reduced availability of escort staff</p> <p>2020 total number of movements out to hospital: 59,688 (MoJ, 2021) <b>in comparison to</b> 113,012 episodes (inpatient, outpatient and A&amp;E attendances) in 2017/18. (Davies, 2020)</p>	<p>Off-site hospital appointments reduced due to reduced hospital outpatient activity/reduced availability of escort staff</p> <p>2021 total number of movements out to hospital to date 5,775 (MoJ, 2021)</p>	<p>Off-site hospital appointments will increase as hospital activity scales up and the appointment backlog is cleared</p>	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> &gt;100,000 hospital attendances per year in non- pandemic situation</p> <p><b>Risk of transmission: MEDIUM/HIGH</b></p> <p><b>Rationale:</b> lower risk of acquiring infection if community prevalence is low, higher risk if COVID-19 is in the hospital setting</p> <p><b>Issues/unknowns within this setting:</b> For visits to out-patients and ED, a stay of less than four hours would not require a new period of quarantine. Stays in hospital for over this length of time would require a period of isolation for the 14 days (dependent on test results).</p> <p>Prison officers (at least two) will be handcuffed to the majority of prisoners for the</p>

				<p>whole of the journey (taxi or other vehicle) minimising ability to socially distance.</p> <p>In the hospital, this will continue and prisoners remain chained to staff, causing difficulties with t social distancing and may be in prolonged contact for overnight stays. Multiple staff may be involved with shifts rotating.</p> <p>Numbers of hospital appointments will need to increase to address the backlog.</p> <p>Factor in that hospital sites have often seen the highest rates of infection and most likely places to become infected.</p>
<b>Family visitation</b>	Family visitation stopped during pandemic peak. Video visitation implemented. Some family visits allowed in some prisons as community infections (and related prison infections) subsided.	Family visitation stopped during pandemic peak and still remains prohibited due to infection risks posed. Video visitation remains although appointments are limited.	Family visitation levels will increase as prisons move back to less restrictive regimes	<p><b>Volume: HIGH</b> (no data on visitation numbers available)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> IPC measures can be put in place, use of LFD/PCR for visitors could be explored, vaccinated visitors will increase as vaccination rollout progresses</p> <p><b>Issues/unknowns within this setting:</b> Unknowns include- total numbers of individuals who will visit, total numbers of</p>

				<p>visits likely to occur, average length of visit, consistency of IPC measures and ability to socially distance in visitation areas</p> <p>Limiting visitation to one named person (as with care homes) will preclude children from seeing their parents and is not feasible – many families have more than one child</p>
<b>Legal visitation</b>	Legal/official face to face visits have continued to be permitted throughout the pandemic, although remote visitation is encouraged	Legal/official face to face visits have continued to be permitted throughout the pandemic, although remote visitation is encouraged	Face to face legal/official visits may return to a predominantly face to face format	<p><b>Volume: MEDIUM</b></p> <p><b>Risk of transmission: MEDIUM</b></p> <p>(no data available )</p> <p><b>Issues/unknowns within this setting:</b> Unknowns include- total numbers of individuals who will visit, total numbers of legal visits likely to occur, average length of visit, consistency of IPC measures and ability to socially distance in legal visits</p>
<b>Core staff contact (prison/healthcare staff)</b>	Continued contact with prison officers and healthcare staff. Some reduced activity in healthcare. Ideally	Continued contact with prison officers and healthcare staff. Some reduced activity in healthcare. Ideally	Increased healthcare activity will lead to more frequent contact with healthcare staff. Increased contact with a	<p><b>Volume: HIGH</b></p> <p>(no data available but every prison essentially has an on-site GP surgery and daily interactions with prison officers)</p>

	contact only with prison officer cohort, although staff absences may have resulted in contact with wider staffing pool.	contact only with prison officer cohort, although staff absences may have resulted in contact with wider staffing pool.	range of prison officers likely to resume, although perhaps less likely to encounter officers from other establishments (via staff absence cover).	<p><b>Risk of transmission: LOW</b></p> <p><b>Rationale:</b> Healthcare staff are aware of IPC measures and use PPE, vaccination is available for all healthcare staff. Routine LFD testing could be used as in other healthcare settings</p> <p>Prison officer routine testing being implemented. Current levels of vaccinated prison officers are low</p> <p><b>Issues/unknowns within this setting:</b></p> <p>Query surrounding routine testing for agency and short-term staff.</p> <p>EDM 4 regime has not yet allowed for the re-introduction of many aspects of in-prison healthcare services e.g. physiotherapy, optometry, sexual health and <u>so when moving to regime 3 EDM</u>, how will prisons account for making the adjustments for this increased number of staff and ensuring they have been vaccinated</p>
<b>Wider staff contact (e.g. voluntary</b>	In general, non-essential staff were not permitted to enter	In general, non-essential staff were not permitted to enter	As prisons move to less restrictive regimes non-essential staff will return	<p><b>Volume: LOW</b> (no data available – based on MoJ advice)</p>

<p><b>sector, researchers, peer engagement teams)</b></p>	<p>prison establishments under regime 4</p>	<p>prison establishments under regime 4</p>	<p>into prisons to usual levels</p>	<p><b>Risk of transmission: MEDIUM</b>  <b>Rationale:</b> Familiarity with prison IPC protocols and vaccination levels may vary</p> <p><b>Issues/unknowns within this setting:</b>  Vaccination levels of these staff likely to be low currently</p>
<p><b>Transfer to secure hospitals</b></p>	<p>Reduced compared to normal levels</p>	<p>Reduced compared to normal levels</p>	<p>Transfers will resume to normal levels</p>	<p><b>Volume: LOW</b>  (no data available – based on MoJ advice)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> As a closed institutional healthcare setting, secure hospitals remain vulnerable to outbreaks</p> <p><b>Issues/unknowns within this setting:</b>  Vaccination levels in these settings likely to be high</p>
<p><b>Movement between prisons (MoJ, 2021)</b></p>	<p>Prison movement reduced</p>	<p>Prison movement reduced</p>	<p>Prison movement likely to increase back to pre-pandemic levels, especially as new receptions rise</p>	<p><b>Volume: HIGH</b>  <b>Rationale:</b> 37,338 modelled transfers between prisons in a normal year</p> <p><b>Risk of transmission: MEDIUM</b>  <b>Rationale:</b> mitigated by testing, RCU upon reception and knowing outbreak status of sending prison)</p>

<p><b>Release on temporary licence (ROTL) for work purposes</b></p> <p><b>(Prison Reform Trust Briefing 2, 2020, HMPPS 2020c)</b></p>	<p>ROTL mainly paused</p>	<p>ROTL mainly paused</p>	<p>ROTL (both day and overnight release) will increase back to pre-pandemic levels to support rehabilitation</p>	<p><b>Volume: MEDIUM</b> 436,531 ROTL incidences in 2019</p> <p><b>Risk of transmission: HIGH</b></p> <p><b>Issues/unknowns within this setting:</b> Unclear how many prisoners will be eligible for ROTL</p> <p>Very porous activity for bringing infection back into prisons but vital in terms of rehabilitation of the individual</p>
<p><b>Release back into community (MoJ, 2021)</b></p>	<p>People continued to be released to community settings at the end of their tariff as usual</p>	<p>People continued to be released to community settings at the end of their tariff as usual</p>	<p>People will continue to be released as usual. Increased court activity/remand prisoners may lead to an increase in the churn in and out of prisons</p>	<p><b>Volume: MEDIUM</b> <b>Rationale:</b> modelled estimate 54,671 releases in a normal year</p> <p><b>Risk of transmission (to community setting): MEDIUM</b> <b>Rationale:</b> should know the outbreak status of the prison they are leaving which is covered by surveillance.</p> <p><b>Issues/unknowns within this setting:</b> Problems include - what to do in regards to someone being released from an outbreak site or is symptomatic who has refused testing/unknown status.</p>

				<p>Transport arrangements after release are not the responsibility of either the prison or the community. How do you relocate a prisoner leaving a prison to their community location without asking them to break the law i.e. using public transport when potentially infectious</p>
<p><b>Release into approved premises (probation)</b></p>	<p>Referrals/acceptances to approved premises continued throughout wave 1</p>	<p>Referrals/acceptances to approved premises continued throughout wave 2</p>	<p>Referrals/acceptances to approved premises will continue</p>	<p><b>Volume: LOW</b></p> <p><b>Rationale:</b> 100 approved premises sites</p> <p>Data as of 11<sup>th</sup> March 2021: average of 6.38 arrivals over 4 last 4 wks (total 174 arrivals) and average 6.09 departures (total 158 departures)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> should know the outbreak status of the prison they are leaving and LFD release testing, higher risk residential setting they are moving to</p> <p><b>Issues/unknowns within this setting:</b> Problems include - what to do in regards to someone being released from an outbreak site or is symptomatic who has refused testing/unknown status.</p>

				Transport arrangements after release are not the responsibility of either the prison or the community. How do you relocate a prisoner leaving a prison to their community location without asking them to break the law i.e. using public transport when potentially infectious
<b>Additional movements within the prison environment</b>				
<b>Communal mealtimes</b>	Paused	Paused	Communal mealtimes will resume	<b>Volume: HIGH</b> <b>Risk of transmission: HIGH</b> <b>Rationale:</b> Essentially mirrors re-opening of hospitality settings in the community
<b>Gym attendance</b>	Paused	Paused	Gym attendance will resume	<b>Volume: MEDIUM</b> <b>Risk of transmission: HIGH</b> <b>Rationale:</b> Gym environments are known high risk transmission settings
<b>Work and education</b>	Paused	Paused	Work and education must resume to deliver rehabilitative activities	<b>Volume: HIGH</b> <b>Risk of transmission: VARIES BY SETTING</b> <b>Rationale:</b> Transmission will vary by setting e.g. large workshop premises vs smaller classroom settings

# Appendices

## SAGE-EMG Commission - Transmission in Prison Settings

### Contents

- **Appendix A – Evidence summary (by question)**
- **Appendix B - Evidence gaps**
- **Appendix C -Timeline of key decisions**
- **Appendix D – Evidence**
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- **Appendix F – LSHTM modelling parameters**
- **Appendix G – HMPPS modelling results**

## Appendix A – Evidence Summary (by question)

### What are the social and epidemiological differences in prisons between the first and second wave in England & Wales?

- 1) Prisons are closed environments with high population density (1.1), turnover (1.8), sharing of facilities and accommodation (3.1.4) - as such they are likely to be highly conducive to transmission of COVID-19 unless there are high levels of immunity and/or extensive restrictions and IPC measures are in place. **High confidence**
- 2) Prisoners and prison staff are at a higher risk of COVID-19 mortality compared to the general population. Standardised Mortality Rates in prisoners compared to the general population have increased from 1.7 in the first wave to > 4 in the second wave. Age adjusted COVID-19 mortality rates are higher in prison staff than the general population (4.4) **High confidence**
- 3) Hospitalisations (rates per 100,000 people) are higher amongst prisoners than the general English resident community (rate ratio 1.28-1.76) (4.4) **High confidence**
- 4) Black and minority ethnic groups, who have been shown to suffer poorer COVID-19 outcomes, are over-represented in the prison population (1.6) **High confidence**
- 5) The risk of COVID-19 infection and of outbreaks is higher in prisons than in the general population. In the second wave more than 79% of prisons (n=102) have had outbreaks where at least 50 prisoners and staff have been infected, many outbreaks have been far larger (4.1-4.3) **High confidence**
- 6) The risk of infection and outbreaks has increased markedly in the second wave of COVID-19 - this has become particularly apparent as B.1.1.7 (with increased transmissibility) has become dominant across the UK. (4.1-4.2) **High confidence**
- 7) There have been intensive infection control measures throughout, implemented early in the first wave, with substantial restrictions on prisoner mixing, confining prisoners to their cells for up to 23 hours a day, reduced socialisation, training and exercise opportunities and restrictions on social visitors. (3.1.1-3.1.6) **High confidence**
- 8) Regular staff testing was added to this regime from November 2020 (3.2.5). Uptake of this testing is incomplete. Reception testing of prisoners was introduced from September 2020 the roll-out of transfer testing continues nationally and wastewater testing pilots are ongoing (3.1.7- 3.1.8). Mass testing during outbreaks was also introduced in the second wave but uptake is highly incomplete.
- 9) The restrictions on mixing have prevented much larger scale transmission of COVID-19 and associated mortality than would otherwise have occurred. Modelling suggests that, in the absence of vaccination, the severe restrictions on social mixing introduced by prisons were warranted (5.2) **High confidence**
- 10) The prolonged intensive restrictions are having a strongly negative impact on prisoner rights, wellbeing and mental health. It will take considerably longer to 'unlock' the prison regime than in the community without some level of risk; ongoing restrictions will become increasingly hard to justify (3.1.11) **High confidence**

## **What is the epidemiological relationship between custody and the community? – To what extent does this differ based on social and geographical dynamics and prison?**

- 11) The prison system is dynamic, with a high level of movement within and between prisons, and also between other community settings (e.g. courts) (1.12). The inflow of prisoners into prison has been at a reduced level through much of the pandemic in large part due to a backlog in sentencing; movements across the wider prison estate have also been restricted. The continued outflow of prisoners but the reduced inflow has decreased the prison population compared to pre-pandemic levels (1.1)
- 12) The category of prison makes a substantial difference to flow rates into and out of the prison population with some prisons focussing on remand and short sentence prisoners and others focussing on longer term sentencing (1.2, 1.9) **High confidence**
- 13) A University of Manchester (UoM) model shows that the process of reverse cohorting (a period of separation and testing of new prisoners) prior to entry into the main prison system can lead to substantial reductions in the introduction of COVID-19 into prisons from the community (5.2). As courts re-started processing cases after the first wave, prisons maintained reverse cohorting arrangements, however the increasing flow of prisoners into prisons has hindered local capacity for separation. As the backlog of sentencing is addressed, both the flow of prisoners into prison and the density of occupation within prisons is likely to increase (1.12). This is likely to increase the risk of transmission and cause bottlenecks in reverse cohorting units. This is analogous to quarantine of travellers arriving in the UK. LFD testing, including daily testing, may be an option to help reduce the quarantine period **High confidence**
- 14) To date no testing has been introduced into upstream areas of the criminal justice system e.g. police custody suites
- 15) Banning visitors may have helped to reduce the introduction of COVID-19 into prisons but may have had high costs on mental health and welfare for prisoners and their families, and a negative impact on rehabilitation and recidivism (3.1.11). UoM modelling suggests visitors are 10-15 times less likely to bring the infection into prison than staff (5.2) **High confidence**
- 16) Appropriate use of social distancing, ventilation within visitor areas, perspex screens, hand hygiene, environmental hygiene and use of PPE could substantially reduce the risk of visitors introducing infection and enable limiting visiting to restart. Risk could be reduced further though use of Point of Care testing of visitors. However, there is a requirement to consider how this could be operationalised to mitigate against transmission in the community and protect against issues of compliance. **High confidence**
- 17) The main connection between prison populations and the wider community is through prison staff. Even when prison visiting was allowed prisoners have far more frequent contact with prison staff than with visitors. **High confidence**
- 18) A University of Manchester model shows that prison staff are the most likely to introduce COVID-19 into prisons (5.2) **High confidence**

- 19) Prison staff mixing with the wider population is likely to increase as population wide control measures are lifted - effectively increasing the interconnectedness between prisons and the community **Medium confidence**
- 20) Whilst vaccination levels are low the regular testing of prison staff is important to reduce the introduction of COVID-19 into these closed settings however to date, uptake levels have been suboptimal (3.2.5) **High confidence**
- 21) Planning of release can be challenging because of the dependence on judicial decisions. Prisoners cannot be held past the end of their sentence, even if they have recently tested positive for COVID-19 or are in isolation
- 22) Around 15% of prisoners are homeless on release and so may end up rough sleeping or in hostel accommodation, where there is a high risk of outbreaks (3.1.10) **High confidence**
- 23) Other prisoners are released to multi-occupancy approved premises. Many will be released to areas with high levels of social deprivation where there is also a higher community risk of COVID-19 transmission. **High confidence**

### **How will these findings apply in the context of increasing vaccine rollout and decreasing prevalence with consideration of future prison health security?**

- 24) Prisoners are held in settings determined and delivered by the Government who hold a duty of care for their residents. Under normal circumstances, confinement to cells, restriction of activities and suspension of visitation rights would be considered a punishment in addition to the deprivation of liberty to which prisoners are sentenced. The early availability of vaccination for all staff and prisoners would allow this restrictive regime to be lifted substantially earlier than if vaccination proceeds in strict age order at the same pace as in the general population. This could also prevent a major disparity between prisons and community whereby prisoners remain under highly restrictive regimes whilst general society returns to normal. **High confidence**
- 25) Community prevalence of COVID-19 is decreasing, whilst movement (churn) amongst the prison estate will increase as courts scale back up, receptions increase, visitations recommence and other contacts such as hospital visits return to 'business as usual (1.12)' **High confidence**. Ongoing plans for the management of COVID-19 and health security in this context must be considered, including vaccination strategies, cohorting and testing procedures and management of dual outbreaks (e.g. influenza/COVID-19) (6.1-6.3)
- 26) An LSHTM model concludes that the most effective strategy for reducing COVID-19 cases, transmission and outbreaks in prisons, is vaccinating everyone living and working in prisons (89% reduction over 3 years).(5.1) **High confidence**
- 27) The number of cases averted through vaccination is highly dependent on assumptions about the effectiveness of measures used to prevent ingress of infection into the prisons. These measures (isolation and testing) are assumed to be 90% effective at preventing ingress of infection. If they are less effective than this then the numbers of cases averted through vaccination will be higher. (5.1)**Medium confidence**

- 28) Vaccination of some clinically vulnerable prisoners has been delayed due to the ability to deploy only one vaccine brand in England, the inability to vaccinate within 28 days of a SARS-CoV-2 positive test, and concerns about vaccine wastage related to the small numbers falling into high priority groups in some prisons in the initial stages. **Medium confidence**
- 29) Poor health information recording leads to difficulties in identifying vulnerable prisoners for vaccination **Medium confidence**
- 30) Homeless people have been prioritised for vaccination, many of whom share the same risk factors as prisoners, or indeed fall into the same cohort (3.1.10) **Medium confidence**
- 31) Widespread vaccination policies for influenza may reduce the risks of dual pathogen outbreaks (6.3) **High confidence**
- 32) The JCVI recently recommended vaccination of prison officers with leftover doses of prisoner vaccine, however this strategy is clinically inefficient and presents major practical challenges (3.2.6) **Medium confidence**
- 33) It is highly likely that the numbers of prisoners will increase over the coming months as the number of court cases increases. It will not be possible to maintain the current high level of distancing under this condition. Vaccination of all staff and prisoners will be the most effective approach to mitigating against increases in transmission as prison overcrowding increases, and subsequently to reduce risk of mortality.(1.12, 5.2, 6.1) **High confidence**
- 34) Vaccination of all prisoners and staff will also be the most effective approach to reducing the prolonged severe restrictions on prisoners that are having a major impact on wellbeing and mental health. **High confidence**

## Appendix B - Evidence gaps

Although the overall picture of high transmission risk and effective control measures are clear, there are a number of unknowns that could improve our understanding and development of longer term strategies for re-opening the prison estate

- We do not know how well IPC measures are applied in different individual establishments
- Information on ventilation
- Limited data on individual outbreaks/establishments
- Little quantitative data on contribution of different activities in prison towards transmission
- Do not yet have models that integrate NPIs and vaccination
- Little impact of the pandemic on other health care pathways e.g. transfer to secure hospitals, secondary care
- Economic cost of continued prison outbreaks

## **Appendix C -Timeline of key decisions**

### **March 2020**

- 23 March – National incident command and response structure implemented
- 24 March – PM announces lockdown
- 25 March – restricted regimes implemented across entire estate
- 31 March – compartmentalisation strategy put into action

### **April 2020**

- 23 April – community testing extended to all essential workers
- 28 April – prison based research testing implemented

### **May 2020**

- 28 May – Test and Trace launched in community

### **June 2020**

- 9 June – gateway decision for prisons to request to move to Stage 3 regimes
- 15 June – face masks become compulsory on public transport

### **July 2020**

- 4 July – prisons begin opening up aspects of the regime and supporting prison visits
- 23 July – decision to continue offering shielding to prisoners
- 24 July – face masks become mandatory in shops
- 30 July –self-isolation period when symptomatic increased from 7 to 10 days

### **August 2020**

- 4 August – Lord Chancellor agrees to continue with Covid-19 compassionate ROTL scheme
- 11 August – guidance published to staff following end of community shielding

### **September 2020**

- 4 September – national gateway decision for progression to Stage 2 regimes is open
- 14 September – community rule of six comes into force
- 28 September – self-isolation following NHS Test and Trace contact becomes legal requirement in England

### **October 2020**

- 14 October – 3 Tier system introduced in England

### **November 2020**

- 2 November – 37,000 PCR tests per week secured from DHSC for testing of frontline staff and double testing of residents on reception and transfer
- 5 November – second lockdown

### **December 2020**

- 2 December – national restrictions in England revert to a refreshed tiered system and CEV staff told to work from home where possible, particularly in Tier 3 areas
- 11 December – testing with Lateral Flow Devices secured for DHSC to pilot in three prisons and three probation offices
- 20 December – London, South East and East of England move to new Tier 4 restrictions

### **January 2021**

- 4 January – all adult prisons move to Stage 4 of National Framework. Youth Estate remains in Stage 3
- 14 January – first vaccines administered to over 80s prison residents in Wales
- 21 January – weekly testing of prison staff live at all establishments
- 29 January – vaccinations to over 80s prison residents in England begins

# Appendix D – Evidence

## Evidence list included:

### 1 Data on prisoner population

- 1.1 Size of prisoner population over time
- 1.2 Distribution across different categories of prisons
- 1.3 Distribution of prison size
- 1.4 Age breakdown
- 1.5 Gender breakdown
- 1.6 Ethnicity breakdown
- 1.7 Levels of comorbidity
- 1.8 Inflow and outflow
- 1.9 Variability in sentence duration
- 1.10 Post release destinations (e.g. to high risk transmission settings such as homeless hostels)
- 1.11 Number of CEV prisoners/establishments with CEV prisoners
- 1.12 Likely changes as the pandemic context evolves

### 2 Staff population

- 2.1 Age distribution
- 2.2 Levels of comorbidity and learning disability

### 3 Information on Control measures

#### 3.1 Prisoners

- 3.1.1 Process of reverse cohorting
- 3.1.2 Process of protective isolation
- 3.1.3 Process of Shielding
- 3.1.4 Shared accommodation
- 3.1.5 Restrictions on movements and mixing
- 3.1.6 Restrictions on visiting
- 3.1.7 Testing and isolation processes
- 3.1.8 Wastewater testing
- 3.1.9 Use of PPE and hand hygiene
- 3.1.10 Vaccine
- 3.1.11 Social/Mental Health Impact of restrictions

#### 3.2 Staff

- 3.2.1 Symptomatic Testing and isolation
- 3.2.2 Social distancing
- 3.2.3 Use of PPE and hand hygiene
- 3.2.4 Movement of staff between prisons
- 3.2.5 Asymptomatic testing programme and uptake
- 3.2.6 Vaccination

### 4 Epidemiological data

- 4.1 Surveillance data on test positives in prisoners and prison staff
- 4.2 Outbreak surveillance reports
- 4.3 Data on routine occupational swabbing
- 4.4 Hospitalisation and Mortality data
- 4.5 Genomics

## **5 Modelling data**

- 5.1 Vaccine
- 5.2 Other control measures

## **6 Summary of future considerations**

- 6.1 Decreasing community prevalence but continued high risk prison environment
- 6.2 Control measures
- 6.3 Dual outbreak risks (Influenza/COVID-19)

# **1 Data on prisoner population**

## **1.1 Size of prisoner population over time**

The English imprisonment rate is one of the highest in Europe, averaging around 150 prisoners per 100,000 inhabitants (pre-pandemic). (Eurostat, 2020) In the year ending March 2020 22.5% of prisoners were held in crowded conditions (HMPPS 2020c).

