Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Evidence synthesis for groups in vaccine allocation group nine - those aged 18-64 years living or working in crowded conditions

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About the Health Information and Quality Authority

The Health Information and Quality Authority (HIQA) is an independent statutory authority established to promote safety and quality in the provision of health and social care services for the benefit of the health and welfare of the public.

HIQA's mandate to date extends across a wide range of public, private and voluntary sector services. Reporting to the Minister for Health and engaging with the Minister for Children, Equality, Disability, Integration and Youth, HIQA has responsibility for the following:

- **Setting standards for health and social care services** — Developing person-centred standards and guidance, based on evidence and international best practice, for health and social care services in Ireland.
- **Regulating social care services** — The Chief Inspector within HIQA is responsible for registering and inspecting residential services for older people and people with a disability, and children's special care units.
- **Regulating health services** — Regulating medical exposure to ionising radiation.
- **Monitoring services** — Monitoring the safety and quality of health services and children's social services, and investigating as necessary serious concerns about the health and welfare of people who use these services.
- **Health technology assessment** — Evaluating the clinical and cost-effectiveness of health programmes, policies, medicines, medical equipment, diagnostic and surgical techniques, health promotion and protection activities, and providing advice to enable the best use of resources and the best outcomes for people who use our health service.
- **Health information** — Advising on the efficient and secure collection and sharing of health information, setting standards, evaluating information resources and publishing information on the delivery and performance of Ireland's health and social care services.
- **National Care Experience Programme** — Carrying out national service-user experience surveys across a range of health services, in conjunction with the Department of Health and the HSE.

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Foreword

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a highly infectious virus which has caused tens of millions of cases of COVID-19 since its emergence in 2019, with a considerable level of associated mortality. In the context of the ongoing COVID-19 pandemic, SARS-CoV-2 constitutes a significant public health concern due to its high basic reproduction rate, the limited evidence of effective treatment approaches, and the constrained supply of vaccines in the early stages of population-level immunisation programmes.

The National Public Health Emergency Team (NPHET) oversees and provides national direction, guidance, support and expert advice on the development and implementation of strategies to contain COVID-19 in Ireland. Since March 2020, HIQA's COVID-19 Evidence Synthesis Team has provided research evidence to support the work of NPHET and associated groups and inform the development of national public health guidance. The COVID-19 Evidence Synthesis Team, which is drawn from the Health Technology Assessment Directorate in HIQA, conducts evidence synthesis incorporating the scientific literature, international public health recommendations and existing data sources, as appropriate.

From September 2020, as part of the move towards a sustainable response to the public health emergency, HIQA provides evidence-based advice in response to requests from NPHET. The advice provided to NPHET is informed by research evidence developed by HIQA's COVID-19 Evidence Synthesis Team and with expert input from HIQA's COVID-19 Expert Advisory Group (EAG). Topics for consideration are outlined and prioritised by NPHET. This process helps to ensure rapid access to the best available evidence relevant to the SARS-CoV-2 outbreak to inform decision-making at each stage of the pandemic.

The purpose of this report is to outline the results of an evidence synthesis concerning group nine of the provisional Irish vaccine allocation plan; that is, individuals aged 18-64 years living or working in crowded accommodation, where self-isolation and social distancing are difficult to maintain.

HIQA would like to thank its COVID-19 Evidence Synthesis Team, the members of the COVID-19 EAG and all who contributed to the preparation of this report.

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Particular thanks are due to the Health Protection and Surveillance Centre (HPSC) for the provision of data, and to the COVID-19 Expert Advisory Group (EAG) and the individuals within the organisations listed below who provided advice and information.

Membership of the Expert Advisory Group involves review of evidence synthesis documents and contribution to a discussion which informs the final report. It does not necessarily imply agreement with all aspects of the evidence synthesis.

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The report is developed by HIQA's COVID-19 Evidence Synthesis Team with support from HIQA's COVID-19 Expert Advisory Group. Not all members of the Expert Advisory Group and Evidence Synthesis Team are involved in the response to each research question. The findings set out in the report represent the interpretation by HIQA of the available evidence and do not necessarily reflect the opinion of all members of the Expert Advisory Group.

Conflicts of Interest

None declared.

List of abbreviations used in this report

ACIP	Advisory Committee on Immunisation Practices
CDC	Centers for Disease Control and Prevention
CIDR	Computerised Infectious Disease Reporting system
COVID-19	Coronavirus disease 2019
CSO	Central Statistics Office
ECDC	European Centre for Disease Prevention and Control
EMA	European Medicines Agency
EROC	Emergency Reception and Orientation Centre
HIQA	Health Information and Quality Authority
HPSC	Health Protection Surveillance Centre
HSE	Health Service Executive
ICU	intensive care unit
IPS	Irish Prison Service
MRCI	Migrant Rights Centre Ireland
NIAC	National Immunisation Advisory Committee
NPHET	National Public Health Emergency Team
OST	opioid substitute treatment
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
UK	United Kingdom
WHO	World Health Organization