On 4 March 2021 the England and Wales prison population stood at c.78,000, spread between 120 establishments (Male, female, youth, adult, closed, open, local/ remand) (MoJ, 2021). This represents a decrease in the prison population since the start of the pandemic of around 7% (MoJ & HMPPS Mar 2020), attributable to the continued release of prisoners from custody during the pandemic and a decrease in new receptions due to decreased court activity, potentially also from a reduction in crime and licence recalls.

To date a total of 262 people have been released from prison as a result of the pandemic early release scheme. (Prison Reform Trust, 2021)

## **1.2 Different types of prisons**

### *Purpose and function*

Establishments are configured by wing/ unit, landing and security risk. Prisons also vary by function and purpose.

Prisoners can be classified as sentenced or on remand, meaning they are being held in prison whilst awaiting their hearing at court. The Ministry of Justice has temporarily increased the limits to time people can spend on remand, from six to eight months (HM Courts & Tribunals Service, 2020). Local prisons tend to operate with a high 'churn' whereby the prison population changes rapidly as people enter or leave the prison, making them

higher risk in terms of infection control. During the pandemic the proportion of people being held on remand has increased due to delays in court proceedings (Howard League 2020); in the year leading up to September 2020 the prison population reduced by 5% but the proportion of people on remand increased by 28%.

Prisoners can also be placed in different security categorisations. Male prisons are designated a letter from A-D. Category A prisons hold the most high-risk prisoners under high security conditions. Category B prisons are either local or training prisons. Local prisons house prisoners that are taken directly from court in the local area (sentenced or on remand), and training prisons hold long-term and high-security prisoners. Category C prisons are training and resettlement prisons; most prisoners are located in a category C. Category D are open prisons, these prisons have minimal security and allow eligible prisoners to spend most of their day away from the prison on licence to carry out work, education or for other resettlement purposes (MoJ blog). Female prisoners are assigned as either restricted status, suitable for closed conditions or suitable for open conditions.

Prisoners can move between categories (and subsequently establishments) during their sentence. During the pandemic open prisons have not been able to operate in the same way as during non-pandemic conditions due to the infection risk this poses.

In addition, it is not legally possible to keep someone imprisoned beyond the end of their sentence, therefore prisoners may need to be released during COVID-19 isolation or having tested positive for COVID-19. This presents challenges in terms of safe release e.g. unable to use public transport.

### *Ventilation*

Ventilation is variable between prisons, with many documented as having poor ventilation. This is particularly noted in 19<sup>th</sup> century prisons, where there have been reports that windows could not be opened properly and that in warm weather, some prisoners break windows to provide ventilation (HMIP 2017). Newer prison builds or new house blocks/wings often have superior ventilation compared to older prisons.

Detailed information on different types of prison ventilation systems is not available, and is a gap in the evidence presented here.

The prison service instruction (PSI 17/2012) on certified accommodation states:

*“[...] must ensure that each cell used for the confinement of prisoners has sufficient heating, lighting and ventilation and is of adequate size for the number of prisoners it is approved for[...].”* (MoJ 2012a)

With further details in the PSI appendix stating:

*C 1.2 For the purposes of certifying basic services within a cell (i.e. heating, lighting, ventilation and cell call) the inspector should assume that those services were designed to the standards which prevailed at the time of the original build and/or any subsequent major refurbishment.*

C1.22 An inspector should confirm that:

- For a cell with openable windows, that the windows open and close.
- For a cell with fixed window ventilators check that the perforated grilles operate correctly between open and closed positions
- For a cell with a separate ventilator through the wall, check that the perforated grille is clear and that, where fitted with an integral fan, that the fan operates.
- For cells with mechanical extract ventilation, the extract system is operating.

Prison cells vary widely in their access to natural ventilation from outside sources and do not ordinarily have air conditioning. Cells doors are closed throughout except for the time in which prisoners are allowed out of their cells (~1hr/day currently). Windows may have additional bars or screens that further hinder the flow of air from outside. The size and position of a window in a cell will vary by establishment, with some older prisons having much smaller windows than newer prisons. Communal spaces will also vary in access to natural ventilation depending on age of construction and layout. This will again vary widely from one prison to another.

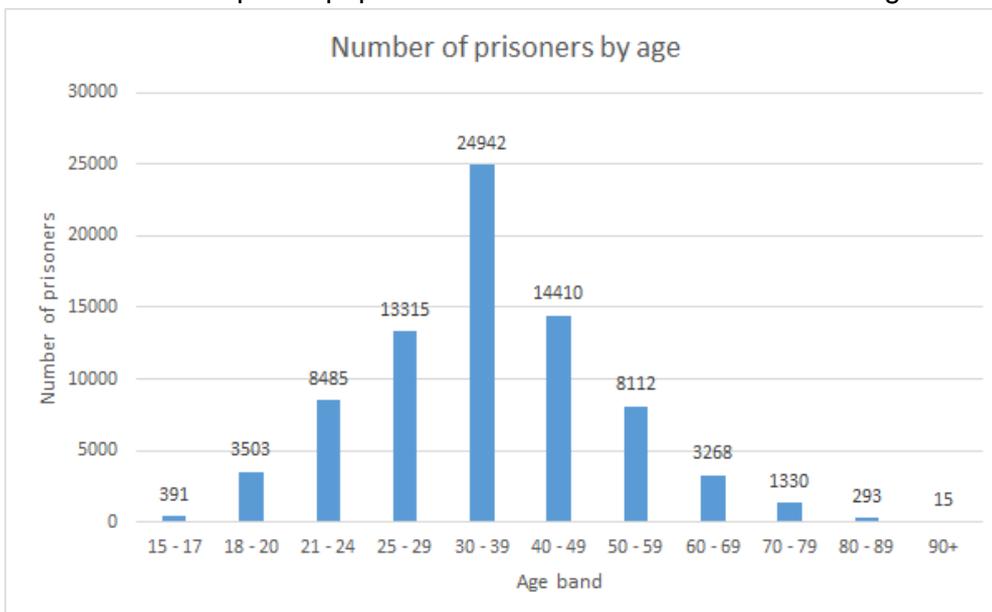
In summer 2020 electric fans were prohibited in prison due to perceived risks of dispersing infection. Not all prisoners have access to a fan; issues around hot weather and confinement may require further consideration in 2021.

### 1.3 Distribution of prison size

Prisons vary in size from c.100 – c.1,800, with an average population of c.650 (MoJ, 2021)

### 1.4 Age breakdown

An age breakdown of the prison population as of March 2021 is shown in Figure A1.



**Figure A1: Prison population of England and Wales, by age group (MoJ, 2021)**

Figure A1 shows the prison population breakdown by age in March 2021. This is a cross-sectional population snapshot and should be considered with the knowledge that the prison system is highly dynamic and will change over time. Under normal (non-pandemic)

circumstances the number of new receptions and prison releases are similar to the total population size (c.80k). (Offender management data, 2020)

The population is traditionally younger than the community population and a relatively large proportion of prisoners are therefore not currently in JCVI vaccination populations.

There are currently 13,018 prisoners aged 50yrs or over (~16.7% population). ~50 establishments contained between 100-550 prisoners aged 50yrs or over. (MoJ, 2021)

People aged 60 and over are the fastest growing age group in the prison estate. There are now almost three times the number there were 16 years ago. (Prison Reform Trust, 2021)

### **1.5 Gender breakdown**

On 5th March 2021 there were 74,917 male prisoners (96% total population) and 3,121 female (4% total population) (MoJ & HMPPS, 5th Mar 2021).

### **1.6 Ethnicity breakdown**

Ethnicity and poor baseline health status have been shown to be important risk factors for severe COVID-19 infection. Black and minority ethnic groups are over-represented in prison populations: 27% (n = 21,574) of people in prison are from BAME backgrounds (HMPPS, 2020), c.f. 14% across the UK population (ONS, 2018), with the highest proportions of people identifying as Black and Black British or Asian and Asian British (House of Commons, 2020).

If the prison population reflected the ethnic make-up of England and Wales, we would have over 9,000 fewer people in prison—the equivalent of 12 average-sized prisons (Prison Reform Trust, 2021).

### **1.7 Levels of comorbidity and learning disability**

Prisoners often come from deprived areas and communities (outside of prison) which experience poor access to healthcare services. People may therefore enter prison with poor health and/or a variety of unmet health needs. As a consequence of these issues prisoners experience a disproportionately higher burden of disease/comorbidity compared to the community population including: infectious diseases (e.g. hepatitis C, tuberculosis, STIs) (Dolan, 2016), long-term conditions (e.g. CVD, type 2 diabetes, asthma) (Gray, 2020, Gray, 2021, Wright, 2019) and mental health problems (e.g. psychosis, depression) (Fazel, 2012), with the standardised mortality ratio amongst prisoners higher than the general population (SMR 2.3 men 95% CI 2.2-2.4, SMR 7.6 women 95% CI 6.9-8.3) (Aldridge, 2018).

People in prison are also subject to the phenomenon of 'accelerated ageing', with evidence suggesting that their health-related needs are advanced by around 10 years, relative to people in the general population (House of Commons Justice Committee, 2020).

Prisoners also traditionally suffer poorer access to secondary care health services than the general community, outside of pandemic conditions. One report found that prisoners had

24% fewer inpatient admissions and outpatient attendances than the equivalent age and sex demographic in the wider population, 45% fewer attendances at accident and emergency departments and 40% of outpatient appointments were not attended (Davies, 2020).

Over a third of people (34%) were identified as having a learning disability or difficulty following assessment on entry to prison in 2017–18. (Prison Reform Trust, 2021).

## **1.8 Inflow and outflow**

Between July 2-Jan 21 there were c.66,000 new admissions into custody (MoJ, 2021). More information on prison movements can be seen in Table 1.

## **1.9 Variability in sentence duration**

### *First receptions*

The latest data from Jul-Sept 2020 showed that 65.7% of first receptions were remand prisoners and 33.9% were sentenced first receptions. Of those who were sentenced, 60% (n=3,119) received a sentence of less than or equal to 6 months. The second biggest category was 12 months to less than four years (21.9% n=1,132). (MoJ, 2021)

### *Sentenced admissions into prisons*

The latest data from Jul-Sept 2020 showed that there were 9,901 sentenced admissions into prisons. 42.5% (n=4,211) had a sentence of less than or equal to six months and 33.2% (n=3,291) 12 months to less than four years. (MoJ, 2021)

## **1.10 Post release destinations**

After release from prisons some people will become resident in further institutional settings such as homeless hostels or approved premises, which provide controlled accommodation for offenders under the supervision of the Probation Service. A small proportion of prisoners may also at some point also be transferred to secure inpatient hospital settings during their sentence (1,016 transfers to secure hospitals recorded in 2019) (Prison Reform Trust, 2021).

Of the 7,814 offenders released between 23 March and 30 April 2020, 14% of adult men, 15% of adult women, and 7% of young adults were homeless. A further 16% of adult men and 15% of adult women and young adults were released into unknown accommodation circumstances (Prison Reform Trust, 2021).

## **1.11 Number of vulnerable prisoners**

There are currently~2400 CEV prisoners who meet JCVI priority definition 4, spread amongst 100 establishments. There are difficulties identifying vulnerable prisoners based on poor previous engagement/recording in clinical health records, therefore this number may be an underestimate. (MoJ, 2021)

There are currently 13,089 prisoners aged over 50 yrs, spread across 114 establishments. (MoJ, 2021)

## 1.12 Likely changes as the pandemic context evolves

During the pandemic the prison regime has fallen to below average levels due to reduced court activity, which has reduced incoming new prison receptions (Criminal Justice Joint Inspection, 2021). As the pandemic context changes, movements in the prison system will start to return to normal levels, in order to deliver a rehabilitative regime, and to keep pace with the community system as it continues to ‘unlock’. HMPPS deliberately reduced the population to help reduce spread of infection - but this reduction cannot be permanent unless alternatives to custody are found.

Despite the view of prisons as a ‘captive’ audience, the prison environment, and indeed the wider criminal justice system, is highly dynamic, with an annual turnover of around 150,000 (PHE, 2021). Prisoners move within prisons, move between prisons and move between prison and community venues e.g. courts or hospitals. As prisons unlock we can expect increased prison churn of residents, increases in the total population and increases in movement. Examples of expected movement changes are shown in Figure A2 and Table 1.

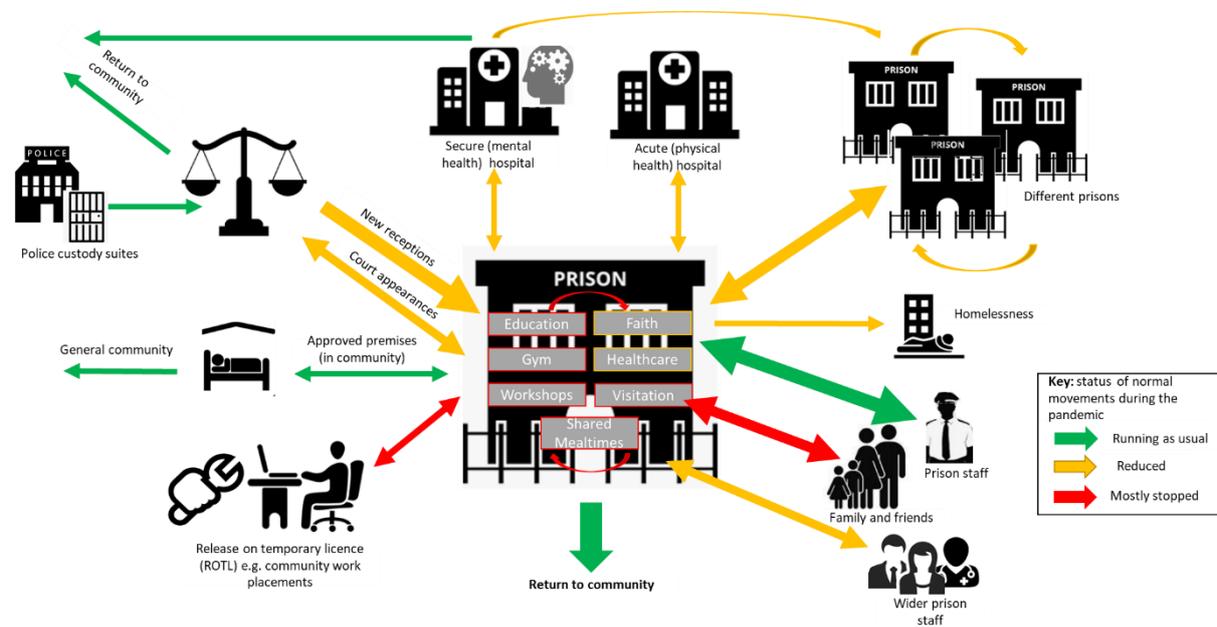


Figure A2: Movement within the prison system during the pandemic

**Table 1: Differences in prison movements - Wave 1, 2 and future scenario**

Type of contact between community and custody or within the prison environment	Wave 1	Wave 2	Potential future scenario	Volume, risk of transmission related to contact point
<p><b>New receptions from courts (HM Courts and Tribunals Service, 2021, Prison Reform Trust, 2021)</b></p>	<p>Courts operating at sub-optimal capacity, volume of new prison receptions reduced compared to pre-pandemic. Larger proportion of prison population is on remand due to delays in court hearings.</p> <p>Before Covid-19 restrictions were introduced, there was a backlog of around 40,000 cases in the Crown Courts and over 400,000 cases in the magistrates' courts</p>	<p>Courts operating at increased capacity compared to wave 1, volume of new prison receptions starting to increase.</p> <p>Court backlogs had increased by around a quarter by September 2020</p>	<p>Court activity increases to normal levels. Combination of case backlog and increased activity will lead to large numbers of new receptions to prisons. Likely that the proportion of sentenced cases will rise in line with pre-pandemic figures.</p>	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> ~53k people received from courts and ~99k people received from community/police settings in a year</p> <p><b>Risk of transmission: HIGH</b></p> <p><b>Rationale:</b> Prisoners arriving direct from community untested for COVID, potentially unvaccinated cohort, pressure on reverse cohorting systems due to high receptions reduces effectiveness</p> <p><b>Issues/unknowns within this setting:</b> Court holding cells can be small and social distancing may not be possible in all settings.</p> <p>Frequency of cleaning unknown</p>

				<p>Difficulties and unknown consistency of the 'chain of custody' for another prisoner being positive and contact tracing</p> <p>There is no record-keeping and it is not easy to share information relating to screening questions being used or case identification</p> <p>Numerous unknowns related to court transport services (PECS) –in regard to cleaning, social distancing with staff and chain of custody for contacts if a staff member were to be identified as positive</p>
<b>Court appearances</b>	Court appearances reduced due to decreased overall activity. Many appearances done via video link.	Court appearances remain slightly reduced due to decreased overall activity. Many appearances done via video link.	Court appearances will increase as courts resume activity. Some video activity will remain. Numbers of jury trials and Crown court hearings will increase, which will likely take place face to face.	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> ~65k people sent out to court in a normal year</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> courts are installing stringent IPC measures, contact with a smaller pool of people than in some other community settings</p> <p><b>Issues/unknowns within this setting:</b></p>

				<p>There is no record-keeping and it is not easy to share information relating to screening questions being used or case identification.</p> <p>There is a backlog of court cases and a new programme of <a href="#">Nightingale</a> Courts</p>
<p><b>Hospital appointments</b></p>	<p>Off-site hospital appointments reduced due to reduced hospital outpatient activity/reduced availability of escort staff</p> <p>2020 total number of movements out to hospital: 59,688 (MoJ, 2021) <b>in comparison to</b> 113,012 episodes (inpatient, outpatient and A&amp;E attendances) in 2017/18. (Davies, 2020)</p>	<p>Off-site hospital appointments reduced due to reduced hospital outpatient activity/reduced availability of escort staff</p> <p>2021 total number of movements out to hospital to date 5,775 (MoJ, 2021)</p>	<p>Off-site hospital appointments will increase as hospital activity scales up and the appointment backlog is cleared</p>	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> &gt;100,000 hospital attendances per year in non- pandemic situation</p> <p><b>Risk of transmission: MEDIUM/HIGH</b></p> <p><b>Rationale:</b> lower risk of acquiring infection if community prevalence is low, higher risk if COVID-19 is in the hospital setting</p> <p><b>Issues/unknowns within this setting:</b> For visits to out-patients and ED, a stay of less than four hours would not require a new period of quarantine. Stays in hospital for over this length of time would require a period of isolation for the 14 days (dependent on test results).</p> <p>Prison officers (at least two) will be physically attached to the majority of prisoners for the</p>

				<p>whole of the journey (taxi or other vehicle) minimising ability to socially distance.</p> <p>In the hospital, this will continue and prisoners remain chained to staff who cannot socially distance and may be in prolonged contact for overnight stays. Multiple staff may be involved with shifts rotating.</p> <p>Numbers of hospital appointments will need to increase to address the backlog.</p> <p>Factor in that hospital sites have often seen the highest rates of infection and most likely places to become infected.</p>
<b>Family visitation</b>	Family visitation stopped during pandemic peak. Video visitation implemented. Some family visits allowed in some prisons as community infections (and related prison infections) subsided.	Family visitation stopped during pandemic peak and still remains prohibited due to infection risks posed. Video visitation remains although appointments are limited.	Family visitation levels will increase as prisons move back to less restrictive regimes	<p><b>Volume: HIGH</b> (no data on visitation numbers available)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> IPC measures can be put in place, use of LFD/PCR for visitors could be explored, vaccinated visitors will increase as vaccination rollout progresses</p> <p><b>Issues/unknowns within this setting:</b> Unknowns include- total numbers of individuals who will visit, total numbers of visits likely to occur, average length of visit,</p>

				<p>consistency of IPC measures and ability to socially distance in visitation areas</p> <p>Limiting visitation to one named person (as with care homes) will preclude children from seeing their parents and is not feasible</p> <p>Unknown who would fund testing programmes for visitors</p>
<b>Legal visitation</b>	Legal/official face to face visits have continued to be permitted throughout the pandemic, although remote visitation is encouraged	Legal/official face to face visits have continued to be permitted throughout the pandemic, although remote visitation is encouraged	Face to face legal/official visits may return to a predominantly face to face format	<p><b>Volume: MEDIUM</b></p> <p><b>Risk of transmission: MEDIUM</b></p> <p>(no data available – based on MoJ advice)</p> <p><b>Issues/unknowns within this setting:</b> Unknowns include- total numbers of individuals who will visit, total numbers of legal visits likely to occur, average length of visit, consistency of IPC measures and ability to socially distance in legal visits</p> <p>Unknown who would fund testing programmes for legal visits</p>
<b>Core staff contact (prison/healthc</b>	Continued contact with prison officers and healthcare staff. Some	Continued contact with prison officers and healthcare staff. Some	Increased healthcare activity will lead to more frequent contact with	<b>Volume: HIGH</b>

<p><b>are staff)</b></p>	<p>reduced activity in healthcare. Ideally contact only with prison officer cohort, although staff absences may have resulted in contact with wider staffing pool.</p>	<p>reduced activity in healthcare. Ideally contact only with prison officer cohort, although staff absences may have resulted in contact with wider staffing pool.</p>	<p>healthcare staff. Increased contact with a range of prison officers likely to resume, although perhaps less likely to encounter officers from other establishments (via staff absence cover).</p>	<p>(no data available but every prison essentially has an on-site GP surgery and daily interactions with prison officers)</p> <p><b>Risk of transmission: LOW</b></p> <p><b>Rationale:</b> Healthcare staff are aware of IPC measures and use PPE, vaccination is available for all healthcare staff. Routine LFD testing could be used as in other healthcare settings</p> <p>Prison officer routine testing being implemented. Current levels of vaccinated prison officers are low</p> <p><b>Issues/unknowns within this setting:</b></p> <p>Query surrounding routine testing for agency and short-term staff.</p>
<p><b>Wider staff contact (e.g. voluntary sector, researchers, peer engagement teams)</b></p>	<p>In general, non-essential staff were not permitted to enter prison establishments under regime 4</p>	<p>In general, non-essential staff were not permitted to enter prison establishments under regime 4</p>	<p>As prisons move to less restrictive regimes non-essential staff will return into prisons to usual levels</p>	<p><b>Volume: LOW</b> (no data available – based on MoJ advice)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> Familiarity with prison IPC protocols and vaccination levels may vary</p> <p><b>Issues/unknowns within this setting:</b></p>

				Vaccination levels of these staff likely to be low currently
<b>Transfer to secure hospitals</b>	Reduced compared to normal levels	Reduced compared to normal levels	Transfers will resume to normal levels	<p><b>Volume: LOW</b> (no data available – based on MoJ advice)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> As a closed institutional healthcare setting, secure hospitals remain vulnerable to outbreaks</p> <p><b>Issues/unknowns within this setting:</b> Vaccination levels in these settings likely to be high</p>
<b>Movement between prisons (MoJ, 2021)</b>	Prison movement reduced	Prison movement reduced	Prison movement likely to increase back to pre-pandemic levels, especially as new receptions rise	<p><b>Volume: HIGH</b></p> <p><b>Rationale:</b> 37,338 modelled transfers between prisons in a normal year</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> mitigated by testing, RCU upon reception and knowing outbreak status of sending prison)</p>
<b>Release on temporary licence (ROTL) for work purposes</b>	ROTL mainly paused	ROTL mainly paused	ROTL (both day and overnight release) will increase back to pre-pandemic levels to support rehabilitation	<p><b>Volume: MEDIUM</b> 436,531 ROTL incidences in 2019</p> <p><b>Risk of transmission: HIGH</b></p>

<p><b>(Prison Reform Trust Briefing 2, 2020, HMPPS 2020c)</b></p>				<p><b>Issues/unknowns within this setting:</b> Unclear how many prisoners will be eligible for ROTL</p> <p>Very porous activity for bringing infection back into prisons but vital in terms of rehabilitation of the individual</p>
<p><b>Release back into community (MoJ, 2021)</b></p>	<p>People continued to be released to community settings at the end of their tariff as usual</p>	<p>People continued to be released to community settings at the end of their tariff as usual</p>	<p>People will continue to be released as usual. Increased court activity/remand prisoners may lead to an increase in the churn in and out of prisons</p>	<p><b>Volume: MEDIUM</b> <b>Rationale:</b> modelled estimate 54,671 releases in a normal year</p> <p><b>Risk of transmission (to community setting): MEDIUM</b></p> <p><b>Rationale:</b> should know the outbreak status of the prison they are leaving which is covered by surveillance.</p> <p><b>Issues/unknowns within this setting:</b> Problems include - what to do in regards to someone being released from an outbreak site or is symptomatic who has refused testing/unknown status.</p> <p>Transport arrangements after release are not the responsibility of either the prison or the community. How do you relocate a prisoner leaving a prison to their community location</p>

				without asking them to break the law i.e. using public transport when potentially infectious
<b>Release into approved premises (probation)</b>	Referrals/acceptances to approved premises continued throughout wave 1	Referrals/acceptances to approved premises continued throughout wave 2	Referrals/acceptances to approved premises will continue	<p><b>Volume: LOW</b></p> <p><b>Rationale:</b> 100 approved premises sites</p> <p>Data as of 11<sup>th</sup> March 2021: average of 6.38 arrivals over 4 last 4 wks (total 174 arrivals) and average 6.09 departures (total 158 departures)</p> <p><b>Risk of transmission: MEDIUM</b></p> <p><b>Rationale:</b> should know the outbreak status of the prison they are leaving and LFD release testing, higher risk residential setting they are moving to</p> <p><b>Issues/unknowns within this setting:</b> Problems include - what to do in regards to someone being released from an outbreak site or is symptomatic who has refused testing/unknown status.</p> <p>Transport arrangements after release are not the responsibility of either the prison or the community. How do you relocate a prisoner leaving a prison to their community location</p>

				without asking them to break the law i.e. using public transport when potentially infectious
<b>Additional movements within the prison environment</b>				
<b>Communal mealtimes</b>	Paused	Paused	Communal mealtimes will resume	<p><b>Volume: HIGH</b></p> <p><b>Risk of transmission: HIGH</b></p> <p><b>Rationale:</b> Essentially mirrors re-opening of hospitality settings in the community</p>
<b>Gym attendance</b>	Paused	Paused	Gym attendance will resume	<p><b>Volume: MEDIUM</b></p> <p><b>Risk of transmission: HIGH</b></p> <p><b>Rationale:</b> Gym environments are known high risk transmission settings</p>
<b>Work and education</b>	Paused	Paused	Work and education must resume to deliver rehabilitative activities	<p><b>Volume: HIGH</b></p> <p><b>Risk of transmission: VARIES BY SETTING</b></p> <p><b>Rationale:</b> Transmission will vary by setting e.g. large workshop premises vs smaller classroom settings</p>

Other contextual factors of note regarding the onwards scenario include:

- Four new prisons to be built over the next 6 years (10,000 extra prison places)
- Continued rollout of the Health and Justice Information System will allow prisons to access existing patient GP health records on entry to prison, and for prison health records to follow the patient into the community. This will support accurate determination of current vaccination status

## **2 Staff population**

The prison staff population (not including agency staff/non directly employed staff) is c. 36,000. Staff turnover rate is 9.5% per year. (MoJ, 2021)

### **2.1 Age distribution**

Amongst public sector prison staff, on 31st Dec 2020, there were 7,341 staff aged <30yrs, 8,227 30-39yrs, 7,053 40-49yrs, 9,763 50-59yrs and 3,257 aged 60+yrs. The regional average age of staff is 40-45 years. (MoJ, 2021)

### **2.2 Levels of comorbidity**

An English research study measured perceived physical health amongst a cohort of prison officers. Results showed that 83.8% of prison officers scored below average on general health, 52.0% below average on role physical (limitations in usual role activities), 50.0% below average on bodily pain, and 32.0% below average on physical functioning (Harvey, 2014). The results showed lower scores on each of the physical health dimensions when compared with data using the SF-36 II with other occupational groups in the United Kingdom. Prison officers have also been found to suffer from high stress levels and poor mental health due to job demands (Kinman, 2017).

## **3 Information on Control measures**

This section presents descriptive information on processes followed. Epidemiological evidence surrounding use of control measures is presented in section 4.5.

### **3.1 Prisoners**

Social distancing was enabled by a new instruction by HMPPS on March 24 to implement a restricted regime. This greatly limited social visits, and classroom based education, training and employment activities (except for essential workers), all access to gyms, religious association and general association, and introduced restrictions on numbers of people unlocked, numbers of people in exercise yards at any one time, and supported enforcement of social distancing of 2M for staff and prisoners wherever possible. Intra-prison movement of prisoners was strongly discouraged and for specific areas with especially vulnerable prisoners, staff cross-deployment was advised against where possible.

**Compartmentalisation** (HMPPS, 2020a) was implemented at a macro-level by reducing significantly transfers between prisons with an order issued by HMPPS on March 31. Reducing movements between prisons was recommended to reduce risk of 'seeding' infections and subsequent outbreaks in prisons receiving infected prisoners. Within prisons, the most effective form of compartmentalisation is single-cell accommodation but it was recognised that this would require significant reductions in prisoner population to achieve across the prison estate (about 15,000 people was the estimate at the time the original advice was provided). But building on best evidence to protect the most vulnerable and reduce transmission of infection, new cohorting strategies were developed by HMPPS advised by PHE which were implemented from March 31. These included establishing:

- **Protective Isolation Units (PIUs):** to accommodate known or probable COVID-19 cases, ideally in single-cell accommodation.
- **Shielding Units (SUs):** to protect the most vulnerable identified through collaboration with NHS England, with enhanced levels of bio-security including dedicated staff;
- **Reverse Cohorting Units (RCUs):** to accommodate new receptions or transfers in for a period of 14 days to detect any emergent infectious cases before entering general population. These units could also accommodate any one returning from hospital (to prevent incursion of infection through nosocomial transmission).

Creation of all of the above units required time and head room and were implemented at a differential pace across individual prisons and the general estate but prioritisation was given to PIUs and SUs initially.

### *3.1.1 Process of reverse cohorting* (Watson, 2019; HMPPS, 2020a)

Reverse Cohorting Unit (RCU) is the process of separating newly arrived prisoners from the rest of the population for a period of 14 days in order to allow for the detection of emerging infectious cases before entering the general prison population. This guidance was subsequently *updated* in response to testing (where present) to allow for a reduction in the time spent in the RCU. Where 2 negative test results were received within a period of 7 days, then asymptomatic persons could be allowed out of the RCU. The purpose is to ensure they are not carrying COVID-19 before they are integrated into the population. This includes prisoners received into an establishment and those moving back and forth for hospital or court.

The definition of a new arrival includes:

- Newly received residents
- On return from hospital if: overnight stay or longer, Prolonged day-case treatment e.g. chemotherapy, dialysis, high risk assessed A&E/OPD visit
- Cell-sharing contacts of symptomatic residents
- Contacts identified by test and trace scheme (contacts may isolate without relocating)
- Attending court trial unless 1-day only with no breach to social distancing

Some establishments have PCR testing available. A prisoner may leave isolation after two subsequent negative PCR tests on day 0/1 and day 5-7. If the second negative test falls before day 10 then they will be kept remote from the rest of the population if possible (e.g. in a single cell) up to day 10. If testing on reception is not available or the prisoner or detainee refuses the test they must complete 14 days isolation.

Reverse cohorting is ended if the individual remains asymptomatic after either: 14 days from arrival, 14 days after arrival of last member to join the household, 14 days after final day of court appearance, 14 days after confirmed case's test date (if asymptomatic contact of confirmed case), 14 days after suspected case's symptom (if asymptomatic contact of suspected case) unless contact tests negative at which case isolation is ceased. If an individual becomes symptomatic they begin at least 10 days isolation in protective isolation units.

During wave 2 court receptions started to increase as court activity scaled back up. As a result reverse cohorting unit capacity reduced causing issues with mixing between different temporal cohorts.

### *3.1.2 Process of protective isolation* (Watson, 2019; HMPPS, 2020a)

Protective isolation is designed to isolate prisoners who are symptomatic for a minimum period of 10 days and until it can be verified that they are symptom-free. Protective isolation is temporary separation for the purposes of infection control/illness monitoring. Symptomatic residents, residents returning to hospital with confirmed COVID-19, household/other contacts of suspected/confirmed cases who become symptomatic and asymptomatic people who test positive are placed in protective isolation. Protective isolation can be undertaken 'in place' for individuals where they are currently residing or in specified areas when they are known as Protective Isolation Units.

People placed in protective isolation should ideally be placed in single occupancy accommodation for at least 10 days and tested for COVID-19. Prisoners or detainees who have had symptoms of COVID-19 may end isolation after 10 days and return to their normal routine. If a prisoner or detainee still has symptoms or signs (such as measurable fever) other than cough or loss of sense of smell or taste after 10 days or longer, they must continue to isolate until well or testing has confirmed a negative result.

Where there are 2 or more prisoners or detainees in a cell or room and one develops symptoms or is confirmed to have coronavirus, those prisoners or detainees sharing the room are considered at risk of COVID-19 infection and are isolated away from the general prison population for 10 days. Practical operational considerations will inform whether that means they stay where they are or can be moved to another location away from the unwell cell or room-mate.

Protective isolation can be ended at 10 days if the suspected/confirmed case has not been admitted to hospital and meets certain clinical criteria e.g. 48hrs free from fever.

Protective isolation is ended at 14 days if the case is a confirmed case returning from hospital following admission for COVID-19 or where households with suspected/confirmed cases and asymptomatic members choose to remain together.

The principles of Protective Isolation must be implemented as standard wherever a symptomatic/COVID-19 positive prisoner is located. This includes:

- Effective barrier control
- Separation between Cohorts of prisoners
- Regimented cleaning in line with relevant SOPs.
- Prison staff should be able to identify those prisoners who are protectively isolating.
- Ensure that prison healthcare provide daily/regular checks on those in protective isolation

### *3.1.3 Process of Shielding* (Watson, 2019; HMPPS, 2020a)

Shielding involves separation from others to prevent infection and minimise risk of severe illness with COVID-19.

Shielding is designed to isolate prisoners who are classed as Clinically Extremely Vulnerable (CEV) to COVID-19. In the prison estate the opportunity to shield will continue to be available for any prisoner who wishes to opt in and establishments must therefore maintain the facilities and services for those who wish to shield, even if there are no prisoners currently shielding in case the community guidelines change or there is a localised outbreak.

**Information published by DHSC on 18<sup>th</sup> March 2021 suggests shielding will be stopped from Thursday 1<sup>st</sup> April. Consideration is needed around how this advice should be interpreted in prison settings if outbreaks continue to occur (DHSC, 2021).**

In current shielding arrangements people shielding are located alone. CEV patients are either grouped together and then bubbled together for hygiene, exercising and feeding or brought to these activities individually.

CEV residents (at high risk of severe illness from COVID-19) in line with national guidance and/or local guidance during any specific COVID-19 outbreak are invited to shield. Residents who fall into the Clinically vulnerable (moderate risk) category have also been shielded in some establishments, following advice from local Health protection teams, where virus transmission levels have been high and where residents have multiple risk factors e.g. age, BMI, multiple co-morbidities.

Poor and/or inconsistent data quality/clinical coding within the SystemOne records has hampered identification of all CEV meaning there have needed to be manual processes to identify current and new CEV arrivals.

Establishments can either:

1. Create a designated Shielding Unit large enough to accommodate prisoners who wish to opt in.
2. Create a separated shielding regime for prisoners wishing to opt in that can be provided to their individual cell location. Prisons adopting this model must consider how they will ensure that shielding applies to all aspects of regime, including meals, showers and exercise.

A recent Prison Reform Trust report suggests that some residents actively choose not to shield, potentially related to the isolation imposed from shielding. For example, in HMP Wandsworth 20 prisoners had declined to be shielded, against medical advice. The same report suggests that prison staff were required to be cross deployed to shielding units from other prison wings, likely due to decreased staffing levels as a consequence of the pandemic. (Prison Reform Trust Briefing 2, 2020)

#### *3.1.4 Shared accommodation* (Watson, 2019; HMPPS, 2020a)

There was an overall reduction in the numbers of people sharing a cell during the pandemic (from ~32k sharing a cell in March 2020 to 27k in June 2020) (MoJ, 2021). As receptions from courts begin to increase, it is likely that >1 cell occupancy will increase, as will the demand on communal facilities, such as showers.

#### *Reverse cohorting*

Reverse cohorting should be undertaken in single occupancy. If this cannot be achieved, people arriving on the say day may share a cell and become a household. People arriving on subsequent days should not mix with arrivals from previous days.

#### *Protective isolation*

If single occupancy accommodation is not available, possible cases should be held alone in higher occupancy accommodation, or where demand exceeds capacity, cases may be cohorted together.

#### *3.1.5 Restrictions on movements and mixing*

During both Wave 1 and 2 similar measures were deployed within the prison estate to reduce the risk of infection through movements/mixing including: Compartmentalisation, maximisation of single-cell occupancy, enhanced social distancing and hand hygiene measures, reduced inter-prison movements and temporary local movement suspensions.

A 5-stage [conditional recovery plan](#) has been developed for prison regimes and services. Adult prisons have generally operated Stage 4 ('lockdown') regimes during the peaks of wave 1 and 2, although between June 2020 and January 2021 many were operating at Stages 3 and 2.

HMIP reported in February 2021 that prisoners are averaging 22.5hrs per day in isolation (HMIP, 2021).

Despite the stringent control measures in place, the prison estate in general is not designed to deliver regimes that significantly reduce levels of social contact within the prison. Even with prolonged isolation of residents in cells, some mixing in small groups will inevitably occur e.g. when accessing showers, medication dispensing or food.

#### *3.1.6 Restrictions on visiting*

Prison social visits are currently suspended in England, except on exceptional compassionate grounds. Visitation has been largely suspended since the start of the

pandemic; some prisons were able to offer limited, socially distanced visits during the 2020 summer period when they moved to a less restrictive regime (Exceptional Delivery Model).

The prison estate in England and Wales did not have video call facilities operational in all prisons until January 2021. Video calls have been limited and problematic for children. Many of these children enjoyed regular and positive contact with their parent prior to prison lockdown and do not understand why this contact has stopped, sometimes blaming themselves. This loss of contact has negatively impacted children's relationships with their imprisoned parents and their mental and physical health and wellbeing. The effects of this loss of contact and disruption to family relationships are likely to be long term and will affect family reunification and resettlement after imprisonment. (Minson, 2021)

### *3.1.7 Testing and isolation processes*

Both routine and research (CiPS study) testing are/have been conducted within prison settings.

Current testing for residents includes:

- Testing of all new arrivals in reverse cohorting units
- Symptomatic individuals - If an individual is displaying COVID-19 symptoms and placed in protective isolation then all symptomatic residents will subsequently be tested (alongside the symptomatic individual)
- Outbreak situations (2 or more cases) - all residents and staff tested using PCR. Residents and staff are tested at day zero, day 5-7 and then recovery testing at day 28 post the last confirmed or suspected case to confirm the outbreak is over (excluding those who tested positive, who should not be re-tested for a minimum of 90 days). If a whole wing needs to be sampled then this cannot be achieved in one day owing to the time taken to test a large number of people. In addition, potential bottlenecks at the pathology lab can delay outbreak testing. Very large wings may need to be spread over 2 or 3 days.
- LFD testing of all prisoners pre court attendance, transfer and release

If testing positive isolation will be followed as in section 3.1.2. If a prisoner is due for release this cannot be delayed by isolation protocols.

Mass testing in prisons is extremely burdensome to healthcare teams and compromises their ability to deliver business as usual and to recover from the pandemic healthcare backlog.

#### *Routine testing in reverse cohorting units*

Up to and including 2nd March 2020, 59,225 PCR tests were registered across 115 prisons for those requiring reverse cohorting. Data for 21st-27th Feb 2021 shows 104 prisons reported data on reception testing, with an average uptake of PCR reception testing of 80.8%. Around half of prisons reported 100% uptake. (MoJ, 2021)

Table 2 shows the proportion of reverse cohorting PCR tests that were positive. This is based on total positives amongst all tests administered, combining those administered on day 0 and day 5/6, therefore many tests will relate to repeated testing on the same individual.

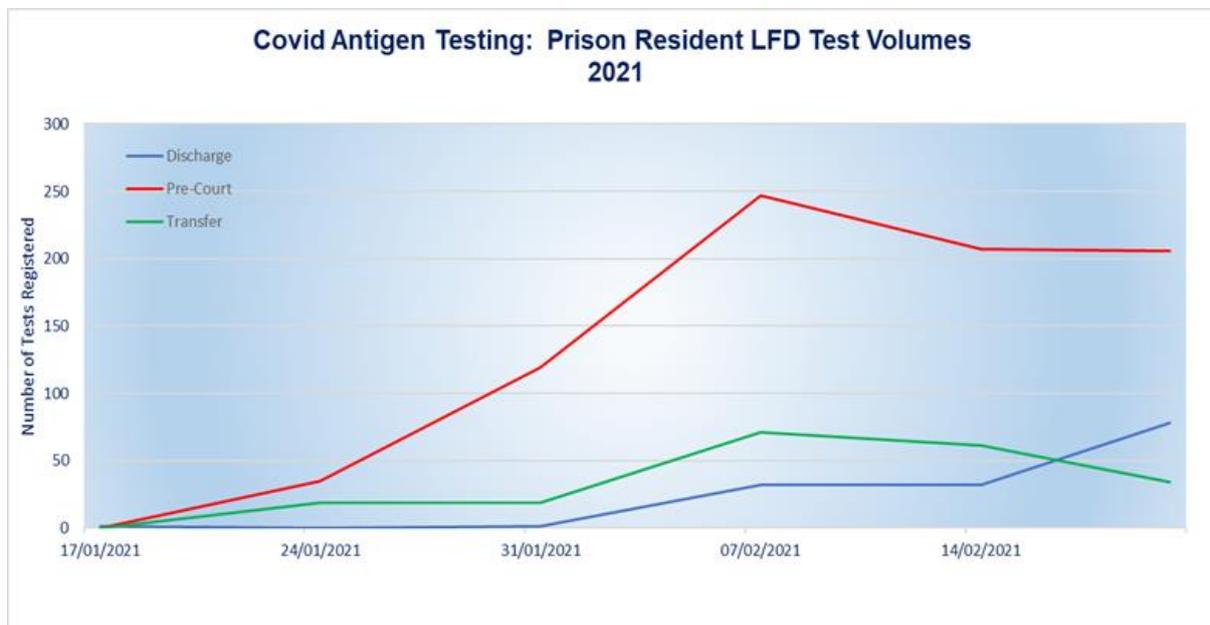
Date	% positive reception tests ( combined to include tests on day 0 & tests on day 5/6)
26 Jan 21	4.23%
2 Feb 21	3.98%
9 Feb 21	3.36%
16 Feb 21	2.95%
23 Feb 21	2.94%
2 Mar 21	2.40%
9 Mar 21	1.80%

**Table 2: Percentage of positive routine PCR tests in reverse cohorting units**

Overall the proportion of positive tests amongst newly arrived prisoners are decreasing in line with decreasing community prevalence.

*LFD testing for transfer and release*

Figure A3 shows the weekly total of prison resident LFD testing for resident discharge, pre-court testing and transfer testing. (MoJ, 2021)



**Figure A3: Weekly total prison resident LFD testing**

A total of eight prisons are now offering a pre-court LFD. The average uptake for LFD pre-court testing in the most recent week (21-27th Feb 21) was 82.0%. (MoJ, 2021)

Table 3 shows the proportion of positive tests for the different LFD programmes as reported up to the 9th March 21.

<b>Date</b>	<b>% positive LFD pre-court tests</b>	<b>% positive LFD pre-discharge tests</b>	<b>% positive LFD pre-transfer tests</b>
16 Feb 21	1.81%	3.13%	0
23 Feb 21	1.45%	0	0
2 Mar 21	0.49%	1.28%	2.94%
9 Mar 21	1.67%	0	0

**Table 3: Proportion of positive LFD tests for pre-court, transfer and release testing**

6,994 resident PCR tests have been registered across 97 approved premises sites. Average uptake amongst residents of APs is 30.7% with wide variation between sites. (MoJ, 2021)

As yet serology has not been undertaken with prison residents. It should be noted that serology on reception into prison is likely to be a difficult strategy to implement, firstly because reception into prison can be a traumatic time, secondly because many prisoners have a history of injecting drugs and may have issues with venous access.