Key points

- Group nine of the provisional Irish vaccine allocation plan includes individuals aged 18-64 years living or working in crowded accommodation, where self-isolation and social distancing are difficult to maintain.
- This evidence synthesis sought to explore the appropriateness of potential populations for inclusion in vaccine allocation group nine based on evidence for risk of infection with COVID-19, and risk of severe disease (that is, hospitalisation, ICU admission, death). This was informed by a review of international public health policy and guidance, and an exploration of Irish level data for infection rates and rates of severe disease within identified populations.
- The policy question, documents from social inclusion groups within the Department of Health and Health Service Executive, and the findings of the international review identified the following 12 potentially at-risk groups for consideration:
    - Travellers, Roma community, residents and staff of accommodation centres for international protection applicants and programme refugees, prisoners and prison staff, people who are homeless and staff in homeless facilities, addiction service users and staff in these services, people working in food processing plants, residents and staff of women's refuges, undocumented migrants, sex workers, seasonal harvest workers, and religious communities.
- Where sufficient data were available, an exploration of Irish data on infection rates with COVID-19 and rates of severe disease was conducted for each group identified using summary data provided by the HPSC (data from 1 March 2020 to 27 February 2021). Estimates of crude risk relative to the general population were calculated where possible. Relative to the general population:
    - Travellers (all ages and those aged 18-64 years) were noted to be at an elevated risk of infection, and in those aged 18-64 years there was an increased risk of severe disease (in terms of hospitalisation when considered as a proportion of cases, and hospitalisation, ICU admission and death when considered as a proportion of the population). Notably, these results are considered to underestimate the true

prevalence, given limitations with the use of ethnic identifiers and the hard to reach nature of this population.

- Members of the Roma community were noted to have comparable rates of infection relative to the general population, but an elevated risk of severe disease across the outcomes assessed in those aged 18-64 years (that is, hospitalisation, ICU admission and death). The results presented are considered to underestimate the true prevalence given the reliance on outbreak data and the hard to reach nature of this population.
- Residents and staff of accommodation centres for international protection applicants and programme refugees presented with an increased risk of infection, but comparable rates of severe disease relative to the general population.
- Those who work in meat processing plants were noted to have an elevated risk of infection relative to the general population, but comparable rates of severe disease (however, an elevated risk of ICU admission was observed when considered as a proportion of the population). Rates of infection and rates of severe disease were low in those working in food processing excluding meat. However, this categorisation encompasses a large number of sectors. Therefore, certain subgroups may be more susceptible than others, but this was not readily discernible from the data.
- Rates of infection were noted to be comparatively low for those living or working in prison settings, and in people who are homeless and staff of services for these individuals; however, these rates are likely reflective of the rigorous measures taken to protect these groups rather than the populations themselves. People who are homeless were noted to be at a potentially elevated risk of severe disease.
- Cases linked with outbreaks have been documented in settings for addiction service users, women's refuges, and residential religious settings. However, reliable estimates of population sizes could not be obtained to enable comparison with the general population.
- Analyses were limited by an absence of available case data for undocumented migrants, sex workers, and seasonal harvest workers. However, these groups were highlighted within the international review

and or national social inclusion groups in Ireland as being potentially at risk.

- Additional important considerations for decision-making related to populations within vaccine allocation group nine include; the eligibility of individuals for vaccination in preceding allocation groupings, the accurate identification of individuals within a number of the groups outlined, the logistics and operationalisation of vaccine rollouts for these groups, the degree to which the groups highlighted are mutually exclusive, and the impact of more transmissible variants of concern. Additionally, a number of groups are considered to face ongoing challenges in terms of transmission, control of outbreaks, and the potential for seeding of cases in the wider community.
- A number of limitations are acknowledged within this evidence synthesis including the use of summary case data linked to outbreaks for the majority of groups, the underestimation of cases in hard to reach populations, the lack of standardisation for potential confounding factors such age and sex, and the potential underestimation of risk in a number of the groups identified given limitations in case data and or population size estimates. Furthermore, the estimates of infection risk may be influenced by the degree of testing in the populations included (for example, the use of serial testing).

DRAFT: Evidence synthesis for groups in vaccine allocation group nine- those aged 18-64 years living or working in crowded conditions

The Health Information and Quality Authority (HIQA) has developed a series of evidence syntheses to underpin advice from HIQA, with input from the HIQA COVID-19 Expert Advisory Group (EAG), to inform the national public health response. This evidence synthesis relates to the following policy question posed by the Department of Health to inform the work of the National Immunisation Advisory Committee:

> "Groups at increased risk of COVID-19 due to crowded living and or working conditions may include Travellers, Roma, international protection applicants, homeless, prisoners and those working in food processing plants. Based on the available national and international evidence in relation to the increased risk of infection with COVID-19, and the increased risk of severe disease from COVID-19 (including hospitalisation, ICU admission and death), is the above list complete and appropriate?"

This current report summarises a review of international public health guidance and analysis of Irish data to inform the following research questions (RQs) that were formulated to inform the above policy question:

- Is the potential composition of the vaccine allocation group nine which comprises named groups of adults aged 18-64 years perceived to be at increased risk of infection with COVID-19 and or serious disease due to their living or working conditions, consistent with international public health guidance and policy?
    - Do other guidance or policy documents prioritise groups of adults aged 18-64 years for vaccination due to their living or working conditions? If yes, are any relevant at-risk groups omitted from the proposed Irish grouping.
- What is the rate of infection and rate of severe disease in each of the groups listed within vaccine allocation group nine (and any additional groups identified as potentially relevant to the Irish context from RQ1), compared with the general population in Ireland?