#### *Test and trace*

Test & Trace has facilitated the isolation of positive cases and their contacts to protect residents, staff and the public from infection. Mass testing is conducted in outbreak sites, in addition to testing of all symptomatic prisoners across England & Wales. (MoJ, 2021)

#### *Dynamic surveillance systems*

Dynamic surveillance systems have been developed to track the risk of transmission into and between sites, whereby HMPPS are considering the population capacity needs of the estate alongside the health needs of staff, residents and the public in order to prevent seeding and feeding infection. HMPPS monitor areas of concern in the community, triangulating infection data in the local authority against that in local establishments and working closely with health partners to ensure HMPPS is able to serve the courts and protect residents and staff. (MoJ, 2021)

#### *3.1.8 Wastewater testing*

A wastewater testing programme is currently being piloted in at least 12 sites across North-East England and Yorkshire & Humber, this project aims to:

- Collate new evidence on the incidence and prevalence of COVID-19 in custody and how this relates to cases identified through symptomatic & asymptomatic testing.

- Determine whether a wastewater surveillance system can work at prison level, i.e. establish the effectiveness of extracting non-infectious SARS-CoV-2 RNA fragments (the virus that results in COVID-19) from in-prison wastewater systems.
- Evaluate the costs of undertaking a wastewater surveillance system at a large scale.
- Explore the feasibility of implementing an early-warning system based on wastewater surveillance data at a prison level.

There are challenges to identifying prison sampling points (to avoid contamination with wider community) so wastewater testing alone is unlikely to provide a whole prison estate detection strategy.

Wastewater testing is less useful as a marker of infection when the background prevalence is high. Many prisons are currently 'hot' i.e. have current infections, and the benefit of wastewater testing is likely to be more notable if/when prisons return to 'cold' (i.e. no infections) or as transmission is increasing.

Wastewater testing is also still likely to require subsequent in-prison mass testing, which is complicated and time-consuming as described previously. It is not possible to identify specific infected individuals through wastewater-based surveillance alone but this analysis provides a useful monitoring tool for SARS-CoV-2 concentration levels (potentially including variants) and other pathogens.

### *3.1.9 Use of PPE and hand hygiene*

In all circumstances individuals (staff and prisoners) must remain at least two metres apart at all times, and use appropriate PPE where this cannot be followed. The recovery EDMs have outlined certain specific situations where establishments are able to move to a one metre plus rule with mitigations (e.g. in social visits where the fabric of the building makes it impossible to maintain 2m), however they must reinforce that two metres is the standard social distancing requirement. (HMPPS, 2020a)

Prisoners may be asked to wear masks by outbreak control teams. Symptomatic prisoners will be asked to wear a mask if they need to be moved to another part of the prison for protective isolation.

### *3.1.10 Vaccine*

Prisoners have not been prioritised for vaccination amongst JCVI guidance. Vaccination of prisoners to date has been in line with the rollout strategy being delivered in community settings, following evolving JCVI guidance.

Vaccinations in prisons commenced on January 29th 2021 with AZ vaccine.

As of 18 March 2021, the percentage of the whole prison population in England who have received a first dose of the Covid-19 vaccine is 23.4%, equivalent to 79% of the priority cohorts 2-6 (as defined by the Joint Committee on Vaccination and Immunisation).

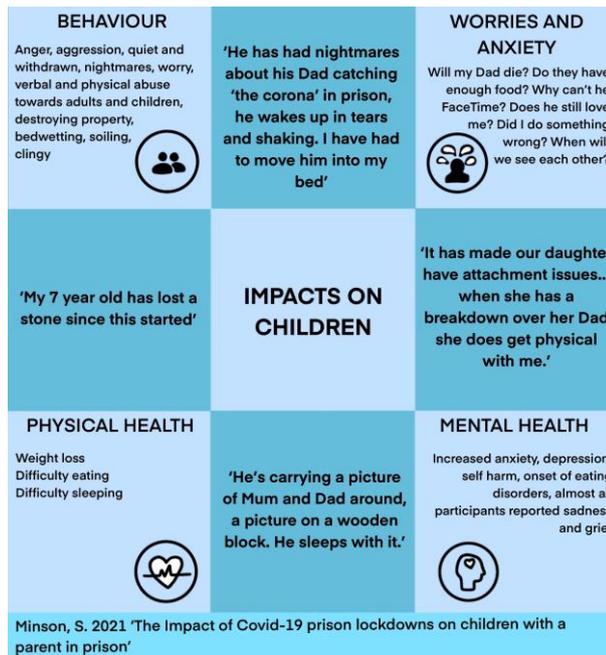
Identifying eligible people in prisons for some vaccine criteria (outside of age) can be difficult due to poor clinical coding and limited interaction with health services, both during and before prison. Many people in prisons are therefore considered low priority by default. (Braithwaite, 2021)

A recent report from a peer engagement organisation surveyed 800 people in nine English prisons about their attitudes to COVID-19 vaccines. Despite concerns, overall 78% of the prison population said they would accept a vaccine if offered. Concerns were similar to those reported in community settings, including side effects and the speed of vaccine development. Also similar to community surveys, younger participants and those from black and minority ethnic groups were less likely to say they wanted a vaccine. Some participants questioned why vaccines would be given to certain prisoners, or prisoners but not staff. The report concluded that simultaneous vaccination of whole prisons including staff could alleviate mistrust and expedite a return to a normal regime. (EP:IC, 2021)

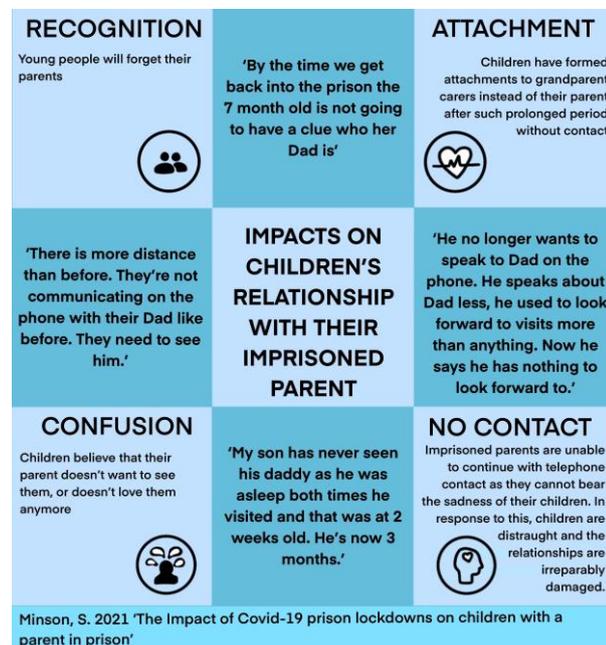
The JCVI recently recommended that homeless groups be prioritised for vaccination, a recommendation which was accepted by the Department of Health and Social Care (H&SC secretary, 2021). There is an inextricable link between imprisonment and homelessness. 15% of prisoners report being homeless before incarceration. Over two in five prisoners (44%) reported being in their accommodation prior to custody for less than a year. Twenty-eight percent of the sample reported living in their accommodation for less than six months. Nearly two in five prisoners (37%) stated that they would need help finding a place to live when they were released. Of these, 84% reported needing a lot of help (MoJ, 2012). A further report from ACMD (2019) found 34.5% of prisoners were released without settled accommodation. Offering a settings based vaccination approach for this highly vulnerable cohort will be far more effective than offering vaccination only when in the state of homelessness. Given the link between prisoners and homelessness the JCVI recommendation around vaccination of homeless groups could also be substantially achieved by vaccinating prisoners.

### *3.1.11 Social/Mental Health Impact of restrictions*

In-person family visits have largely been prohibited to reduce risk of COVID-19 transmission from community settings into prison environments. This has had negative impacts both for prisoners and their families, with a disproportionate impact on women and their children (Prison Reform Trust Briefing 1, 2020). It is estimated that more than 300,000 children in England and Wales have a parent in prison each year, and many of these children have not had any face-to-face contact with their parent since early March 2020 (Minson, 2021). Figures A4-A5 are taken from a recent report about the effects felt by children who have had a parent in prison during the pandemic (Minson, 2021).



**Figure A4: Effects on children caused by having an imprisoned parent during the pandemic**



**Figure A5: Effects on children's relationships caused by having an imprisoned parent during the pandemic**

According to Her Majesty's Inspectorate of Prisons (HMIP): "The prevalence of mental health problems among the prison population before the pandemic was well-documented. The effect of COVID-19 restrictions on this population had therefore been significant" (HMIP, 2021). As discussed above, increased time spent in cells (up to 23h per day), scarcity of meaningful activities, and little or no contact with others, especially for people in isolation because of COVID-19, imitates solitary confinement. This is known to be associated with psychological consequences including depression, anxiety, paranoia, psychosis, and exacerbation of underlying mental illness, and increased mortality after release from prison,

even with relatively short periods of confinement (Hewson, 2020a). Prisoners access to mental health staff has also been curtailed by the lockdown conditions including access to therapy and face to face contacts (HMIP, 2021).

Research from a service user led organisation found around half of all respondents said that their mental health had deteriorated since the start of the pandemic. (EP:IC, 2021a) Respondents expressed frustration that they were unable to complete planned rehabilitative activities and also reported a lost sense of purpose. Both prisoners and their families reported high levels of pain and anxiety related to the prolonged separation from their immediate family, including children, evidenced in the following verbatim quotations (EP:IC 2021b):

*“A year ago I used to thank god that I was lucky not to have mental health issues. It’s taken just one year in lockdown for me to be shocked by how fast I lost a sense of purpose and wellbeing, and now to realise I have been broken as a human being by twelve months in lockdown”*

*“We are all human [...] my punishment for my crimes is being sent to prison. During this pandemic it’s been hard and lonely. 23 hours a day in a cell for the past 11 months, that’s loneliness. [...] We seem to be forgotten, maybe no one cares, why should they?”*

*“Prison causes mental health issues and we will be joining your community. Just more broken than when we went in. That helps no-one. Please help, for everyone’s sake”*

*“(a message) to my sons. Perhaps my destiny is to watch you from afar as I have always done. I’m missing hugging you guys but I love you nevertheless. [...] I am sorry sons [...] I never left or abandoned you. Daddy loves you and always will. I am sorry. To the lights of my light you each are half of my heart. Daddy loves you.”*

## 3.2 Staff

Staff in closed settings work in the same confined, densely populated and high turnover conditions as the imprisoned population but also interact with the community. Many staff have social networks with a high proportion of others who work in custodial settings, similar to other institutions, such as the Police and Armed force. HMPPS evidence has suggested that incidence per day can be up to 75% higher amongst the prison staff population than the general community population (ONS, 2020), not controlling for demographic differences, such as age, ethnicity and gender. Behaviour of staff in custody are thus a significant driver of transmission and prisons face analogous risks to care homes and cruise ships (PHE, 2021; MoJ 2021).

### 3.2.1 Symptomatic Testing and isolation (PHE & MoJ, 2020)

If a member of staff becomes unwell with symptoms of COVID-19, they are sent home immediately, told to follow the Stay at home guidance, self-isolate for at least 10 days from first onset of symptoms and arrange a test.

Staff without symptoms of COVID-19 but who share a household with symptomatic or confirmed cases of COVID-19 must follow guidance to stay home and self-isolate for 10 days.

Given the high-risk setting, it is important to interpret negative results in symptomatic staff with caution and a clinical assessment should be undertaken before they start working. Staff who test negative but continue to have symptoms of COVID-19 should stay home for at least 10 days from symptom onset and should only return to work after that if they feel well enough to do so.

If a member of staff has helped someone who was taken unwell with symptoms of COVID-19 they do not need to go home unless they develop symptoms themselves or have been advised to do so by the local HPT or NHS Test and Trace system

### *3.2.2 Social distancing*

As described in 3.1.9, in all circumstances individuals (staff and prisoners) must remain at least two metres apart at all times.

### *3.2.3 Use of PPE and hand hygiene* (PHE & MoJ, 2020)

All staff are advised to wear appropriate PPE and ensure they undertake hand hygiene measures.

For activities requiring close contact with a possible or confirmed case of COVID-19, for example, patient assessment, interviewing people at less than 2 metres distance, or arrest and restraint, PHE guidance on PPE should be adhered to. For all staff, PPE must be changed regularly, depending on the nature of the activity and local context. Full staff PPE guidance for secure detained settings can be found here:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/900040/PPE\\_Table\\_Recommended\\_personal\\_protective\\_equipment\\_PPE\\_for\\_staff\\_clinical\\_and\\_non-clinical\\_in\\_custodial\\_settings\\_and\\_in\\_community\\_offender\\_V3.11.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/900040/PPE_Table_Recommended_personal_protective_equipment_PPE_for_staff_clinical_and_non-clinical_in_custodial_settings_and_in_community_offender_V3.11.pdf)

All used PPE must be disposed of as clinical waste. Scrupulous hand hygiene is an important component of infection prevention and control measures and essential to reduce cross-contamination and infection.

### *3.2.4 Movement of staff between prisons*

Staff regularly work across prisons for reasons of supplementing resource, managing incidents of disorder, regional drug-searching teams or assurance, however HMPPS reduced the movement of staff between prisons during the pandemic to reduce the risk of seeding and feeding infection across the prison estate. Where this is not possible, weekly self-swab PCR testing has been provided.

### *3.2.5 Asymptomatic testing programme and uptake* (MoJ, 2021)

Asymptomatic staff testing commenced in November 2020. The programme includes:

- Routine weekly PCR testing and twice weekly LFD testing of all staff working in prisons, secure training centres and IRC Morton Hall
- Routine weekly PCR testing of all Approved Premises staff and residents
- Twice weekly LFD testing of all staff working in Probation Contact Centres

PHE advises weekly staff testing should aim to be at least 75%. (PHE, 2021)

Up to and including 2nd March 2021, 228,428 prison staff PCR tests have been registered and 6,808 approved premises PCR kits. Uptake of staff PCR testing for 21-27th Feb 2021 averaged 38.1%.

115 prisons currently offer staff LFD testing with a further 4 planned to 'go live' imminently. Average uptake for the most recent testing week of staff LFD tests (21-27th Feb) was 31.3%, a 2.7% increase on the previous week. Uptake of staff testing varies by prison from 28%-92% (LFD), 2%-92% (PCR).

Between 24th Feb and 2nd March there was an average approved premises staff PCR uptake of 31.2%, with large variation between different APs.

Routine staff LFD testing has commenced at 22 probation contact centres, and 26 have a 'go live' date. Average uptake in March 2021 was reported at 50.8%, with no positive results reported as yet.

### *3.2.6 Vaccination*

JCVI guidance has not listed prison staff as a priority vaccination group. Any vaccination of prison staff that has taken place to date will therefore be in line with JCVI age/clinical vulnerability guidance. Currently 7.8% of prison staff have been vaccinated according to community criteria (PHE, 2021).

A recent letter from the Secretary of State for Health (H&SC secretary, 2021) suggests that prison officers may be able to receive 'leftover' doses from prisoner vaccinations. However, from a clinical, ethical and information governance perspective this is not straightforward for prison healthcare teams. The concept of prison healthcare providers potentially offering vaccination to staff brings up the following issues:

- Prison healthcare providers delivering prisoner vaccines have no clinical responsibility to treat staff (at all) and so cannot be expected to vaccinate and monitor post vaccination. This would also result in staff time being directed away from patient care
- Healthcare providers have no indemnity for vaccinating prison staff

- There is no means to record vaccination status – healthcare in prisons has an agreement not to use Pinnacle to record for vaccination status, instead to use the prison healthcare record SystemOne. There is no option to record vaccination status of prison officers

### 3.2.7 Staff absences

Prison staff absences can negatively impact prison regime and prisoners ability to access facilities/hospital appointments. High levels of staff absence also increase the likelihood that staff may have to provide cover in another establishment.

Figure A6 shows data on staff absences since May 2020.

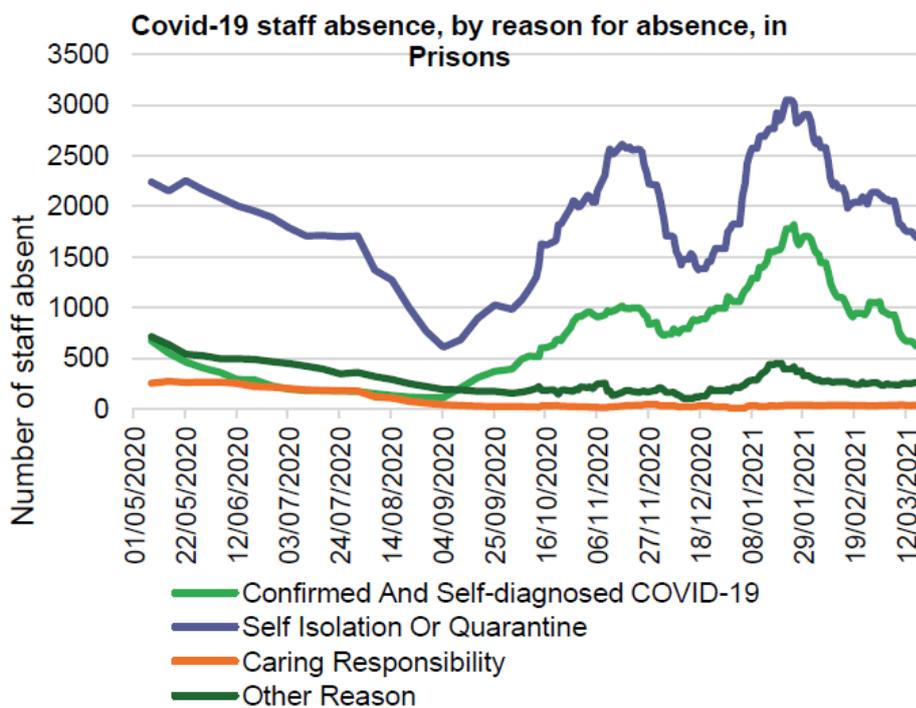
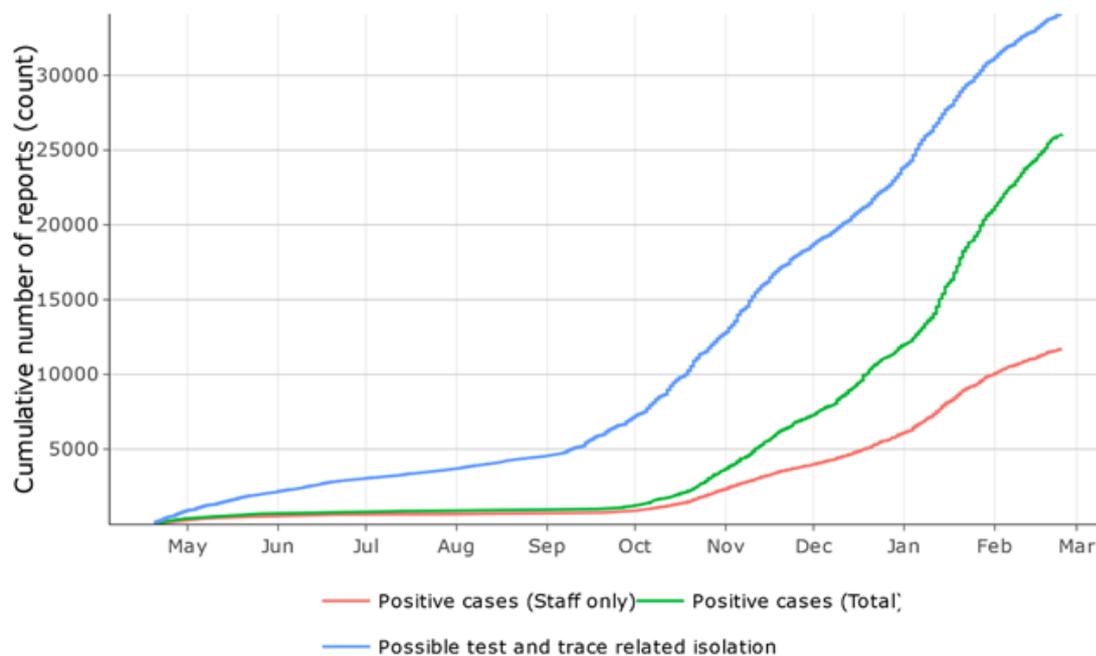


Figure A6: Prison staff absences

## 4 Epidemiological data

### 4.1 Surveillance data on test positives in prisoners and prison staff

Figure A7 shows the cumulative total of positive cases for staff and cumulative total of staff and prisoners during the pandemic in its entirety (MoJ, 2021). This graph includes pillar 2 symptomatic testing and routine testing results. At the start of the pandemic testing was limited as with community settings.



**Figure A7: Known positive staff cases and Test & Trace isolations**

Table 4 shows the rate of infection in prison staff and residents since December 2020 (MoJ, 2021), and where possible compares to ONS infection survey data (ONS, 2020).

Week ending	Staff in public prisons					Service users in prisons					ONS infection survey
	Population count	Total Positive (Weekly)	Daily Avg Pos Cases	Daily ROI per 10k	1 in	Population count	Total Positive (Weekly)	Daily Avg Pos Cases	Daily ROI per 10k	1 in	1 in
11-Dec-20	37,209	224	32	8.6	166	77,964	448	64	8.2	174	95
18-Dec-20	37,209	285	41	10.9	131	77,964	701	100	12.8	111	85
25-Dec-20	37,209	351	50	13.5	106	77,964	545	78	10	143	No data
01-Jan-21	37,386	313	45	12	119	77,880	243	35	4.5	320	50
08-Jan-21	37,386	466	67	17.8	80	77,880	363	52	6.7	215	No data
15-Jan-21	37,386	548	78	20.9	68	77,880	1,025	146	18.8	76	55
22-Jan-21	37,386	603	86	23	62	77,880	1,252	179	23	62	55
29-Jan-21	37,386	481	69	18.4	78	77,880	1,008	144	18.5	77	65
05-Feb-21	37,382	380	54	14.5	98	77,773	844	121	15.5	92	80
12-Feb-21	37,382	313	45	12	119	77,773	730	104	13.4	107	115
19-Feb-21	37,382	263	38	10.1	142	77,773	854	122	15.7	91	145
26-Feb-21	37,382	255	36	9.7	147	77,773	605	86	11.1	129	220
05-Mar-21	37,382	131	19	5	285	77,843	459	66	8.4	170	270
12-Mar-21	37,382	104	15	4	359	77,843	411	59	7.5	189	No data

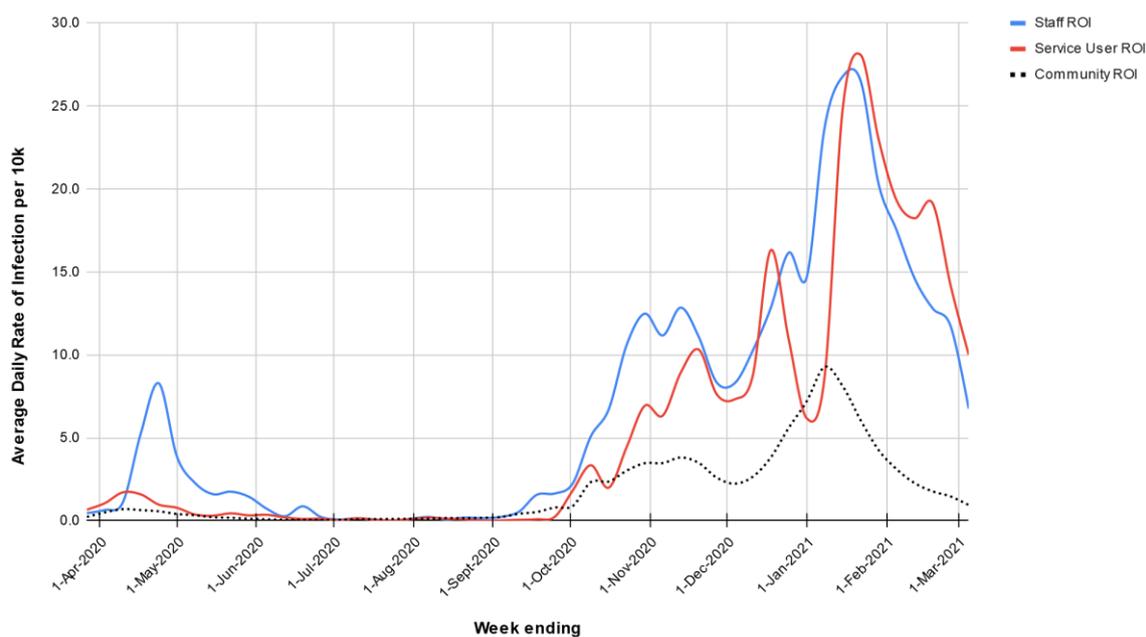
**Table 4: Daily rate of infection per 10,000 by prison staff and service users (HMPPS only hold total numbers of directly employed staff within public establishments, therefore have actively removed staff employed by private prisons, non-directly employed staff and agency staff from the positive case figures to align datasets).**

## Comparison to the community

Figure A8 shows the rate of infection amongst prisoners and prison staff during wave 1 and 2 of the pandemic, compared to the infection rate in the general community. The average daily rate of infections has been far higher for prisoners and staff in wave 2 than in wave 1. This is expected given the larger pool of community infection, more frequent testing in custodial settings and the presence of a more transmissible strain in wave 2, which will have been amplified in the institutional setting. During both waves the average daily rate of infections has been higher amongst prison staff, and for the most part residents, than in community settings.

Data from the first wave (up to July 2020) reported 7.6 confirmed COVID-19 cases per 1,000 population in prison, compared to 4.9 in the English and Welsh populations overall, although it is not known whether a higher or lower proportion of potential cases were tested as compared to the general population. Data up to July 2020 showed prisoners over 60 years old were at particular risk, with a rate of 15.5 per 1,000 (Davies, 2020a; Davies 2021). The same researchers found that up to the end of December there were 75 cases per 1,000 population in prison, compared to 46 cases per 1,000 in England and Wales, rising to 138.9 per 1,000 in prisons vs 64.66 per 1000 in England and Wales in January, and 181.21 per 1,000 in prisons vs 70.19 per 1000 in England and Wales in February 1 (Davies, 2021).

Rate of Infection Comparison - Community vs Prison Data



**Figure A8. Comparison of Rate of Infection (per 10,000) by prison staff, service users/ prisoners & community (provided by Gov.uk)**

## 4.2 Outbreak surveillance reports

Outbreaks in prisons tend to grow over a number of weeks, showing they are difficult to control. Infections are likely introduced for the most part by people coming into the

establishment, at which point they spread to affect many people, causing large scale disruption.

Prison outbreaks are challenging to manage due to:

a) nature of the environment- although a standard recommendation by Health Protection Teams in response to outbreaks, prisons cannot usually simply cease movements of people (into, around and between prisons) due to the need to serve courts, manage population pressures and deal with security issues so this risks population inter-mixing and disease transmission

b) although recommended by PHE, the ability to deliver mass testing of all residents and staff is not readily available currently in most prisons resulting in often prolonged outbreaks recruiting large numbers of cases driven by asymptotically infected people- this is being address currently at national level but in many outbreaks OCTs have been limited by testing constraints focussing testing on specific parts of prisons with higher identified attack rates and clinically symptomatic cases which is a strategy likely to miss many cases;

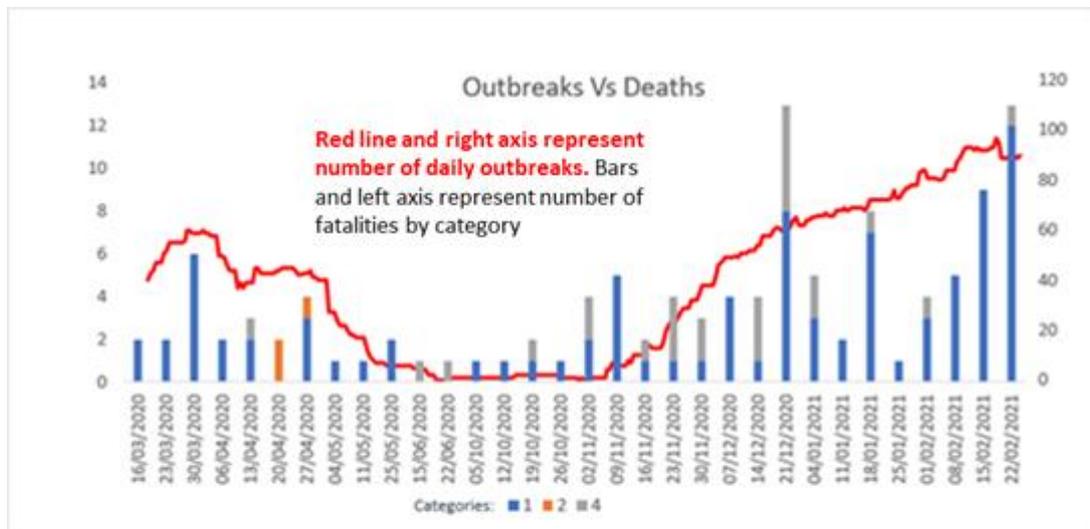
c) many perverse incentives operate in prisons for both staff and prisoners to not get tested, even if symptomatic- the former due to financial impacts e.g. availability for over-time, and the latter due to impact on self and others in terms of isolation/restrictions to regime which can result in reluctance to come forward for testing or possibly coercion not to do so by others;

d) prisons have limited primary healthcare teams delivering testing, vaccination and other infection control interventions in outbreaks as well as trying to deliver primary healthcare services, with teams often depleted due to staff cases or isolating contacts- this impacts on ability to manage outbreaks operationally.

Outbreaks in prisons only require the importation of a single infection. The speed, scale and severity of an outbreak is then dependent on: number of introductions into the prison, infrastructure, density, efficacy of containment measures, behaviours of staff and residents inside and outside the prison, and population susceptibility. It is therefore likely that, with regular movement into and between the estate of a transient population from courts, hospital and the community, prisons may have multiple outbreaks until an effective treatment or vaccine programme is available. (PHE, 2021)

Data for the 17th March 2021 shows there are currently 65 active outbreaks and 12 establishments on the watch list (The prisons watchlist (introduced 9 November 2020) monitors those sites where there are either five or more positive staff cases within a 14-day period, two or more positive cases and at least one positive resident case in the last 14 days, or by exception following a review of case information). Between March-April 2020 (peak of wave 1) there were 135 outbreaks across 75 different establishments. Since August there have been a total of 154 outbreaks in wave 2 (PHE, 2021). Recent data on outbreaks during Jan-Feb 2021 suggests that more than 79% of prisons (n=102) have had outbreaks where at least 50 prisoners and staff have been infected (PHE, 2021). Some outbreaks have been far larger, it should also be recognised that the outbreaks after frequently 'rolling' or 'merging' and as such not a static metric.

The total numbers of outbreaks and COVID-19 related deaths in wave 1 and 2 can be seen in Figure A9 (PHE, 2021). Reported deaths in this figure include all those where the person tested positive within 28 days of the death or where there was a clinical assessment COVID-19 was a contributory factor in their death regardless of cause of death. The cause of death is provisional until the official cause of death has been determined by the coroner.



Category 1 - COVID-19 Confirmed  
 Category 2 - COVID-19 Clinical assessment (of COVID19 symptoms and / or corroborating intelligence)  
 Category 4 - COVID-19 Positive but not the cause of death.

**Figure A9: Outbreaks and fatalities in prisons during wave 1 and 2**

The reported doubling times of cases within a single outbreak in a prison for COVID are (MoJ, 2021):

On average, from one case, it takes 71 days to get to 50 cases (where 50 cases do occur) with a SD of 30 days. Of all prisons, 102 (79%) have reached 50 cases (this is a mixture of both staff and service user cases), during the course of this pandemic wave (post-September, 2020).

- \* For the 102 sites which reached 50 cases, the average doubling times are as follows:
  - Between 5 and 10 cases = 13.1 days (SD of 12.1 days)
  - Between 10 and 20 cases = 11.5 days (SD of 10.7 days)
  - Between 20 and 40 cases = 14.6 days (SD of 13.7 days)

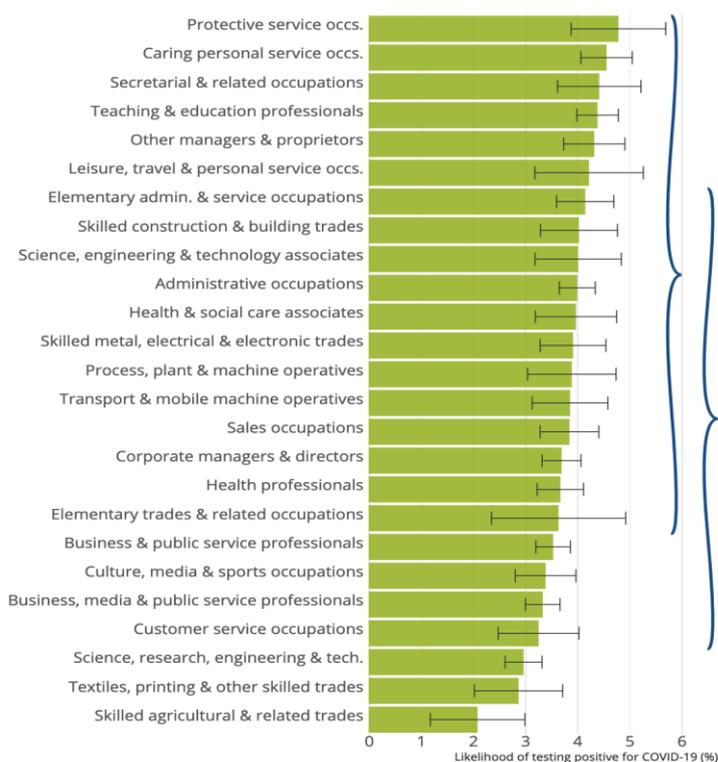
**\*Please note:** Such data is subject to testing bias and thus these estimates of doubling time are effected by testing behaviour. For example, mass asymptomatic testing upon discovery of a symptomatic case may lead to many confirmed positive cases detected simultaneously, so is not necessarily representative of the speed of transmission within the prison. Conversely, new cases are treated as part of the same outbreak that may not have a direct relationship via internal transmission (e.g. new introductions). This results in highly over-dispersed distributions of doubling time, particularly given the small number of cases under consideration.

The amplified numbers of cases within prison outbreaks have also caused several local areas to experience some of the highest rates of infection in England during wave 2 (Media reports, 2021).

The mass testing processes required during outbreaks are incredibly labour intensive for prison healthcare teams and detract from their ability to deliver both business as usual, and also the recovery of healthcare after pandemic delays.

### 4.3 Data on routine swabbing of occupations

The ONS Infection Survey analysis of occupational risk of COVID-19 found those in Protective Service Occupations (which includes prison officers) had the highest risk of testing positive for COVID-19 at around 4.5% positivity between 1st September and 7th January (Figure A10). Prison officers had a 6.3% chance of testing positive. (ONS, 2021)



Source: Office for National Statistics – Coronavirus (COVID-19) Infection Survey

Figure A10: Occupation risk of COVID-19

### 4.4 Hospitalisation and Mortality data

#### Hospitalisation

MoJ data shows that up to 16th March 2021, 353 people had been hospitalised for COVID from prison, c. 0.45% of the prison population. Admission rates per 100,000 population are compared in table 5 to that of the English resident population. Note: the prison denominator used was that as of 16th March 2021, as this was the population data available by relevant age bands, and may be slightly lower than the yearly average.

At all age groups the rates of admission were higher for prisoners than for English residents.

**Table 5: COVID-19 rates of admission for prisons versus all English residents**

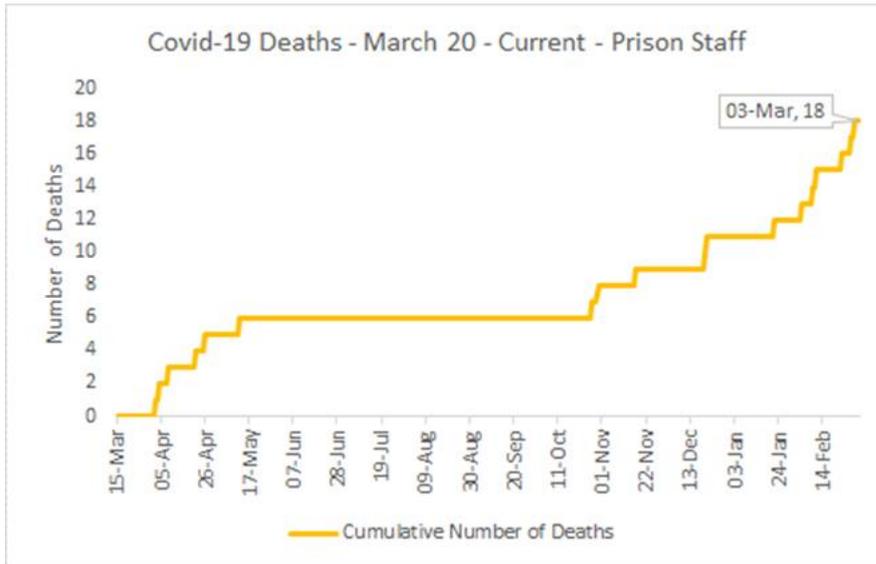
Age band	Rates of admission per 100,000 English resident population (cumulative as of 17th Mar 2021) (Gov.UK, 2021)	Rates of admission per 100,000 prison residents (cumulative)	Rate ratio
18-64	403.50	514.80	1.28
65-84	1822.10	3211.99	1.76
85+	5987.10	9523.81	1.59

### Mortality

Deaths in prisons have risen steadily amongst prison residents and staff since the end of October 2020 (Figure A11-A12) (PHE, 2021; MoJ, 2021)



**Figure A11: Cumulative deaths amongst prisoners**



**Figure A12: Cumulative deaths amongst prison staff**

HMPPS staff deaths data only includes staff employed directly by HMPPS in public establishments. Reported deaths include all those where the person tested positive within 28 days of the death or where there was a clinical assessment COVID-19 was a contributory factor in their death regardless of cause of death.

Table 6 shows indirect age-standardised mortality of the prison population relative to the general population, comparing wave 1 to wave 2. The overall SMR (for wave 1 & 2 combined) was 3.3 (95% CI 2.7–3.9) (Braithwaite, 2021). Full workings available [here](#).

These SMRs are higher than the adjusted Hazard Ratios seen for many chronic diseases (calculated by the QCOVID tool used to inform vaccine prioritisation in younger adults e.g. Adjusted Hazard Ratio = 1.5 for COPD, 1.24 for cardiovascular disease). (Clift, 2020)

**Table 6: Indirect standardisation of COVID-19 mortality among people in prisons compared to that in the general population, accounting for the age and sex structure of people in prisons**

	Observed deaths	Expected deaths (base)	Expected deaths (low)	Expected deaths (high)
<b>Wave 1</b>				
March 2020	4	2.9	2.7	3.7
April	17	8.8	7.9	12.2
May	4	2.5	2.2	3.8
June	2	0.9	0.8	1.4
July	0	0.3	0.2	0.4
August	0	0.2	0.2	0.2
Wave 1 Total	27	15.6	14	21.7
<b>Wave 1 SMR (95% C.I.)</b>		<b>1.73 (1.14-2.52)</b>	<b>1.93 (1.27-2.81)</b>	<b>1.24 (0.82-1.81)</b>
<b>Wave 2</b>				
September	0	0.3	0.3	0.4
October	5	1.3	1.1	1.7
November	15	3.7	3.2	5.2
December	24	2.5	2.2	3.6
January 2021	15	8.7	7.9	11.8
February	35	4.2	3.9	5.5
Wave 2 Total	94	20.7	18.6	28.2
<b>Wave 2 SMR (95% C.I.)</b>		<b>4.54 (3.67-5.56)</b>	<b>5.05 (4.08-6.18)</b>	<b>3.33 (2.69 - 4.08)</b>

## 4.5 Genomics

The below summary outlines some of the work that COG-UK members have/are undertaking to look at outbreaks in prison settings in different regions. This summary should not be viewed as exhaustive.

Overall prison outbreaks follow similar patterns to other closed environments. Some clusters take off explosively, whilst other times lineages pop up and go nowhere. Staff introductions are the likely route of spread.

Close collaboration between COG-UK and the public health agencies has enabled genomic investigations in these prison settings.

### *East of England:*

Dr Andrew Page and colleagues at the Quadram Institute have looked at outbreaks from 4 prisons (all male), with 194 samples yielding a lineage via Pillar 1. They have very limited data on these.

**1. HMP Norwich** had 2 large outbreaks, one of B.1.177 (98 samples) and a second of B.1.1.7 (28 samples). Overall from the 28th Nov 2020 to 19th Jan 2021, ten distinct clusters were observed in this prison. The clusters overlapped with local hospitals in a few cases. The first large outbreak (B.1.177) was seeded from the local community where the lineage was observed three weeks earlier in people who were not prisoners (under 18 and females). After this outbreak was halted (mass screening), the lineage then circulated in the community for a further six weeks.

Three samples were part of a large hospital outbreak (~170 samples, very little P2 transmission detected), indicating that prisoners may have potentially picked it up visiting

this hospital. Another cluster overlapped with singleton cases in 2 local hospitals (working age males, matching prisoner/guard profile, but no other metadata available).

Other clusters overlapped with the community, in people who definitely were not prisoners (over 80 living near prison, working age females in the same city), and one cluster overlapping with a poultry factory outbreak cluster. HMP Norwich banned visiting after the first large outbreak. The genomic patterns observed are consistent with a free flow of lineages into and out of the prison.

**2. HMP Bure** had a single large outbreak (25 samples) of B.1.1.7 over 2 weeks in December and none since.

**3. HMP Wayland** had a large outbreak (22 samples) of B.1.1.7 from 9th Jan 2021 to 24th Feb 2021, with 2 samples from a different cluster popping up and vanishing.

**4. HMP Warren Hill** had a single sample (B.1.1.7).

#### *North East:*

Professor Darren Smith and colleagues at Northumbria University have been working with PHE North East infection control teams and are supporting a paper that is being written on transmission of SARS-CoV-2 in regional prisons.

They have performed a CIVET cluster investigation analysis on 179 samples from North East UK prisons spanning the start of the pandemic to 22nd Jan 2021. These samples were provided from 6 prisons and tested across 5 different local health trusts, identified through regional sites supporting sample metadata and PHE line list. The analysis was stratified via outer postcode, TS25, TS18, DL12, DH1, NE65, that relate to individual prisons, apart from DH1 that is the culmination of multiple prisons. Genomic data will be married to local site and transmission data presented by PHE.

The analysis clearly shows clonal outbreaks amongst the different institutions, and the involvement of staff and also local care workers from NHS trusts. The local epidemiology alongside genomics may help explain the transmission across the time period in question. These prison outbreaks were mainly clonal and involved the B.1.177 lineage, with only 1 isolated case of B.1.1.7.

Of note, more samples from HMP sites have been tested in local pillar 1 testing sites and so the likelihood is this analysis could be expanded, with support of HMP/PHE. Unfortunately not all trusts identify samples from prison outbreaks in an identifiable way which can complicate their inclusion into analyses.

#### *Midlands:*

Prof Nick Loman's group at the University of Birmingham working with Dr Esther Robinson and team at PHE Midlands have generated sequencing data from 112 PHE regional laboratory samples from prisons. Between October 2020 - March 2021 a total of 10 prisons across the East and West Midlands have been surveyed. Samples include both prisoner and staff isolates.

Detailed analysis is ongoing, but there are clear patterns of multiple introductions into institutions during a single outbreak period. Detected lineages in prisons are closely related to the predominant circulating strains in the community at the time of sampling (from pillar 2 sequencing).

Combined phylogenetic and epidemiological analysis supports within-institution transmission of some of these community importations. Further work is required to perform mapping of sequence data to more detailed epidemiological data including known movements of staff and prisoners within prisons to better understand intra-prison transmission dynamics and inform infection control policy.

#### *London:*

Dr Rohini Manuel (PHE National Infection Service), Dr Sunando Roy (UCL), Dr Paul Randell (Imperial College Healthcare Trust), Professor Judy Breuer (UCL) and their colleagues were involved in genomic investigation of the Oct 2020 outbreak at Wormwood Scrubs, the largest prison in London (>1200 inmates).

Of the 88 samples taken between 5th and 23rd of Oct 2020, 45 genome sequences were available for phylogenetic analysis (39 inmates, 2 staff). Three lineages were detected, the most commonly shared lineage (UK3566\_1.3.17) was present in 35 inmates and one staff member, other cases were from two other lineages.

If prisoners remain at higher risk of infection, then they will potentially select for variants that are able to escape pre-existing immunity and/or able to transmit more effectively. The high prevalence and frequent exposure also creates a possibility for generation of de novo variants including recombination events (Jackson, 2021).

## **5 Modelling data**

### **5.1 Vaccine**

#### *5.1.1 LSHTM modelling*

A prison vaccination model (LSHTM, 2021) has evidenced that vaccinating all prisoners and staff is the only vaccination strategy that prevents a further large wave of cases within two years. This strategy was predicted to reduce cases by 89%. Vaccination of all prisoners and staff over the age of 50 was considerably less effective at preventing outbreaks. Vaccinating all staff would reduce rates in prisoners by 24%. The transmission group considered some of the models assumptions unrealistic (e.g. that measures to reduce importation of COVID-19 into prisons were 90% effective, or that due to high infection rates the majority of prisoners already had natural immunity). These would tend to lead to underestimate the relative importance of early vaccination of staff and prisoners.

The modelling explored the impact of 7 different vaccination strategies on cases of COVID-19 in an average category B prison in England and Wales, using a transmission-dynamic compartmental SEIR-type model for SARS-CoV-2 transmission. Seven vaccination scenarios were considered: no vaccination (1); non-prisoner-facing staff only (2); prisoner-

facing staff only (3); all staff (4); all prisoners (5); all prisoners and staff over 50 years old (6); and all prisoners and staff (7).