Background

Up to March 2021, the European Medicines Agency (EMA) has granted conditional marketing authorisations for four vaccines to prevent COVID-19, with additional candidate vaccines under evaluation or rolling review.[1] The approved vaccines offer a potential means to limit mortality and morbidity associated with COVID-19, protect healthcare and other essential services, and revive social and economic activity.[2, 3]

Widespread vaccination has begun within the European Union with the majority of member states initiating their vaccination programmes prior to the end of 2020.[4] The successful roll-out of COVID-19 vaccines requires a robust vaccination strategy and deployment plan at a national level which is adapted based on the local context.[4] The European Centre for Disease Prevention and Control (ECDC) highlights that such strategies must be flexible and adaptable to meet changing disease, vaccine, and or resource considerations.[4] Components of such strategies include logistics, allocation groupings, infrastructure, resources, communications and surveillance. Of critical importance is the consideration of priority groups for vaccination given finite supplies of the vaccines, at least in the short to medium term.[3-6]

The European Commission outlines that prioritisation of groups for vaccination should aim to protect the most vulnerable groups and individuals, and to slow down and eventually stop the spread of the disease, with this position largely reflected by the ECDC and World Health Organisation (WHO).[3-6] The implementation of priority groupings for vaccination should ensure that vaccines are ethically and equitably distributed, acknowledging that although the population at large may be at risk of COVID-19, the risk as a whole is not equal and some groups have been disproportionately impacted by COVID-19 in terms of morbidity, mortality, and transmission.[2, 7] The Department of Health allocation framework cites that the ethical principles of moral equality of all persons, minimisation of harm, fairness, and reciprocity are of key importance to decision making on vaccine prioritisation and to ensure that existing health inequalities are not further compounded.[2]

At a European and international level, emphasis for prioritisation has been placed on groups who are likely to be most impacted through risk of severe disease and or risk of exposure and onward transmission.[3-6, 8] While acknowledging the changing influence of epidemiological indicators, supply of vaccines and vaccine outcome data, health agencies cite that initial vaccination will likely be most impactful if allocated to older individuals, healthcare workers, and those who are medically vulnerable;[3-6] a position taken by the majority of European countries to date including Ireland.[4, 9] Individuals who are at increased risk due to their living and or working conditions

impacting on their ability to socially distance or self-isolate are further emphasised as key groups for inclusion in priority allocation.[3-6] Such groups reflect a potential inequity in risk and vaccine access, may be more likely to experience outbreaks of COVID-19, and can potentially represent groups of socially vulnerable individuals.[3, 5, 6, 8, 10] As with other priority groups, a tiered strata may be included within such allocation with a noted adaptability and context specification dependent on the country in question.[3, 5] Consistent with this, the National Immunisation Advisory Committee (NIAC) in Ireland highlight the need for value judgements when considering individuals who fall into such priority groupings.[7] In the provisional Irish vaccine allocation plan, individuals aged 18-64 years living or working in crowded accommodation, where self-isolation and social distancing is difficult to maintain, are included as group nine.[9] The rationale for the inclusion of this group is cited as being that these individuals may represent socially disadvantaged groups more likely to experience a higher burden of disease; in prioritising this group the ethical principles of fairness, moral equality and minimisation of harm are noted with recognition that structural inequalities make some people more vulnerable to COVID-19 than others.[2, 7]

The aim of this evidence synthesis is to explore potential populations for consideration in vaccine allocation group nine based on national and international evidence for the risk of infection, and risk of severe disease, with COVID-19.

Methods

A protocol outlining the associated processes was adhered to throughout the conduct of this evidence synthesis (available here). This evidence synthesis encompasses two elements, namely: a review of international public health guidance and policy, and an analysis of Irish level data.

The list of potentially at-risk groups identified within the policy question (that is, members of the Traveller community, members of the Roma community, international protection applicants, people who are homeless, prisoners and those who work in food processing plants) is further supplemented by documents from the Drug Policy and Social Inclusion Division of the Department of Health,[11] the Health Service Executive (HSE) National Social Inclusion Office,[12] and potential at-risk groups relevant to the Irish context identified from the review of international public health guidance and policy.

To inform the analysis of the risk of infection with COVID-19 and risk of severe disease (that is, hospitalisation, ICU admission and death) in each potential at-risk group identified, Irish level data were sourced from the Health Protection Surveillance Centre (HPSC) Computerised Infectious Disease Reporting (CIDR)

system. Data were requested for all potential groups identified; however, data were not available for all groups of interest. Data were categorised at source and summary counts of each outcome of interest provided separately for all ages and for those aged 18-64 years where possible. For members of the Traveller community, the summary data included cases from outbreaks affecting this group and or cases whose ethnicity was reported. For the remaining groups of interest, categorisation by demographics was not feasible, therefore the data provided were cumulative counts of outcomes linked to outbreaks in settings relevant to these groups. Of note, an outbreak is defined as two or more cases of laboratory-confirmed COVID-19 regardless of symptomatic presentation, or two or more cases of illness with symptoms consistent with COVID-19 infection with at least one person confirmed as a case of COVID-19.[13] It must be noted that this methodology excludes individual cases, which were not linked to outbreaks and hence likely underestimates the true prevalence. Additionally, the use of ethnic identifiers may undercount populations as complete coverage is not presented in the CIDR database (approximately 28% of cases are categorised as unknown ethnicity). Unless ethnicity information is missing at random, there is the potential that ethnic minorities are systematically undercounted or underidentified.

Where possible, the total numbers of people within each group of interest were sourced, or estimated, to determine the proportion of the population infected to date, and the proportion who experienced a severe form of disease (that is hospitalisation, ICU admission, death). Given the data available, this analysis was crude in nature with no adjustments made for any potential confounding factors. For each group of interest for which sufficient data were available for infection rates and population estimates, comparative data were drawn from the general population. These data excluded the outcome counts and population figures for each at-risk group of interest. Compared to the general population, crude relative risk (RR) and associated 95% confidence intervals were estimated for the risk of infection with COVID-19 and risk of severe disease in each group of interest.[14] For the severe disease outcomes of interest these estimates were expressed as a proportion of cases; however, these estimates may be sensitive to coverage of testing in populations. Therefore these crude RRs are further presented by population in Appendix 2 for information, with risk defined for severe outcomes using the population rather than using COVID-19 cases as the denominator. Where there were no occurrences of an outcome within a group (for example deaths) a continuity correction of 0.5 was used to enable RR estimation. Again, given the data available, these estimates represent crude measures only without adjustment for any confounding factors.[14] Data on infection rates and rates of severe disease included within the analysis capture the time period of 1 March 2020 to 27 February 2021, inclusive.