The prison population was considered as three separate but interacting sub-populations: prisoner-facing staff (A), non-prisoner-facing staff (B), and prisoners (C). Non-prisoner-facing staff were assumed to have no contact with prisoners, whilst prisoner-facing staff had contact with non-prisoner-facing staff and prisoners. Movement into and out of the subpopulations were based on prisoner reception rates in category B prisons and on overall staff leaving rate. Vaccination was assumed to have 70% efficacy against infection, with an average duration of immunity of one year. Vaccination rate was assumed to 20 individuals a day. Model simulations were run for four years, with vaccination introduced after one year. In a secondary analysis, vaccination was introduced at  $t=0$ . The potential for ingress of SARS-CoV-2 via non-prisoner-facing staff was included, based on current community prevalence in England whilst assuming that 90% of cases would be detected through regular testing and isolate.

### **Key findings**

- Vaccinating all prisoners and staff (strategy 7) led to an 89% reduction in cases over three years (Fig. A13).
- Vaccinating all prisoners led to a 56% reduction over three years, whilst vaccinating all prisoners and staff over the age of 50 (strategy 6) led to a 52% reduction.
- Vaccinating prisoner-facing staff (strategy 3) had a comparable impact on overall case numbers to vaccinating all staff (strategy 4).
- Vaccinating all staff have a substantial impact on case numbers in non-prisoner facing (60% reduction) and prisoner-facing (83% reduction) but only reduced case numbers in prisoners by 24%.
- Vaccinating non-prisoner-facing staff (strategy 2) led to an 8% reduction in overall case numbers and had a minimal impact on cases in prisoner-facing staff and prisoners.
- Duration of natural and vaccine-induced immunity and  $R_0$  were the most important drivers of uncertainty in the model estimates (Fig.A14-A15).

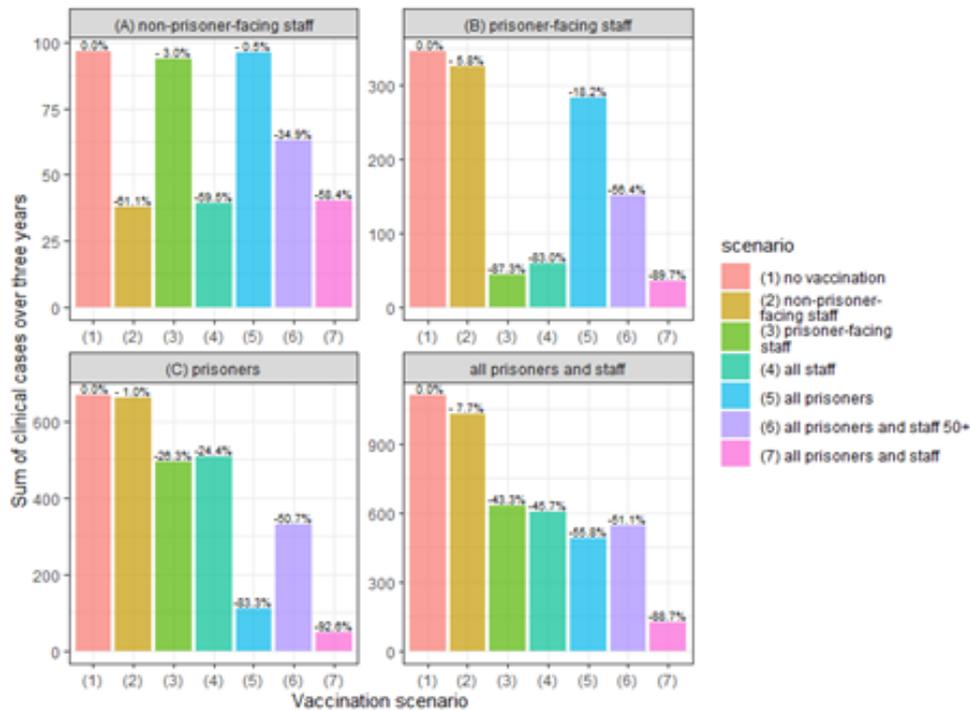


Figure A13. Percentage reduction in clinical cases over a three-year period under each vaccination scenario when vaccination is introduced at one year. Note the different y-axis scales, reflective of the different sizes of the sub-populations.

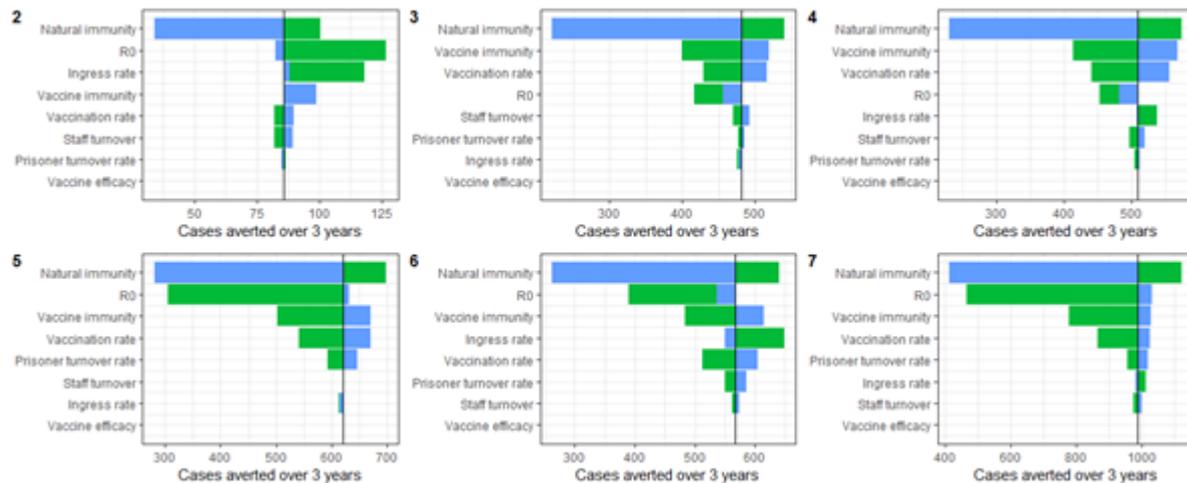
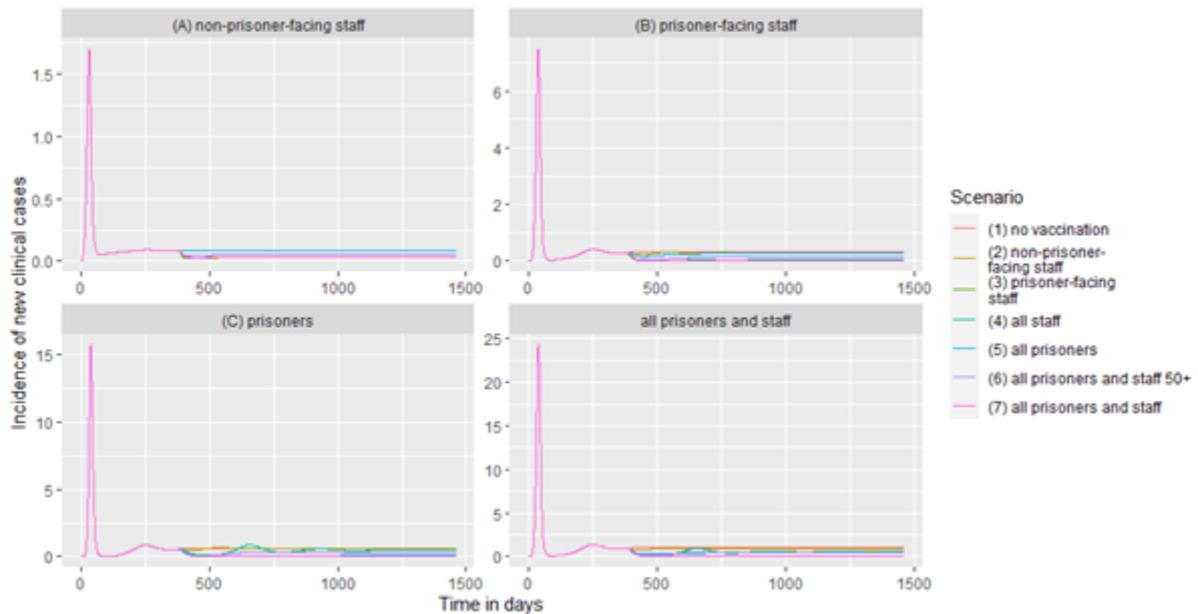


Figure A14. Tornado diagram showing the impact of key parameters on cases averted over three years. Note: Both  $R_0=1.5$  and  $R_0=5$  produced lower estimates for the number of cases averted than the base case value of  $R_0=4$ . This may be due to a higher number of prisoners/staff becoming infected prior to vaccination.



**Figure A15. Incidence of new clinical cases over three years, with vaccination introduced at  $t=365$ . As discussed, the high  $R_0$  has meant that a large proportion of the population are immune at the point when vaccination is introduced.**

## Discussion

- The assumption  $R_0=4$  means that a large proportion of prisoners and prison staff are no longer susceptible at the point at which vaccination is introduced. Whilst it may be the case that a large proportion of prisoners in the UK have already been infected, the assumption that  $R_0=4$  is likely to lead to an overestimation of the number of prisoners infected before vaccination was introduced and therefore underestimate the impact of vaccination.
- In the sensitivity analysis, uncertainty around  $R_0$  was also found to have a substantial impact on cases averted (Fig. 16). Future research will explore varying  $R_{eff}$  reactively according to the incidence levels. In addition, more data with which to inform this parameter value would improve the precision of estimates.
- Vaccinating prisoners at  $t=0$  (when all prisoners and staff are still susceptible) produced results that were fairly consistent in terms of percentage case reduction with those found when vaccination was introduced after one year
- The model accounts for risk of SARS-CoV-2 importation via infected non-prisoner-facing staff but not infected prisoners, making the assumption that current strategies used to isolate new prisoners are successfully preventing transmission via this route. If importation via new prisoners is an important source of infection, then this model would currently underestimate the impact of vaccinating the prisoner population. This is likely to be the case as court activity returns to pre-pandemic levels and higher inflow of prisoners makes it logistically difficult to reverse-cohort effectively.
- The conclusions rely on the assumption that vaccination provides 70% protection against infection. This could mean that the model may overestimate the impact of vaccination on transmission and therefore the impact on the overall number of

cases. Previous studies for the general UK population indicate ongoing SARS-CoV-2 transmission in the community is to be expected even in a vaccination scenario with a reasonable assumption for vaccine efficacy against infection of 70% (Sandmann., 2020). With a vaccine efficacy of 70%, high vaccine coverage of 85% would also be required to achieve herd immunity (Hogan , 2020). Even at higher vaccine efficacy against infection of 85%, non-pharmaceutical measures may continue to be required as lifting them too early may otherwise be risking subsequent outbreaks (Moore, 2020).

- It is also assumed that initially individuals have an age-dependent susceptibility profile consistent with that estimated for the UK general population. Other measures to reduce transmission in prisons, such as testing of staff or prisoners, are not explicitly considered, although we assumed a 90% reduction of ingress due to effective testing and isolation. Nonetheless, for both of these reasons, the current model output may overestimate the impact of vaccination by overestimating the number of cases expected to occur in the absence vaccination.
- As vaccinated prisoners may return to their community and vaccinated staff will have contacts outside of the prison, vaccination of prisoners and staff is also likely to be beneficial for the general community. However, this effect has not been captured in this model.
- Many of the prison-specific parameter values, such as prisoner reception rate, are based on data from category B prisons. These conclusions therefore may not be generalisable to prisons with different structures, such as open or high security prisons.

### 5.1.2 University of Manchester modelling

A second, more data-driven analysis was performed by the University of Manchester on currently available data on cases, hospitalisations and deaths in prison by 16 March 2021. The likely impact of vaccination is explored by comparing what would have likely happened if a vaccine had been available since the beginning of the pandemic, but NPIs had not been put in place.

#### Key findings

- Infections, hospitalisations and deaths are observed in prison in 3 age classes: <40, 40-50, 50+.
- About 20% of the prison population has been infected, as of 16 March 2020 (broadly independently of age class).
- Only 16% of the prison population is 50+, so vaccinating based on age as in the community requires only 13k vaccine doses (single dose, 26k for double).
- Assuming an expected outbreak attack rate of 80% without current NPIs, and a 70% vaccine efficacy at blocking infection:
  - Vaccinating all prisoners: would have led to the same number of COVID cases, hospitalisations and deaths as observed up to now;
  - Vaccinating only the over 50s: would have led to 1.5x more deaths, 2x more hospitalisations and 3x more cases than observed up to now.

- Whilst the key findings suggest deaths averted, by extending the vaccination from the over-50s only to all prisoners, are the smallest gain, the reduction in hospitalisations and infection contribute to significantly less health burden on prisoners, prison system and community, including: fewer cases of long COVID, lower pressure on hospitals, lower chance of spill-overs in the community and of prisons being outbreak amplifiers, lower chance of evolution of COVID variants, etc.
- Comparison of hospitalisations and deaths in prison with published estimates (Salje et al. *Science*, July 2020) suggests that, whilst hospitalisation rates are largely in keeping with true age rates, for ages 40+ death rates are more in keeping with prisoners' age being increased by about 10 years.

- **Caveats and discussion**

- It is hard to second-guess the expected attack rate in a prison where NPIs are not implemented (it is expected that in the event of an outbreak, some form of response will be put in place, albeit late). Therefore, we assume at baseline 80% of the prison population would be infected in the event of an outbreak (*expected attack rate*). We also look at results assuming 50% expected attack rate.
- This is not a transmission model. However, the same 80% expected attack rate would be observed by a simple transmission model with and  $R_0$  of 2 and no outbreak response, or with a larger  $R_0$  but some response reducing it to  $<1$  as the outbreak is detected. Given the complexity at parameterising this, the expected attack rate is instead used as a free parameter.
- We assume a single vaccine dose, whose only effect is to block infection, and perfect vaccine uptake.
- Vaccine efficacy might be larger than shown here, because of the additional effect of reducing the probability of going to hospital or dying (or transmitting) in the vaccinated individuals that get infected, and the increased efficacy after the second dose. However, a higher infection-blocking efficacy might account for this (e.g. assuming 70% infection-blocking efficacy and no other effect might be akin to 60% infection-blocking plus other benefits). Given estimates are still limited, we consider a baseline of 70% infection-blocking efficacy and explore the 60% and 80% scenarios.
- The hospitalisation and fatality rates per infection have been calculated directly from numbers in prison, because they differ from the information available from the studies in the community – broadly speaking, they are worse than in the community but better than community shifted by 10 years of age (suggested as a proxy for general worse health status of prisoners compared to the general population).
- Investigation of uncertainty is limited to Figure A19, at present. Therefore, results are qualitative in nature.
- This model is focussed only on the prison population. Prison and medical staff are ignored.

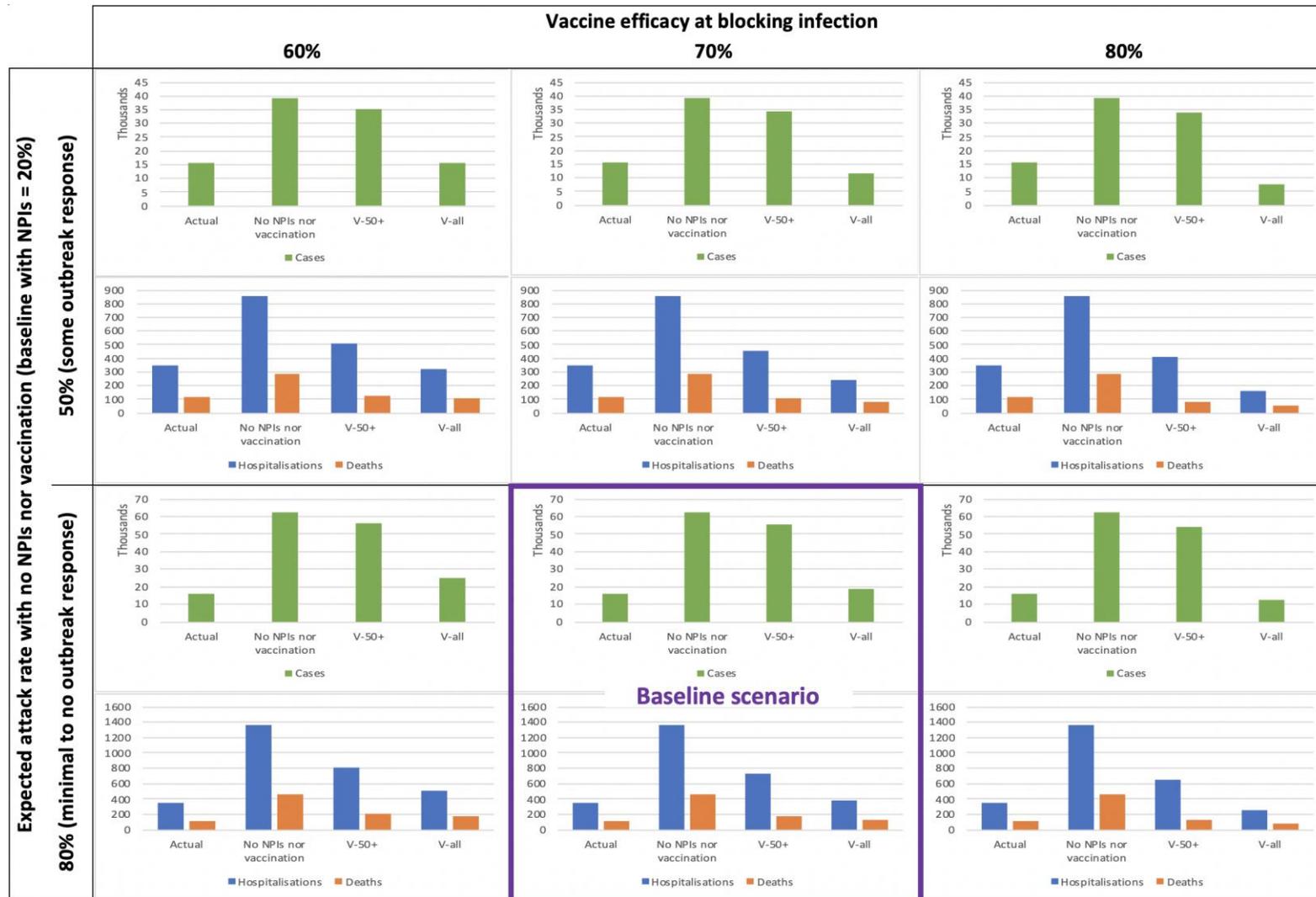
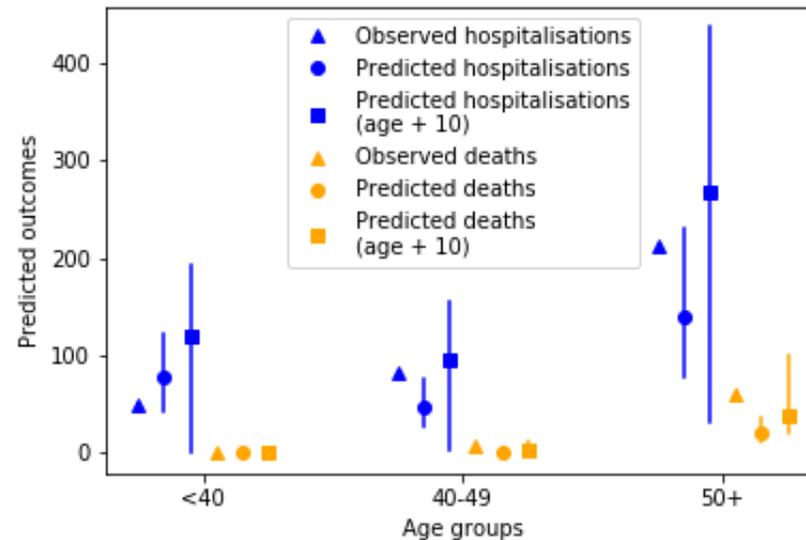
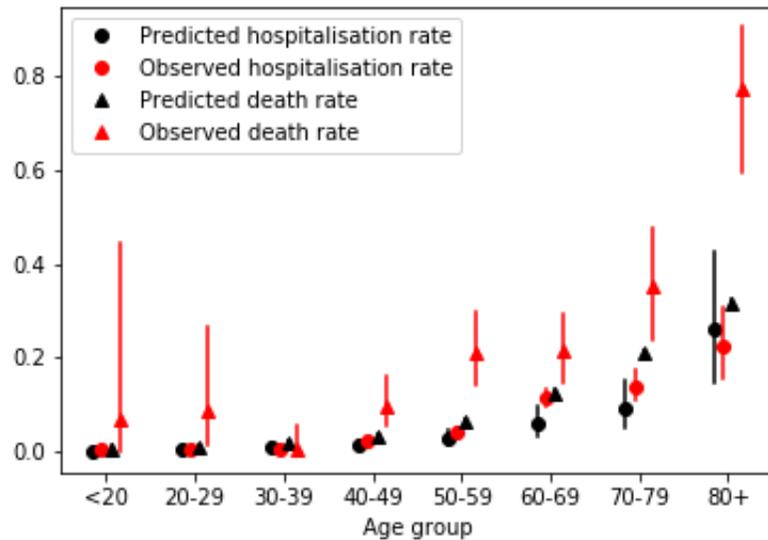


Figure A16. Numbers of cases, hospitalisations and deaths observed up to now (Actual) and after lifting restrictions but no prisoner is vaccinated (No NPIs nor vaccination), only 50+ (V-50+) or all prisoners (V-all) are vaccinated.



**Figure A17. Observed and predicted rates (left) and numbers (right) of hospitalisation and subsequent death following infection in prison, based on prison data and estimates by Salje *et al* (*Science*, July 2020), which refer to the community and ignore higher severity of new variants. Observed values are fitted to beta distributions with a Jeffreys prior to obtain approximate rates. Age boundaries are approximate due to inconsistency between data and published estimates. Hospitalisation are counted as any recorded hospital stay, not including in prison healthcare facilities.**

## 5.2 Other control measures

### *PHE and HMPPS Wave 1 modelling*

In April 2020 PHE and HMPPS undertook initial modelling to understand the potential impact of reduced social contact on transmission of COVID-19 in prisons (Table 7).