Of note, there are definitions for overcrowded accommodation used by organisations such as Eurostat to facilitate comparisons between countries.[15] However, it would be challenging to operationalise a vaccination plan based on the composition of individual private households, with a number of likely interacting factors. Therefore the approach adopted in this report is to synthesise the available data based on groups for which, on average, there is an identified higher likelihood that they live or work in crowded conditions. It is acknowledged that the groups included in the report will therefore include a proportion of individuals for whom the risk of infection or severe disease is no greater that the general population, and similarly that there may be individuals living or working in overcrowded accommodation within the general population that are excluded based on the approach adopted.

Results

The potential at-risk groups outlined within the policy question were:

- Travellers
- Roma community
- international protection applicants
- people who are homeless
- prisoners
- those working in food processing plants.

Additional potentially applicable groups to this policy question outlined by the Drug Policy and Social Inclusion unit of the Department of Health and or the HSE National Social Inclusion Office were:[11, 12]

- staff working in homeless facilities
- residents and staff of Direct Provision centres and Emergency Reception and Orientation Centres (EROCs) (that is, international protection applicants and programme refugees)
- addiction service users and staff of addiction services
- residents and staff of women's refuges
- undocumented migrants
- sex workers.

Review of international public health guidance and policy

In total, guidance from four international organisations,[3, 6, 16, 17] and 23 countries, were explored for information relating to vaccine prioritisation for groups living or working in crowded conditions.[18-39] Sources were reviewed up to 15 March 2021.

Non-European and International organisations

The websites of four Non-European or international organisations (the European Commission, ECDC, WHO and the US Centers for Disease Control and Prevention (CDC)) were reviewed.[3, 6, 16, 17]

The European Commission identified a list of potential priority groups for the initial phasing of vaccine deployment in European countries.[3] The proposed priority groups included communities (for example, dormitories, prisons and refugee camps) and workers (for example, factories, meat cutting plants and slaughterhouses) that are unable to physically distance. The commission noted that a vaccine which is effective against disease severity should target vulnerable groups while a vaccine which is effective in reducing virus transmission should target groups that are more susceptible to spreading the disease, and that dynamic vaccine strategies may be required to adjust to wider societal and economic needs as the pandemic evolves. Adaptable and flexible vaccination strategies will be necessary to respond to rapid changes in the epidemiological situation at local, regional and national levels.

The ECDC has published four reports on national vaccine deployment planning and allocation of priority groups for vaccination.[4, 5, 16, 40] Among potential target groups, the ECDC highlighted that there is an increased risk of virus transmission in occupational settings where there is a lack of physical distancing, and that inadequate use of personal protective equipment is a key risk factor for transmission. Other settings where the ability to physically distance may be impeded (and should accordingly be considered for prioritisation) included prisons, migrant centres, crowded housing and homeless centres. Over time, these strategies will need to be adapted to reflect epidemiological changes, new evidence on disease pathogenesis and risk groups, vaccine supply, and emerging knowledge regarding safety, immunity and vaccine-attributable protection.

The WHO's Strategic Advisory Group of Experts on Immunisation has developed a:

- values framework for the allocation and prioritisation of COVID-19 vaccination[41]
- roadmap for prioritising the use of vaccines in the context of limited vaccine supply.[6]

The Values Framework identified population subgroups that could be prioritised by advancing one or more of its principles and objectives. Among the subgroups identified were social and employment groups at an elevated risk of acquiring or transmitting infection due to an inability to effectively maintain physical distancing (such as those working or living in detention facilities or prisons, dormitories, informal settlements or urban slums, homeless people, low-income people in dense urban neighbourhoods, and those working in particular occupations such as meat processing).

The US CDC has published a rolling list of recommended groups for vaccination.[17] Of note, the recommendations serve as guidance only and individual states in the US can elect to use their own prioritisation strategy. The list takes the form of a tiered system informed by the Advisory Committee on Immunisation Practices (ACIP). The initial groups listed include healthcare workers, frontline essential workers, those aged over 65 years in age bands, those aged 16-64 years with underlying medical conditions, and other essential workers. As vaccine supplies increase, additional groups will be added to the rollout recommendations and prioritised by the ACIP. The goals of the recommendations are to decrease death and serious disease as much as possible, preserve functioning of society, and reduce the extra burden COVID-19 is having on people already facing disparities. The ethical principles guiding the recommendations are outlined as: maximise benefits and minimise harm, mitigate health inequalities, promote justice, and promote transparency. The ACIP is further guided by a number of frameworks including the WHO documents outlined above, and two additional COVID-19 vaccine allocation frameworks:

- John Hopkins Bloomberg School of Public Health: Interim Framework for COVID-19 Vaccine Allocation and Distribution in the United States.[8]
- The National Academies of Sciences, Engineering, and Medicine: Framework for Equitable Allocation of COVID-19 Vaccine.[42]

Both of these frameworks include, under tier two of the rollout, those whose living or working conditions give them an elevated risk of infection, even if they have a lesser or unknown risk of severe illness and death. This includes people who are unable to maintain safe physical distances in their home or work environments, such as people living in shelters, people who are incarcerated, and people who work in prisons. The rationale for these groups is that they are at higher personal risk of getting COVID-19 (and hence more severe forms), and prioritising these groups might, in some circumstances, slow transmission of the virus through their communities.

National public health agencies

The websites of national public health agencies in 23 countries (see Appendix 1) were reviewed.[18-39] A list of priority groups for vaccine allocation was identified for all 23 countries. Broadly speaking, these generally entailed prioritisation of health and social care workers, the elderly and the clinically vulnerable before prioritising the rollout of vaccinations to the wider general population.

Summary of relevant priority groups

Nine countries (Austria, Czechia, Germany, Greece, Italy, Slovakia, Spain, Switzerland and Sweden) identified priority groups relevant to people aged 18-64 years living or working in crowded accommodation where self-isolation and physical distancing is difficult to maintain, as prescribed in the provisional vaccine allocation groups in Ireland.[23, 24, 28, 32, 33, 36-39] These priority groups, presented in detail in Table 1, can be summarised as follows:

- people living or working in shared accommodation facilities or in precarious conditions, such as accommodation facilities for the homeless or asylum seekers, and other (religious and non-religious) community settings
- people in working conditions or environments which are more susceptible to virus transmission (for example, where physical distancing cannot be maintained, work spaces with poor ventilation or potential aerosol formation, workplaces where cool temperatures or refrigeration is required, workplaces where protective clothing is not worn or not worn correctly), such as meat processing plants.
- prisoners and people who work in prison settings
- people that provide services to or belong to marginalised communities that have an elevated risk of infection outbreak, such as the Roma community.

Summary of the rationale underpinning priority group allocation

A description of the rationale supporting prioritisation of relevant allocation groups was not identified for one country (Switzerland). Seven countries (Austria, Czechia, Greece, Italy, Slovakia, Spain and Sweden) provided an overarching rationale for the general allocation of priority groups. This was on the basis of risk of serious illness or mortality and job-related risk of infection during the delivery of critical infrastructure (for example, healthcare workers).

In addition to this overarching rationale, the strategy document from Sweden noted that the risk of serious illness and mortality can vary by country of origin, residential area (which may be due to the prevalence of multiple risk factors amongst

residents), socioeconomic status (because diseases may be more common in those with poorer socioeconomic status) and certain types of occupation. Such inequalities may exist as a result of material conditions, working conditions, psychosocial aspects, living habits and access to healthcare. These considerations were informed by international evidence, but did not lend themselves directly to the currently prioritised vaccination groups in Sweden. Instead, it is noted that socioeconomic status should be taken into consideration should a vaccine shortage transpire.

In Spain, a values framework pertaining to the risk of morbidity and mortality, risk of transmission and exposure, acceptability and feasibility, and the risk of adverse economic outcomes was developed. Within that framework, consideration was given to people who work in closed communities (for example, people working in prisons), people that belong to vulnerable populations due to their socioeconomic status, and subpopulations with a high incidence of infection outbreaks. Taking into account the heterogeneous characteristics of these subpopulations together with the difficulty of identifying and accessing these subpopulations, vaccination of these groups is not currently prioritised (other than for those that work in prison settings).

The most comprehensive rationale directly informing the prioritisation of target groups in crowded settings, where it is difficult to physically distance, was provided by Germany. In the strategy document, the rationale for each target group was informed by contextualised epidemiological information (for example, incidence of outbreaks in certain settings) and international literature on the health outcomes of marginalised subgroups and communities at-risk of virus transmission. The rationale, in relation to the priority groups of relevance, can be summarised as follows:

- Residents and workers in initial reception facilities and collective accommodation for asylum seekers – increased incidence of infection outbreaks in cramped living conditions in initial reception facilities and communal accommodation for asylum seekers.

- Residents and workers in shelters for the homeless – homelessness is associated with poorer health and an increased risk of infection, which results from unhealthy living conditions, often restricted access to (standard) medical care, difficulties in complying with physical distancing and infection prevention and control guidelines, restricted access to information and staying in overnight emergency or communal shelter accommodation where the potential of outbreak is high.

- People with precarious working and or living conditions – the risk of transmission and outbreaks is increasingly observed at workplaces where many people work together in rooms where there is inadequate air

ventilation, in which maintaining physical distancing is difficult (for example, meat processing plants) or protective clothing is not worn or not worn correctly. It was also noted that often people who work in such low-wage areas (such as seasonal harvest workers) have short-term contracts and inadequate social security which may lead to situations where the worker continues to attend the workplace despite symptoms of infection. In addition, such workers may live in cramped living conditions and communal accommodation, and may be at-risk due to their transport conditions (for example car-pooling).

Countries that considered relevant groups without formal inclusion

UK, France and Norway provided consideration of relevant groups that may be at-risk due to their living or working conditions, but these groups were not directly allocated priority in the initial national vaccine schedule.[18, 22, 35] Of note, these guidance documents typically reflect living documents therefore these groups may be included in subsequent versions (note sources were reviewed up to 15 March 2021).

In England, prioritisation was considered for people in Black, Asian and Minority Ethnic communities given that these communities are disproportionately affected by higher rates of infection, severe illness and mortality which may be a result of societal factors (such as occupation, household size, deprivation, and access to healthcare). However, the Joint Committee on Vaccination and Immunisation (JCVI) advised that these inequalities can be reduced by ensuring good vaccine coverage in these groups through provision of culturally competent, tailored communications and flexible models of delivery during implementation of all priority groups during the vaccination programme (as opposed to the definition of an explicit vaccine allocation group).

A letter dated 1 March 2021 (and published 11 March 2021), from the JCVI in the UK further highlights people who are homeless and those living or working in prison settings for consideration under phase 1 of vaccination. However, as of 16 March 2021, this has not been reflected in the formal priority list.[43] In their letter, the JCVI noted that emergency accommodation housing homeless people provides an opportunity to offer vaccination to this hard-to-reach population that is often unable to access basic healthcare. Furthermore, they note that many homeless people have underlying health conditions, (which would place them in other priority groups for vaccination), but that these are likely to be under-diagnosed. Consequently, the JCVI advises that local teams exercise operational judgement and consider offering vaccination to all people experiencing homelessness (alongside priority group 6 –

people aged 16-64 with underlying health conditions that put them at higher risk of serious disease and mortality).