Changes proposed		Reproduction R <sub>0</sub> <sup>1</sup>	Number of people infected	NHS bed required for Covid cases	Deaths (SAGE 2.7% fatality rate)
No regime changes	100% contact	3	77,800	4500	2,700
Compartmentalisation strategy (Cohorting and shielding)	No regime changes	2	62,400	3500	1,900
Regime changes AND Compartmentalisation strategy (Cohorting and shielding)	Reduces contact by up to 50%*	1	2,800	200	100

**Table 7: Modelling by HMPPS and PHE on reasonable worst case scenario and then escalating level of containment with compartmentalisation and regimen changes on numbers of people infected in prisons, hospitalisations and death rates due to COVID-19 infection.**

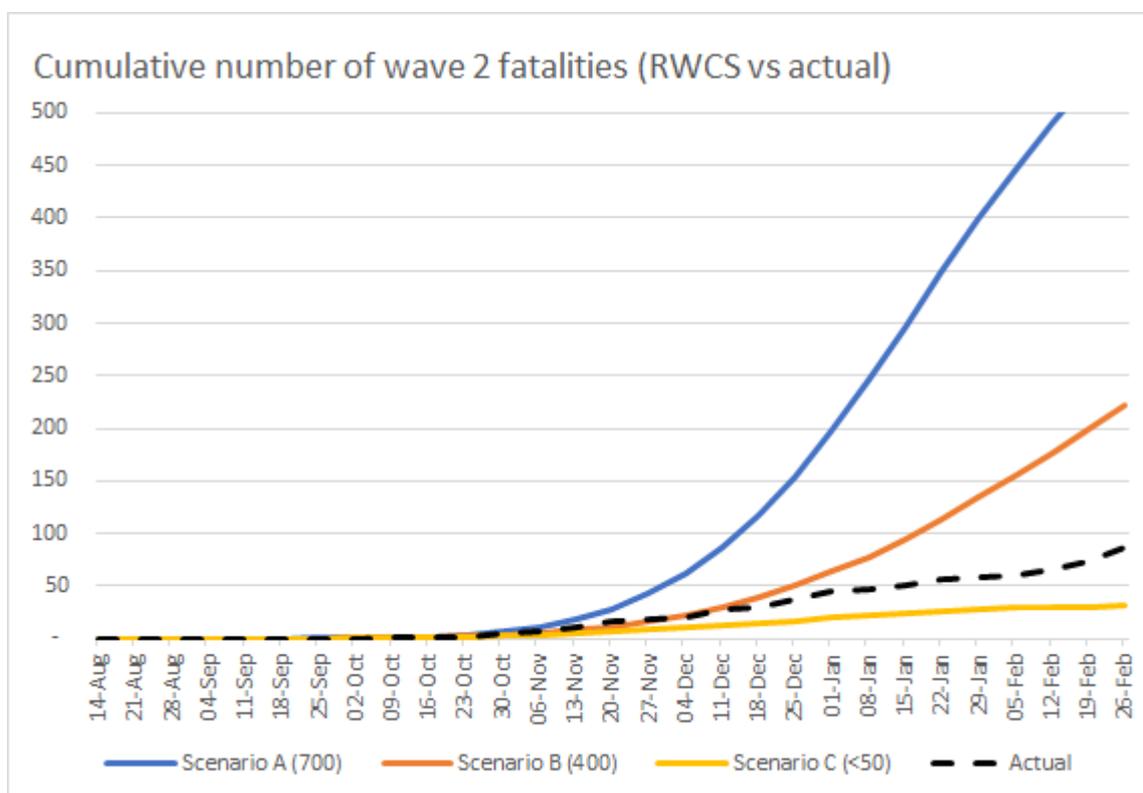
The modelling found the impact of social distancing through regime changes and use of cohorting strategies is profound – reducing the R<sub>0</sub> to 1 or less, with resultant significant reductions on numbers of people infected, and consequently rates of hospitalisation and deaths. This strategy was therefore employed.

### *Reducing normal contacts and the relationship to hospitalisations and deaths*

In December 2020 this modelling was updated, conducted in collaboration between HMPPS, University of Manchester and PHE, and suggested that maintaining a reduction in social contacts would have a significant impact on the risk of infection in prison populations and consequences, including hospitalisation or death (MoJ, 2021). It evidenced that no reduction in contacts (scenario A) would result in c.700 fatalities, compared to fewer than 50 fatalities if contacts in custody were reduced by half.

**Table 8: Modelling conducted in collaboration between HMPPS, University of Manchester and PHE on the reasonable worst-case scenario for Winter/Spring, 2020/21**

<i>Based on population size as of 13/11 (78,868)</i>	<b>Reduction% of 'normal' contacts</b>	<b>Number of people infected</b>	<b>NHS beds required for COVID-19 cases</b>	<b>Deaths</b>
Scenario A	0%	60,100	2,200	700
Scenario B	25%	37,700	1,400	400
Scenario C	50%	2,800	100	<50



**Figure A218: Cumulative number of fatalities by RWC scenarios and actual data**

To date, deaths have been slightly higher than the predicted numbers at a 50% reduction in social contacts.

*Risk of Covid-19 introduction (November 2020 University of Manchester modelling)* (MoJ, 2021)

The absolute probability of introduction of COVID-19 in prisons is high. If community incidence was constant at c.60-70,000 new infections a day, a >80% probability of introduction in an average prison within the next 2 weeks would be expected, even with COVID measures in place (i.e. masks, hand sanitisers, etc.).

Without COVID measures in place, even if incidence were not growing from current levels, introduction would appear almost certainly in every prison within the next 2 weeks.

This highest risk of incursion into prison is via staff given the protections for resident populations afforded by compartmentalisation. Prison staff working 3-day shifts are better than 4-day, in turn better than 5-day, which is better than no shift, which is better than no testing.

Visitors appear to be 10-15 times less likely to bring the infection in the prison. This results from the combination of being, compared to members of staff: fewer in number; visiting only for a few hours, rather than for the duration of a full work shift; less closely in contact with prisoners; and less likely to be infected in the first place (prison staff more at risk than general population due to contacts with prisoner and among themselves).

The expected number of importations from members of staff is directly proportional to the number of members of staff working in the prison; the expected number of importations from visitors is directly proportional to their expected daily number. Assuming a larger prison has more members of staff working in it and allows more visitors per day, the risk of importation is higher in larger prisons.

### *Reverse cohorting units and testing approaches*

Requiring incoming prisoners to spend longer periods in reverse cohorting decreases the expected number of case importations. Isolating symptomatic cases and introducing steps that mitigate risk of transmission could reduce the total number of infections by 98% and 99%, while also reducing the probability that an outbreak will propagate by 69.8% and 86.8% respectively. However, with higher inflow of prisoners as court activity returns to pre-pandemic levels, the ability to reverse cohort prisoners individually is logistically impaired.

### *Attack rates*

By isolating clinically attacked prisoners, we can reduce the size of an outbreak and delay the time in which it peaks quite substantially (by 19% and 42% respectively) without considering any further interventions. Furthermore, if we utilise this cohorting method in conjunction with reducing the risk of transmission, the effects are amplified; cohorting and reducing transmission risk by 50% result in only 1.4% of the total population being infected.

### *Testing*

Testing always reduces the risk of introduction, but its effect is generally limited. The impact of testing is substantially increased if:

- The chance of a positive result is higher as early as possible after infection
- The delay between test and result is as short as possible;

- The time of the test is as close as possible to the early part of the pre-symptomatic period (with a trade-off between early testing potentially stopping more transmission but being less likely to be positive);
- The more infectious asymptomatic individuals (for which the test also stops the transmission later on in the infectious period) are.

For these reasons daily testing, tests which offer rapid results and higher test sensitivity is important.

For staff tests, if the testing is uncorrelated with shifts, no improvement of the impact of testing is expected. However, if testing is done on the morning of the first working day of the shift, the impact of testing can be significantly improved. The impact of testing is even larger if the test result comes on the morning of the first day of the shift. Assuming PCR results arrive 1 day after swabbing, this would require members of staff to take the test one day before starting their shift, which is logistically difficult. However, if LFDs have the same false negative rate as a function of time since infection and PCR tests and results are obtained on the spot, the use of LFDs on the morning of the first day of the shift would lead to the same (highest) impact and be also logistically feasible.

**Table 9: Average number of infections caused by a single member of staff among residents, under various testing regimes.**

		Number of infections caused by an infected member of staff without COVID measures (and percentage reduction due to testing, compared to no testing)								
		Lower bound			Best estimate			Upper bound		
		Symptomatic	Asymptomatic	Mixed	Symptomatic	Asymptomatic	Mixed	Symptomatic	Asymptomatic	Mixed
<b>No testing</b>		<b>2.4</b>	<b>2</b>	<b>2.28</b>	<b>2.4</b>	<b>3</b>	<b>2.7</b>	<b>2.4</b>	<b>4</b>	<b>3.52</b>
Random testing	No shifts	1.78	1.17	1.59	2.21	2.36	2.29	2.36	3.51	3.16
		26%	42%	30%	8%	21%	15%	2%	12%	10%
Test on shift start	5-day shift	1.53	0.95	1.35	2.14	2.13	2.13	2.34	3.31	3.02
		36%	53%	41%	11%	29%	21%	3%	17%	14%
	4-day shift	1.35	0.87	1.20	2.07	2.01	2.04	2.32	3.20	2.93
		44%	57%	47%	14%	33%	24%	3%	20%	17%
	3-day shift	1.22	0.86	1.11	1.97	1.94	1.96	2.30	3.10	2.86
		49%	57%	51%	18%	35%	28%	4%	22%	19%
Result on shift start	5-day shift	1.53	0.87	1.33	2.14	2.11	2.12	2.34	3.31	3.02
		36%	56%	42%	11%	30%	21%	3%	17%	14%
	4-day shift	1.31	0.69	1.13	2.07	1.92	1.99	2.32	3.14	2.90
		45%	65%	51%	14%	36%	26%	3%	21%	18%
	3-day shift	1.00	0.50	0.85	1.96	1.68	1.82	2.30	2.93	2.74
		58%	75%	63%	18%	44%	33%	4%	27%	22%

\*The "mixed" column is a combination of symptomatic and asymptomatic individuals (50% asymptomatic rate at baseline, 25% for lower bound and 75% for upper bound). Percentages reflect the reduction in transmission due to testing compared to no testing. The much larger impact of testing in the "lower bound" scenario is essentially motivated by the extremely high sensitivity of testing early

The expected number of introductions and probability of at least one infection, for scenarios both with/without COVID measures are shown in tables 10-11.

Expected number of introductions											
Time horizon	Inursion risk from:	Staff testing	Daily incidence in the general population								Medium-term projection (no change to current growth)
			50k	100k	150k	200k	250k	300k	350k	400k	
2 weeks	Visitors	-	0.13 [0.05, 0.25]	0.25 [0.11, 0.49]	0.38 [0.16, 0.74]	0.51 [0.21, 0.99]	0.63 [0.27, 1.24]	0.76 [0.32, 1.48]	0.89 [0.37, 1.73]	1.01 [0.43, 1.98]	0.19 [0.08, 0.37]
		No	1.52 [0.64, 2.97]	3.04 [1.28, 5.94]	4.56 [1.92, 8.91]	6.08 [2.56, 11.88]	7.59 [3.21, 14.85]	9.11 [3.85, 17.82]	10.63 [4.49, 20.79]	12.15 [5.13, 23.76]	2.28 [0.96, 4.46]
	Staff	Yes	1.29 [0.45, 2.67]	2.57 [0.9, 5.33]	3.86 [1.35, 8.0]	5.14 [1.79, 10.67]	6.43 [2.24, 13.33]	7.71 [2.69, 16.0]	9.0 [3.14, 18.67]	10.28 [3.59, 21.33]	1.93 [0.67, 4.0]
		No	1.65 [0.69, 3.22]	3.29 [1.39, 6.44]	4.94 [2.08, 9.65]	6.58 [2.78, 12.87]	8.23 [3.47, 16.09]	9.87 [4.17, 19.3]	11.52 [4.86, 22.52]	13.16 [5.56, 25.74]	2.47 [1.04, 4.83]
	Staff and visitors	No	1.41 [0.5, 2.91]	2.82 [1.0, 5.83]	4.24 [1.51, 8.74]	5.65 [2.01, 11.66]	7.06 [2.51, 14.57]	8.47 [3.01, 17.49]	9.89 [3.51, 20.4]	11.3 [4.02, 23.31]	2.12 [0.75, 4.37]
		Yes	1.65 [0.69, 3.22]	3.29 [1.39, 6.44]	4.94 [2.08, 9.65]	6.58 [2.78, 12.87]	8.23 [3.47, 16.09]	9.87 [4.17, 19.3]	11.52 [4.86, 22.52]	13.16 [5.56, 25.74]	2.47 [1.04, 4.83]
4 weeks	Visitors	-	0.25 [0.11, 0.49]	0.51 [0.21, 0.99]	0.76 [0.32, 1.48]	1.01 [0.43, 1.98]	1.27 [0.53, 2.47]	1.52 [0.64, 2.97]	1.77 [0.75, 3.46]	2.02 [0.86, 3.96]	0.51 [0.21, 0.99]
		No	3.04 [1.28, 5.94]	6.08 [2.56, 11.88]	9.11 [3.85, 17.82]	12.15 [5.13, 23.76]	15.19 [6.41, 29.7]	18.23 [7.7, 35.64]	21.26 [8.98, 41.58]	24.3 [10.26, 47.52]	6.08 [2.56, 11.88]
	Staff	Yes	2.57 [0.9, 5.33]	5.14 [1.79, 10.67]	7.71 [2.69, 16.0]	10.28 [3.59, 21.33]	12.86 [4.49, 26.67]	15.43 [5.38, 32.0]	18.0 [6.28, 37.33]	20.57 [7.18, 42.67]	5.14 [1.79, 10.67]
		No	3.29 [1.39, 6.44]	6.58 [2.78, 12.87]	9.87 [4.17, 19.3]	13.16 [5.56, 25.74]	16.45 [6.95, 32.17]	19.74 [8.34, 38.61]	23.03 [9.73, 45.04]	26.32 [11.12, 51.48]	6.58 [2.78, 12.87]
	Staff and visitors	No	2.82 [1.0, 5.83]	5.65 [2.01, 11.66]	8.47 [3.01, 17.49]	11.3 [4.02, 23.31]	14.12 [5.02, 29.14]	16.95 [6.02, 34.97]	19.77 [7.03, 40.8]	22.59 [8.03, 46.63]	5.65 [2.01, 11.66]
		Yes	3.29 [1.39, 6.44]	6.58 [2.78, 12.87]	9.87 [4.17, 19.3]	13.16 [5.56, 25.74]	16.45 [6.95, 32.17]	19.74 [8.34, 38.61]	23.03 [9.73, 45.04]	26.32 [11.12, 51.48]	6.58 [2.78, 12.87]
6 weeks	Visitors	-	0.38 [0.16, 0.74]	0.76 [0.32, 1.48]	1.14 [0.48, 2.23]	1.52 [0.64, 2.97]	1.9 [0.8, 3.71]	2.28 [0.96, 4.46]	2.66 [1.12, 5.2]	3.04 [1.28, 5.94]	0.95 [0.4, 1.86]
		No	4.56 [1.92, 8.91]	9.11 [3.85, 17.82]	13.67 [5.77, 26.73]	18.22 [7.7, 35.64]	22.78 [9.62, 44.55]	27.34 [11.54, 53.46]	31.89 [13.47, 62.37]	36.45 [15.39, 71.28]	11.39 [4.81, 22.28]
	Staff	Yes	3.86 [1.35, 8.0]	7.71 [2.69, 16.0]	11.57 [4.04, 24.0]	15.43 [5.38, 32.0]	19.28 [6.73, 40.0]	23.14 [8.07, 48.0]	27.0 [9.42, 56.0]	30.85 [10.77, 64.0]	9.64 [3.36, 20.0]
		No	4.94 [2.08, 9.65]	9.87 [4.17, 19.3]	14.81 [6.25, 28.96]	19.74 [8.34, 38.61]	24.68 [10.42, 48.26]	29.62 [12.5, 57.92]	34.55 [14.59, 67.57]	39.49 [16.67, 77.22]	12.34 [5.21, 24.13]
	Staff and visitors	No	4.24 [1.51, 8.74]	8.47 [3.01, 17.49]	12.71 [4.52, 26.23]	16.95 [6.02, 34.97]	21.18 [7.53, 43.71]	25.42 [9.04, 52.46]	29.66 [10.54, 61.2]	33.89 [12.05, 69.94]	10.59 [3.76, 21.86]
		Yes	4.94 [2.08, 9.65]	9.87 [4.17, 19.3]	14.81 [6.25, 28.96]	19.74 [8.34, 38.61]	24.68 [10.42, 48.26]	29.62 [12.5, 57.92]	34.55 [14.59, 67.57]	39.49 [16.67, 77.22]	12.34 [5.21, 24.13]

Probability of at least one introduction											
Time horizon	Inursion risk from:	Staff testing	Daily incidence in the general population								Medium-term projection (no change to current growth)
			50k	100k	150k	200k	250k	300k	350k	400k	
2 weeks	Visitors	-	11.89 [5.2, 21.92] %	22.36 [10.14, 39.04] %	31.59 [14.81, 52.41] %	39.72 [19.24, 62.84] %	46.89 [23.45, 70.99] %	53.2 [27.43, 77.35] %	58.77 [31.21, 82.32] %	63.67 [34.79, 86.19] %	17.29 [7.7, 31.01] %
		No	78.1 [47.34, 94.87] %	95.2 [72.27, 99.74] %	98.95 [85.39, 99.99] %	99.77 [92.31, 100.0] %	99.95 [95.95, 100.0] %	99.99 [97.87, 100.0] %	100.0 [98.88, 100.0] %	100.0 [99.41, 100.0] %	89.75 [61.78, 98.84] %
	Staff	Yes	72.35 [36.15, 93.05] %	92.36 [59.23, 99.52] %	97.89 [73.96, 99.97] %	99.42 [83.37, 100.0] %	99.84 [89.38, 100.0] %	99.96 [93.22, 100.0] %	99.99 [95.67, 100.0] %	100.0 [97.24, 100.0] %	85.46 [48.97, 98.17] %
		No	80.7 [50.08, 95.99] %	96.28 [75.08, 99.84] %	99.28 [87.56, 99.99] %	99.86 [93.79, 100.0] %	99.97 [96.9, 100.0] %	99.99 [98.45, 100.0] %	100.0 [99.23, 100.0] %	100.0 [99.61, 100.0] %	91.52 [64.73, 99.2] %
	Staff and visitors	No	75.64 [39.47, 94.58] %	94.07 [63.36, 99.71] %	98.55 [77.82, 99.98] %	99.65 [86.57, 100.0] %	99.91 [91.87, 100.0] %	99.98 [95.08, 100.0] %	99.99 [97.02, 100.0] %	100.0 [98.2, 100.0] %	87.98 [52.9, 98.74] %
		Yes	75.64 [39.47, 94.58] %	94.07 [63.36, 99.71] %	98.55 [77.82, 99.98] %	99.65 [86.57, 100.0] %	99.91 [91.87, 100.0] %	99.98 [95.08, 100.0] %	99.99 [97.02, 100.0] %	100.0 [98.2, 100.0] %	87.98 [52.9, 98.74] %
4 weeks	Visitors	-	22.36 [10.14, 39.04] %	39.72 [19.24, 62.84] %	53.2 [27.43, 77.35] %	63.67 [34.79, 86.19] %	71.79 [41.4, 91.58] %	78.1 [47.34, 94.87] %	83.0 [52.67, 96.87] %	86.8 [57.47, 98.09] %	39.72 [19.24, 62.84] %
		No	95.2 [72.27, 99.74] %	99.77 [92.31, 100.0] %	99.99 [97.87, 100.0] %	100.0 [99.41, 100.0] %	100.0 [99.84, 100.0] %	100.0 [99.95, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	99.77 [92.31, 100.0] %
	Staff	Yes	92.36 [59.23, 99.52] %	99.42 [83.37, 100.0] %	99.96 [93.22, 100.0] %	100.0 [97.24, 100.0] %	100.0 [98.87, 100.0] %	100.0 [99.54, 100.0] %	100.0 [99.81, 100.0] %	100.0 [99.92, 100.0] %	99.42 [83.37, 100.0] %
		No	96.28 [75.08, 99.84] %	99.86 [93.79, 100.0] %	99.99 [98.45, 100.0] %	100.0 [99.61, 100.0] %	100.0 [99.9, 100.0] %	100.0 [99.98, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	99.86 [93.79, 100.0] %
	Staff and visitors	No	94.07 [63.36, 99.71] %	99.65 [86.57, 100.0] %	99.98 [95.08, 100.0] %	100.0 [98.2, 100.0] %	100.0 [99.34, 100.0] %	100.0 [99.76, 100.0] %	100.0 [99.91, 100.0] %	100.0 [99.97, 100.0] %	99.65 [86.57, 100.0] %
		Yes	94.07 [63.36, 99.71] %	99.65 [86.57, 100.0] %	99.98 [95.08, 100.0] %	100.0 [98.2, 100.0] %	100.0 [99.34, 100.0] %	100.0 [99.76, 100.0] %	100.0 [99.91, 100.0] %	100.0 [99.97, 100.0] %	99.65 [86.57, 100.0] %
6 weeks	Visitors	-	31.59 [14.81, 52.41] %	53.2 [27.43, 77.35] %	67.99 [38.18, 89.22] %	78.1 [47.34, 94.87] %	85.02 [55.14, 97.56] %	89.75 [61.78, 98.84] %	92.99 [67.44, 99.45] %	95.2 [72.27, 99.74] %	61.3 [33.02, 84.37] %
		No	98.95 [85.39, 99.99] %	99.99 [97.87, 100.0] %	100.0 [99.69, 100.0] %	100.0 [99.95, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [99.18, 100.0] %
	Staff	Yes	97.89 [73.96, 99.97] %	99.96 [93.22, 100.0] %	100.0 [98.23, 100.0] %	100.0 [99.54, 100.0] %	100.0 [99.88, 100.0] %	100.0 [99.97, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	99.99 [96.54, 100.0] %
		No	99.28 [87.56, 99.99] %	99.99 [98.45, 100.0] %	100.0 [99.81, 100.0] %	100.0 [99.98, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [99.45, 100.0] %
	Staff and visitors	No	98.55 [77.82, 99.98] %	99.98 [95.08, 100.0] %	100.0 [98.91, 100.0] %	100.0 [99.76, 100.0] %	100.0 [99.95, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [97.68, 100.0] %
		Yes	98.55 [77.82, 99.98] %	99.98 [95.08, 100.0] %	100.0 [98.91, 100.0] %	100.0 [99.76, 100.0] %	100.0 [99.95, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [97.68, 100.0] %

Table 10: Expected number of introductions (top) and probability of at least one introduction (bottom) with COVID measures in place. Best estimates are provided, together with lower and higher bounds from the sensitivity analysis