The Welsh government has extended this recommendation to provide practitioners with discretion to adopt a policy of inclusion when homeless people are identified and can be vaccinated.[44] They suggest that Health Boards can utilise local knowledge of homelessness and housing-support providers, local authority homelessness coordination cells and housing support grant leads, support provider representative bodies, and where appropriate, specialist services such as substance misuse services, to identify people who are eligible to be added to the priority group 6 list. Additionally, the following risk factors should be considered by those exercising professional judgement and clinical discretion: clinical vulnerability and frailty, the presence of pre-existing or co-occurring health conditions and level of complexity of those health conditions, ethnicity, socio-economic factors, type of accommodation – living in a communal setting (such as in supported or emergency temporary accommodation), inability to consistently practise protective behaviours such as social distancing, wearing a mask and hand hygiene (potentially due to trauma, mental health problems and substance use issues), ability to adhere to treatment routine and tolerate intervention.

In relation to prison officers, the JCVI acknowledged that prison settings may be sources of transmission where there is an outbreak, but the extent to which vaccination prevents transmission is not yet known and vaccination solely for prevention of transmission is not currently advised. However, it is noted that where vaccine remains unused following an offer to those in detained settings, such vaccine could be reasonably offered to prison officers in order to minimise vaccine wastage. With regard to detainees in closed settings (such as prisons and immigration detention centres, or mental health facilities), the JCVI found that additional prioritisation of detainees above the wider population could not be justified solely based on the potential for increased risk of exposure.

In France, inequalities of access were highlighted, noting that mechanisms which enable people to receive community-based vaccination (such as mobile vaccination units) should be in place to allow people living in precarious or disadvantaged areas to access vaccination. However, settings where outbreaks have occurred due to difficulties in the implementation of infection protection measures (such as prisons, social accommodation and work environments where it is challenging to maintain physical distancing) are not currently prioritised.

In Norway, vaccine priority group allocation in the context of scarcity of resources was underpinned by a values framework with principles relating to the health-benefit balance, resource requirements and the risk of severe disease in those afflicted.

Socially disadvantaged groups were not proposed as a separate priority category despite being disproportionately represented among those that have had severe disease, but it was noted that those who are targeted for vaccination receive tailored information and access. It was also acknowledged in the guidance that the national vaccination programme is dynamic and context-specific responses will be required.

Table 1. Relevant vaccine priority groups identified in review of non-European and international guidance

Country/ Organisation	Relevant groups prioritised in vaccine allocation (when provided, number indicates order of priority)	Rationale provided for inclusion
International organisations		
ECDC	▪ Prisons, migrant centres, crowded housing and homeless shelters.	Lack of physical distancing increases the risk for viral transmission due to the risk of close contacts with COVID-19 cases.
European Commission	▪ Communities that cannot physically distance (for example, dormitories, prisons, refugee camps). ▪ Workers who cannot socially distance (for example, factories, meat cutting plants and slaughterhouses).	Priority should be driven by two criteria: to protect the most vulnerable groups and individuals, and to slow down and eventually stop the spread of the disease.
WHO	▪ Employment categories (such as mining and meat processing) and social groups (such as geographically remote clustered populations, detention facilities, dormitories, military personnel living in tight quarters, refugee camps) unable to physically distance, groups in dense urban neighbourhoods or in multigenerational households, homeless people and people living in extreme poverty, incarcerated people, and those living in informal settlements or urban slums.	Values framework is based on principles of human well-being, equal respect, global and national equity, reciprocity and legitimacy.
US CDC	▪ Rolling recommendations based on tiered system. Groups of interest not included in initial rollout but documented in supporting frameworks under tier two. Those whose living or working conditions give them an elevated risk of infection, even if they have a lesser or unknown risk of severe illness and death. This includes people who are unable to maintain safe physical distances in their home or work environments, such as people living in shelters, people who are incarcerated, and people who work in prisons.	There are two distinct reasons for prioritizing this broad group over the general population: first, they are at higher personal risk of getting COVID-19, and offering them the protection of vaccination advances the goal of preventing COVID19-related illness and death. Second, those at higher risk of infection may be more likely to transmit the virus to others and contribute to spread of the virus through their community. Therefore, prioritizing these groups might, in some circumstances, slow transmission of the virus through their communities and prevent the emergence of "hot spots."
National organisations		

Country/ Organisation	Relevant groups prioritised in vaccine allocation (when provided, number indicates order of priority)	Rationale provided for inclusion
Austria* (Ministry of Social Affairs)	1) Residents as well as those working in collective accommodation and in tight / precarious living and or working conditions (e.g. Homeless shelters) 2) People in employment that favours virus transmission (minimum distance cannot be maintained, low air movement, strong aerosol formation, workplaces in the cooling area)	Based on recommendations of the WHO
Czechia* (Ministry of the Interior)	▪ People working in asylum seeker detention centres with established quarantine facility for new admissions ▪ Employees and members of the prison services working in prisons	The groups were chosen with regard to the high degree of threat to their health, ensuring the functionality of the health system in the Czech Republic in terms of the threat of lack of medical staff. WHO and the ECDC were cited.
Germany (Robert Koch Insitut)	1) Residents and workers in shared accommodation 2) People with precarious working and or living conditions, including seasonal harvest workers	Low wages, short-term contracts, inadequate social security supports, shared accommodation and shared transport were identified as barriers to self-isolating as well as facilitators of onward transmission.
Italy* (Ministry of Health)	▪ At-risk settings such as prisons and other at-risk community settings (e.g. religious and non-religious) and other essential services.	Groups are based on risk of disease severity
Greece* (Ministry of Health)	▪ People aged 18-59 living in crowded group living structures.	Implementation of the National Vaccination Operational Plan through a transparent framework, based on the principles of parity, which will achieve fair access as a matter of priority according to the prevailing clinical indications, due to the quantitative limitations of the available formulations.
Slovakia* (Ministry of Health)	▪ People in the Roma community, that are homeless or asylum seekers and the workers that provide services to these populations.	Priority is given to vaccination of those that routinely come into contact with people at-risk of serious illness and mortality (for example, front-line healthcare workers) as this will likely lead to the greatest immediate benefit from a public health perspective.
Spain* (Ministry of Health)	▪ People who work in prisons.	Depending on the level of occupational exposure, people in these settings may be unable to adopt adequate infection prevention measures.

Country/ Organisation	Relevant groups prioritised in vaccine allocation (when provided, number indicates order of priority)	Rationale provided for inclusion
Sweden* (Public Health Agency)	▪ People with a condition that makes it difficult to follow the advice on infection control measures. This also applies to people who live in socially vulnerable situations.	The risk of serious illness and death in COVID-19 is affected by country of birth, residential area and socio-economy. Mortality has been increased among people born in e.g. The Middle East, Africa and the other Nordic countries, as well as among people with lower incomes, workers with short duration working hours and certain types of occupations. In addition, a higher mortality rate has been noted in some residential areas, probably because several of the risk factors are common among residents in those areas. Many diseases are more common among people with poorer socio-economic conditions. This is largely due to inequalities in, for example, material conditions, working conditions, psychosocial aspects, living habits and health care. All these factors together mean that people in certain areas are generally at a higher risk of ill health.
Switzerland (Federal Office of Public Health)	▪ People in communal facilities with an increased risk of infection and outbreaks.	Based on the disease burden per target group and the estimated contribution to achieving overall vaccination goals.

Key: ECDC – European Centre for Disease Prevention and Control; EU – European Union; WHO – World Health Organization.
* Guidance was translated using Google Translate and may be subject to error.

Exploration of Irish data on rates of infection and severe disease

Collectively, the potentially at-risk groups relevant to vaccine allocation group nine identified from the policy question, Irish social inclusion group documents, and the review of international public health guidance were:[11, 12]

- Travellers
- Roma community
- residents and staff of accommodation centres for international protection applicants and programme refugees
- prisoners and prison staff
- people who are homeless and staff in homeless facilities
- addiction service users and staff in addiction services
- people working in food processing plants
- residents and staff of women's refuges
- religious communities
- undocumented migrants
- sex workers
- seasonal harvest workers.

For each group listed, data were sought from the Irish context on rates of infection, rates of severe disease (that is hospitalisations, ICU admissions and deaths), and estimates of the population size. The following sections present the results of the analyses by group at a population level for proportion infected, proportion hospitalised, proportion admitted to ICU and proportion who died, and are summarised in Table 2. Where sufficient coverage was available for a group in terms of case data and population estimates, crude risk relative to the general population (excluding the group of interest) is presented in Table 3. For outcomes of severe disease, these estimates were calculated per case. However, as noted, these estimates may be sensitive to biases in testing therefore crude RRs as a proportion of population affected for outcomes of severe disease are further presented in Appendix 2. It should be noted that, with the exception of Travellers, all data reflect cases associated with outbreaks in settings relevant to the groups of interest. Therefore, single sporadic cases are not captured within the data and hence likely underestimates the case counts within each population as a whole.

General population

Up to 27 February 2021, on the CIDR system, there were 221,189 notified cases of COVID-19 across the population in Ireland. Based on 2020 Central Statistics Office (CSO) population estimates,[45] approximately 4.4% of the population had been infected to this point, of which 5.9% (n = 13,031) of cases were hospitalised, 0.6% (n = 1,305) admitted to ICU, and 1.8% (n = 3,994) died. Restricting to those aged 18 to 64 years, there were 165,524 cases inferring 5.4% of the population had been infected, of which 3.4% (n = 5,604) of cases were hospitalised, 0.4% (n = 728) admitted to ICU, and 0.2% (n = 285) died.

Travellers

From ethnic identifiers or outbreaks documented as affecting Travellers, there were 4,021 documented cases in the Traveller community from 1 March 2020 to 27 February 2021. The 2016 census data estimates that there are approximately 30,987 Travellers in Ireland,[46] inferring an infection rate of 13.0% across all age groups, of which 4.6% (n = 185) cases were hospitalised, 0.5% (n = 20) admitted to ICU, and 0.2% (n= 10) died. Relative to the general population, across all ages, this represents a crude RR of 2.96 for infection (95% CI 2.87 to 3.04), 0.78 for hospitalisation (95% CI 0.68 to 0.90), 0.84 for ICU admission (95% CI 0.54 to 1.31), and 0.14 for mortality (95% CI 0.07 to 0.25). As highlighted, this analysis does not include adjustments for age, which is notable when considering the age profile of the Traveller population in Ireland (that is, approximately 3% aged over 65 compared with 13% of the general population).

Restricting the analysis to those aged 18 to 64 years, there were 2,509 documented cases in 15,844 Travellers of this age category (as per 2016 census) denoting a 15.8% infection rate. Of these cases, 5.0% (n = 125) were hospitalised, 0.6% (n = 16) were admitted to ICU, and 0.2% (n = 5) died. Relative to the general population of this age, this represents a crude RR for infection of 2.96 (95% CI 2.85 to 3.06), 1.48 for hospitalisation (95% CI 1.25 to 1.76), 1.46 for ICU admission (95% CI 0.89 to 2.39), and 1.16 for mortality (95% CI 0.48 to 2.81). Of note, when crude RR is assessed as a proportion of the population affected for outcomes of severe disease, notably elevated risks are presented for the Traveller population as a whole, and in those aged 18-64 years (see Appendix 2).