Expected number of introductions												
Time horizon	Inursion risk from:	Staff testing	Daily incidence in the general population								Medium-term projection (no change to current growth)	
			50k	100k	150k	200k	250k	300k	350k	400k		
2 weeks	Visitors	-	0.25 [0.21, 0.33]	0.51 [0.43, 0.66]	0.76 [0.64, 0.99]	1.01 [0.86, 1.32]	1.27 [1.07, 1.65]	1.52 [1.28, 1.98]	1.77 [1.5, 2.31]	2.02 [1.71, 2.64]	4.38 [0.32, 0.5]	
		No	3.04 [2.56, 3.96]	6.08 [5.13, 7.92]	9.11 [7.7, 11.88]	12.15 [10.26, 15.84]	15.19 [12.82, 19.8]	18.23 [15.39, 23.76]	21.26 [17.96, 27.72]	24.3 [20.52, 31.68]	4.56 [3.85, 5.94]	
	Staff	Yes	2.57 [1.79, 3.56]	5.14 [3.59, 7.11]	7.71 [5.38, 10.67]	10.28 [7.18, 14.22]	12.86 [8.97, 17.78]	15.43 [10.77, 21.33]	18.0 [12.56, 24.89]	20.57 [14.35, 28.45]	3.86 [2.69, 5.33]	
		No	3.29 [2.78, 4.29]	6.58 [5.56, 8.58]	9.87 [8.34, 12.87]	13.16 [11.12, 17.16]	16.45 [13.89, 21.45]	19.74 [16.67, 25.74]	23.03 [19.45, 30.03]	26.32 [22.23, 34.32]	4.94 [4.17, 6.44]	
	Staff and visitors	Yes	2.82 [2.01, 3.89]	5.65 [4.02, 7.77]	8.47 [6.02, 11.66]	11.3 [8.03, 15.54]	14.12 [10.04, 19.43]	16.95 [12.05, 23.31]	19.77 [14.06, 27.2]	22.59 [16.06, 31.09]	4.24 [3.01, 5.83]	
		No	0.51 [0.43, 0.66]	1.01 [0.86, 1.32]	1.52 [1.28, 1.98]	2.02 [1.71, 2.64]	2.53 [2.14, 3.3]	3.04 [2.57, 3.96]	3.54 [2.99, 4.62]	4.05 [3.42, 5.28]	1.01 [0.86, 1.32]	
4 weeks	Visitors	-	6.08 [5.13, 7.92]	12.15 [10.26, 15.84]	18.23 [15.39, 23.76]	24.3 [20.52, 31.68]	30.38 [25.65, 39.6]	36.45 [30.78, 47.52]	42.53 [35.91, 55.44]	48.6 [41.04, 63.36]	12.15 [10.26, 15.84]	
		No	5.14 [3.59, 7.11]	10.28 [7.18, 14.22]	15.43 [10.77, 21.33]	20.57 [14.35, 28.45]	25.71 [17.94, 35.56]	30.85 [21.53, 42.67]	36.0 [25.12, 49.78]	41.14 [28.71, 56.89]	10.28 [7.18, 14.22]	
	Staff	Yes	6.58 [5.56, 8.58]	13.16 [11.12, 17.16]	19.74 [16.67, 25.74]	26.32 [22.23, 34.32]	32.91 [27.79, 42.9]	39.49 [33.34, 51.48]	46.07 [38.9, 60.06]	52.65 [44.46, 68.64]	13.16 [11.12, 17.16]	
		No	5.65 [4.02, 7.77]	11.3 [8.03, 15.54]	16.95 [12.05, 23.31]	22.59 [16.06, 31.09]	28.24 [20.08, 38.86]	33.89 [24.1, 46.63]	39.54 [28.11, 54.4]	45.19 [32.13, 62.17]	11.3 [8.03, 15.54]	
	Staff and visitors	Yes	0.76 [0.64, 0.99]	1.52 [1.28, 1.98]	2.28 [1.92, 2.97]	3.04 [2.56, 3.96]	3.8 [3.21, 4.95]	4.56 [3.85, 5.94]	5.32 [4.49, 6.93]	6.08 [5.13, 7.92]	1.9 [1.6, 2.48]	
		No	9.11 [7.7, 11.88]	18.22 [15.39, 23.76]	27.34 [23.09, 35.64]	36.45 [30.78, 47.52]	45.56 [38.48, 59.4]	54.68 [46.17, 71.28]	63.79 [53.87, 83.16]	72.9 [61.56, 95.04]	22.78 [19.24, 29.7]	
6 weeks	Visitors	-	7.71 [5.38, 10.67]	15.43 [10.77, 21.33]	23.14 [16.15, 32.0]	30.85 [21.53, 42.67]	38.57 [26.91, 53.34]	46.28 [32.3, 64.0]	54.0 [37.68, 74.67]	61.71 [43.06, 85.34]	19.28 [13.46, 26.67]	
		No	9.87 [8.34, 12.87]	19.74 [16.67, 25.74]	29.62 [25.01, 38.61]	39.49 [33.35, 51.48]	49.36 [41.68, 64.35]	59.23 [50.02, 77.22]	69.1 [58.35, 90.09]	78.97 [66.69, 102.96]	24.68 [20.84, 32.17]	
	Staff	Yes	8.47 [6.02, 11.66]	16.95 [12.05, 23.31]	25.42 [18.07, 34.97]	33.89 [24.1, 46.63]	42.37 [30.12, 58.29]	50.84 [36.14, 69.94]	59.31 [42.17, 81.6]	67.78 [48.19, 93.26]	21.18 [15.06, 29.14]	
		No	9.11 [7.7, 11.88]	18.22 [15.39, 23.76]	27.34 [23.09, 35.64]	36.45 [30.78, 47.52]	45.56 [38.48, 59.4]	54.68 [46.17, 71.28]	63.79 [53.87, 83.16]	72.9 [61.56, 95.04]	22.78 [19.24, 29.7]	
	Staff and visitors	Yes	7.71 [5.38, 10.67]	15.43 [10.77, 21.33]	23.14 [16.15, 32.0]	30.85 [21.53, 42.67]	38.57 [26.91, 53.34]	46.28 [32.3, 64.0]	54.0 [37.68, 74.67]	61.71 [43.06, 85.34]	19.28 [13.46, 26.67]	
		No	9.87 [8.34, 12.87]	19.74 [16.67, 25.74]	29.62 [25.01, 38.61]	39.49 [33.35, 51.48]	49.36 [41.68, 64.35]	59.23 [50.02, 77.22]	69.1 [58.35, 90.09]	78.97 [66.69, 102.96]	24.68 [20.84, 32.17]	

Probability of at least one introduction												
Time horizon	Inursion risk from:	Staff testing	Daily incidence in the general population								Medium-term projection (no change to current growth)	
			50k	100k	150k	200k	250k	300k	350k	400k		
2 weeks	Visitors	-	22.36 [19.24, 28.11] %	39.72 [34.79, 48.31] %	53.2 [47.34, 62.84] %	63.67 [57.47, 73.29] %	71.79 [65.66, 80.8] %	78.1 [72.27, 86.19] %	83.0 [77.6, 90.07] %	86.8 [81.91, 92.86] %	31.59 [27.43, 39.04] %	
		No	95.2 [92.31, 98.09] %	99.77 [99.41, 99.96] %	99.99 [99.95, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
	Staff	Yes	92.36 [83.37, 97.14] %	99.42 [97.24, 99.92] %	99.96 [99.54, 100.0] %	100.0 [99.92, 100.0] %	100.0 [99.99, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	96.28 [93.79, 98.63] %	99.86 [99.61, 99.98] %	99.99 [99.98, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
	Staff and visitors	Yes	94.07 [86.57, 97.95] %	99.65 [98.2, 99.96] %	99.98 [99.76, 100.0] %	100.0 [99.97, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	39.72 [34.79, 48.31] %	63.67 [57.47, 73.29] %	78.1 [72.27, 86.19] %	86.8 [81.91, 92.86] %	92.04 [88.21, 96.31] %	95.2 [92.31, 98.09] %	97.11 [94.98, 99.01] %	98.26 [96.73, 99.49] %	63.67 [57.47, 73.29] %	
4 weeks	Visitors	-	99.77 [99.41, 99.96] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	99.42 [97.24, 99.92] %	100.0 [99.92, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [99.92, 100.0] %	
	Staff	Yes	99.86 [99.61, 99.98] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	99.65 [98.2, 99.96] %	100.0 [99.97, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [99.97, 100.0] %	
	Staff and visitors	Yes	99.65 [98.2, 99.96] %	100.0 [99.97, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	53.2 [47.34, 62.84] %	78.1 [72.27, 86.19] %	89.75 [85.39, 94.87] %	95.2 [92.31, 98.09] %	97.76 [95.95, 99.29] %	98.95 [97.87, 99.74] %	99.51 [98.88, 99.9] %	99.77 [99.41, 99.96] %	85.02 [79.87, 91.58] %	
6 weeks	Visitors	-	99.99 [99.95, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	99.96 [99.54, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
	Staff	Yes	99.99 [99.98, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	99.98 [99.76, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
	Staff and visitors	Yes	99.99 [99.98, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	
		No	99.98 [99.76, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	100.0 [100.0, 100.0] %	

Table 11: Expected number of introductions (top) and probability of at least one introduction (bottom) without COVID measures in place. Best estimates are provided, together with lower and higher bounds from the sensitivity analysis.

## 6 Summary of future considerations

### 6.1 Decreasing community prevalence but continued high risk prison environment

The community prevalence of COVID-19 is decreasing, however prison outbreaks can happen even with low levels of community transmission, due to the amplification that occurs within the institutional setting. Outbreaks in prisons only require the importation of a single infection (PHE, 2021). In the closed prison setting either a high level of immunity or ongoing stringent protective measures will be required to reduce transmission.

If future research suggests there is a time limited benefit to vaccination this, combined with high turnover of prisoners means there is a risk that prisons will not reach/maintain sufficient levels of immunity to avoid outbreaks.

Failure to protect prisons from increased transmission levels will leave a window of opportunity for new variants to amplify, potentially leading to prisons as a reservoir of infection for the community as has been observed with other infectious diseases (Fazel, 2011). During wave 2 there have been several instances where large prison outbreaks have meant that the surrounding local area has measured some of the highest infection rates in England (media articles, 2021), supporting this theory.

As discussed in section 1.1.2, the prison system will **have** to resume normal movements to support continued delivery of justice and a rehabilitative regime. We have evidence of increased infections and mortality that have taken place *despite* severely restricted regimes and reduced movements.

### 6.2 Control measures

It is likely that no one strategy will be sufficient to support lifting of the prison lockdown regime in its entirety. Rather a package of interventions will be required to support a staged return to the normal regime. New or existing control measures need to take into account the welfare of prisoners and their families and security in prisons. Considerations may include:

- Measures to reduce the risk of morbidity and mortality to people living and working in prisons (e.g. vaccination)
- Consideration of the role of PCR/LFD testing and additional control measures to support the re-introduction of prison visitation for families and friends. This could be a negative PCR test 48hrs prior to the visit or a lateral flow test on arrival if travel to the prison takes >48hrs
- Measures to reduce the likelihood of introduction of new infections into prison establishments (e.g. reverse cohorting, vaccination to reduce transmission, regular staff testing), mindful that the prison population may rise rapidly as courts resume near normal levels of activity and capacity may reduce. Only 1/3 of the prison estate is able to take new receptions from court.

- Consideration of testing in other areas of the criminal justice system e.g. LFD testing in police custody or PECS transport contractors
- Measures to spot early warning signs of infection (e.g. wastewater testing)
- Measures to allow rapid testing/control of prison outbreaks (e.g. dedicated mass testing resources)
- Measures to understand further transmission dynamics (e.g. genomics, air & surface sampling, modelling)

### **6.3 Dual outbreak risks (Influenza/COVID-19)**

Prisons are high risk environments for influenza outbreaks (WEPHREN, 2018), for the same reasons that they are susceptible to COVID-19 outbreaks. Influenza vaccination is currently only recommended for 'at risk' groups in prisons as per community guidelines. Despite this the prison estate sees high numbers of influenza outbreaks under non-pandemic circumstances.

In 2018-19 there were 13 influenza outbreaks in secure establishments and an average 10.6 cases per outbreak. In 2019-20 there were 7 outbreaks, including two in immigration removal centres, and an average of 6.4 cases per outbreak. In 2018-19 7.1% of prisoners or detainees were hospitalised (PHE 2020). Higher cases and outbreaks seen in 2018-19 are likely attributable to the poorer match between the seasonal influenza vaccine and circulating strains that winter (CDC, 2020; Chung, 2020). Vaccine mismatch is a plausible scenario for winter 2021-22 given the lack of influenza circulation in 2020-21 to inform the northern hemisphere influenza vaccine strain selection.

There is a high possibility that dual pathogen outbreaks will occur during the 2021 winter season as influenza circulation resumes, and prisons may face challenges in distinguishing between influenza or COVID outbreaks.

To reduce the very real risk of dual pathogen outbreaks, we suggest consideration is given to wider influenza vaccination policy in prisons, in conjunction with COVID-19 vaccination policies.

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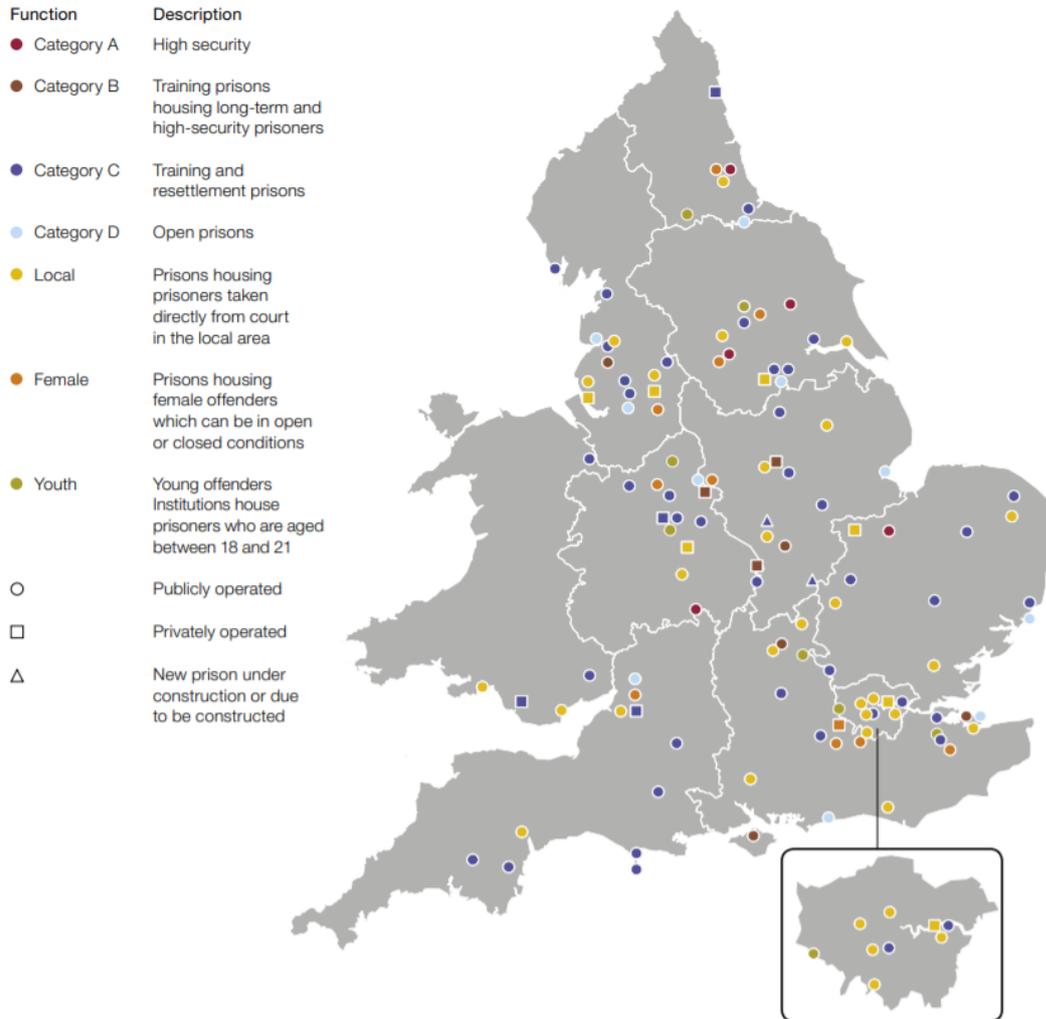
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# Appendix E – Map of prison establishments

**Figure 1**

Map of prisons in England and Wales by function, as at October 2019

There were 117 prisons in England and Wales as at October 2019, of which 104 were publicly operated; two prisons are under construction



**Notes**

- 1 We have adjusted some prison locations by up to several millimetres to prevent exact overlaps and improve visual clarity.
- 2 We have added data points for two prisons under construction: Wellingborough and Glen Parva. HM Prison & Probation Service (HMPPS) has obtained planning approval for a new Category C prison at HMP Full Sutton, which will be adjacent to the existing Category A prison at this site.
- 3 We have recorded HMP Belmarsh, HMP Manchester and HMP Woodhill as local prisons. These prisons serve local courts and also accommodate Category A prisoners.

Source: National Audit Office analysis of HM Prison & Probation Service data

## Appendix F – LSHTM modelling parameters

Parameter	Value	Lower	Upper	Source/Notes
<i>Prison-specific parameters</i>				
Reff	4	1.5	5	Assumption/personal communication (O. O'Mara)
Vaccine efficacy	0.7	0.5	0.95	0% efficacy until day 14; VE estimates were based on phase 3 clinical trial data
Duration of natural immunity	45 weeks	1 year	3 years	Kissler et al. (2020) - for 45 weeks; 1 year and 3 years – assumption.
Duration of vaccine immunity	45 weeks	1 year	3 years	Assumption
Staff turnover rate	8.6%/year	4.3%	12.9%	HMPPS Workforce Statistics Bulletin, September 2020 (Lower and upper bounds = +/- 50%)
Prisoner reception rate	13.2%/year	6.6%/year	19.8%/year	Mean for cat B prisons –personal communication (O. O'Mara) 26/790/quarter (Lower and upper bounds = +/- 50%)
# vaccinated per day	20	10	40	Assumption/Personal communication (O. O'Mara) 40 = two vaccination teams
Prisoner popn size	790			Prison population bulletin: monthly December 2020. <a href="https://www.gov.uk/government/statistics/prison-population-figures-2020">https://www.gov.uk/government/statistics/prison-population-figures-2020</a>
Staff popn size - NPF	90			Mean for cat B prisons –personal communication (O. O'Mara)

Staff popn size - PF	375			Mean for cat B prisons – personal communication (O. O'Mara)
Rate of ingress	0.0128*0 .1	No ingress	0.0128	Coronavirus (COVID-19) Infection Survey UK: 12 February 2021, ONS
<i>Disease parameters</i>				
Latent period	4.0 days			Davies et al. (2020)
Duration of preclinical infectiousness	1.5 days			Davies et al. (2020)
Duration of clinical infectiousness	3.5 days			Davies et al. (2020)
Duration of subclinical infectiousness	5.0 days			Davies et al. (2020)
Probability of clinical symptoms, given infection	Age- depende nt			Davies et al. (2020)
Relative infectiousness of subclinical cases	50%			Assumption

# Appendix G – HMPPS modelling results

## Winter worst case scenario - limitations and PHE attack rate

### *Limitations*

HMPPS has worked closely with PHE and University of Manchester to develop this modelling, however all parties recognise limitations of the modelling assumptions and parameters.

- This modelling is based on unmitigated scenarios and is not a prediction. It covers the second peak starting from September 2020 and ending in May 2021. The possibility of a third peak, and its potential impact is not considered.
- This modelling is based on the Reasonable Worst Case and thus, deliberately assumes an outbreak occurs upon an introduction of the virus into the service user population
- This model does not consider prison population inflows and outflows into susceptible populations, this would require a more complex modelling approach where vital dynamics (susceptibility) is introduced
- HMPPS rely on health and modelling partners for the latest epidemiological assumptions and parameters around infectivity and transmission
- Due to insufficient evidence, the modelling does not reflect the role and behaviours of prison staff in outbreak dynamics
- Modelling is based on a closed environment at establishment level and to consider outbreak dynamics and transmission at wing-level would require complex and potentially unquantifiable considerations that address differences in infrastructure, population size, internal transmission dynamics and prison regime
- There is limited evidence on:
  - Infectiousness and infectivity profile of different cases;
  - clinical attack rate – how many people infected really have symptoms/ proportion of asymptomatic;
  - infection fatality rate
  - whether asymptomatic cases are as infectious as those with symptoms;
  - whether infectiousness varies between populations/ individuals/ symptoms;
  - what dose of virus leads to infection;
  - whether immunity is whole or partial;
  - how long immunity lasts and how variable it is;

- whether reinfection is not possible, or possible but with reduced symptoms and/or infectiousness;
- correlations with severity of disease or other factors such as age, sex and ethnicity;
- impact of COVID-measures & Non-Pharmaceutical Interventions (and compliance), such as compartmentalisation, PPE, testing, hand hygiene, social distancing etc.
- Susceptibility and immunity of the prison population
- There are policy interventions that may affect outbreak dynamics and transmission, however the effect of interventions, such as Outbreak Control Team measures, a vaccination programme or effective treatments is unknown

***PHE Attack Rate: Parameterisation, interpretations and model framework (provided by PHE)***

*Parameters provided*

- Reproduction number of 3
- 50% of a prison population are clinically attacked
- 6-day incubation period
- 4 day symptomatic period
- 1 day to detection for those who are clinically attacked
- Individual prison populations

*Modelling assumptions*

- For each introduction of the disease to prison this modelling assumes only a single index case
  - When the reproduction number is greater than 1, this seeding number will not be significantly affected by additional infections.
  - Once there is transmission within a prison, this will outweigh any risk of importing an infection until the epidemic has been brought under control or reached its natural end.
  - Multiple outbreaks are not considered.
  - Should a significant number of susceptible individuals remain within an institution's population following an outbreak, which is likely when intervention

measures are in place, then subsequent introductions could lead to additional outbreaks.

- Similarly, following an outbreak in an institution that has a high population turnover it is highly likely that the susceptible population may be sufficiently replenished to permit secondary outbreaks, even where a substantial outbreak has already occurred.
- We have applied a modelling structure to the average prison size, and scale appropriately to provide the numbers for the total estate.
- Not all disease introductions will result in an epidemic due to an effect called stochastic die-out (by chance someone carrying the disease does not transmit to anyone else). As the initial number of infections increases, the chance of stochastic die-out occurring decreases. We only consider scenarios where more than 5 infections are observed.

## Modelling framework

### Parameters

- Incubation period  $t_a$
- Infectious period  $t^i$
- Time to detection  $t_d$
- Proportion of clinically attacked infections  $k_c$

### Assumptions

- Homogeneously mixed prison population
- Staff are not considered within this prison model
- There is no mixing with non-prison population
- There is no birth or death process such as prisoners arriving or leaving, non-COVID-19 mortality
- The population is uniform, so does not account for age, health or other differences (*this is done later in the RWCS model structure by HMPPS*)
- Transition times between compartments follow Erlang distribution (two compartments for E,  $I_u$ ,  $I_d$ )
- On detection, individuals who are clinically attacked are removed from the general population number in the force of infection expression.
- Individuals who go to hospital do not return to the general prison population.