It should be further considered that the estimates presented within this analysis rely on the use of an ethnicity code identifier for the Traveller population. Given the challenges that exist in identifying members of this ethnic group, the rates presented are considered to underrepresent the true prevalence in this population.

Roma community

From outbreaks documented as affecting the Roma community there were 214 cases in this population from 1 March 2020 to 27 February 2021. There are no official statistics on the size of the Roma population in Ireland; however, estimates are typically between 4,000 and 5,000.[47] Therefore, for the purposes of this analysis an estimate of 4,500 has been used for population size. This estimate infers an infection rate of 4.8% across all ages, with 11.2% (n = 24) of cases hospitalised, 3.7% (n = 8) of cases admitted to ICU, and 2.3% (n = 5) died. Relative to the general population, across all ages, this represents a crude RR of 1.07 for infection (95% CI 0.94 to 1.22), 1.91 for hospitalisation (95% CI 1.31 to 2.78), 6.37 for ICU admission (95% CI 3.22 to 12.60), and 1.29 for mortality (95% CI 0.54 to 3.08).

If the proportion of the Roma community aged between 18-64 years is assumed to be similar to the Traveller community (51%),[46] this gives an estimated population of 2,295 individuals aged between 18 and 64 years in the Roma community. There were 141 documented cases in this cohort, representing a 6.1% infection rate, based on the assumed population estimate. Of these cases, 15.6% (n = 22) were hospitalised, 5.7% (n = 8) were admitted to ICU, and 3.5% (n = 5) died. Relative to the general population of this age, this represents a crude RR of 1.14 for infection (95% CI 0.97 to 1.33), 4.62 for hospitalisation (95% CI 3.15 to 6.79), 13.03 for ICU admission (95% CI 6.62 to 25.65) and 20.95 for mortality (95% CI 8.79 to 49.93). It should be noted that the estimates of infection risk are particularly sensitive to the population size estimates for the Roma community; for example, if a lower bound estimate is used (that is, 4,000 people) then the crude RR for infection becomes significant inferring a larger risk compared to the general population for the Roma community as a whole, and for those aged 18-64 years.

It should be further considered that the estimates above represent only cases from outbreaks linked to the Roma community. The use of an ethnic identification code from the CIDR system has not been used given limitations of this method for the Roma population. Furthermore, this population are considered to be a hard to reach group in Ireland. Therefore, the rates presented are considered to underrepresent the true prevalence in this population. As further evidence of the limitations above, a study completed in Connolly Hospital in Blanchardstown (from 13 March 2020 to 1 May 2020) noted 34 members of the Roma community amongst a cohort of 257 hospitalised COVID-19 patients, of whom 10 were admitted to ICU, and three died.[48] For this single hospital study, there were more documented cases of ICU admission than within the collective analysis presented above. It is unclear if all of these cases were linked to outbreaks or included sporadic cases.

Residents and staff of accommodation centres for international protection applicants and programme refugees

Documented outbreaks involving residents and staff of Direct Provision centres have been associated with 670 cases up to 27 February 2021. Direct Provision is accommodation provided for international protection applicants. A unique identifier is not available to distinguish residents or staff of EROCs (accommodation provided for programme refugees), but it was assumed that such facilities are likely documented under Direct Provision. For the purposes of this analysis, a population size has been estimated considering both Direct Provision centres and EROCs. These populations are assumed to be relatively constant,[49] with a collective estimate of 7,300 individuals at any point in time.[12] Data provided by the Department of Children, Equality, Disability, Integration and Youth estimates that approximately 5,000 of these individuals are aged between 18 to 64 years, and 953 staff work across Direct Provision, emergency accommodation, and EROC centres (who are also assumed to be predominantly aged 18-64 years).

For all age groups, the outbreak data and associated estimates represent an infection rate for the population of 8.1% (n = 670), of which 2.8% (n = 19) of cases were hospitalised. There were no documented cases of ICU admission or death. Relative to the general population, this represents a crude RR of 1.83 for infection (95% CI 1.70 to 1.97) and 0.49 for hospitalisation (95% CI 0.31 to 0.75), 0.13 for ICU admission (95% CI 0.01 to 2.01) and 0.04 for mortality (95% CI 0.003 to 0.657). Restricting to those aged 18 to 64 years infers an infection rate of 9.4% (n = 557), of which 3.1% (n = 17) were hospitalised. Relative to the general population of this age, this represents a crude RR of 1.73 for infection (95% CI 1.60 to 1.87), 0.90 for hospitalisation (95% CI 0.56 to 1.44), 0.20 for ICU admission (95% CI 0.01 to 3.25) and 0.52 for mortality (95% CI 0.03 to 8.30).

Prisoners and prison staff

Documented outbreaks affecting prisoners and prison staff were associated with 149 cases up to 27 February 2021. Data from the Irish Prison Service (IPS), indicate a relatively stable occupancy level of approximately 3,800 prisoners;[50] however, the majority of prison sentences are less than 12 months.[51] Therefore data were sought from the IPS for the cumulative number of prisoners in the system since the beginning of the pandemic, a provisional figure of 9,158 individuals was estimated. Given the typical age profile of prisoners,[50] an assumption was made that this population are predominantly aged 18-64 years. Staffing estimates from the IPS indicated 3,761 staff with exposure to prison environments (who are also assumed to be predominantly aged 18-64 years). Collectively, this provides an estimated population size of 12,919.

This population estimate presents an infection rate of 1.2% (n = 149), of which 2.0% of cases were hospitalised (n = 3), with no cases admitted to ICU and no associated deaths. Relative to the general population this infers a crude RR of 0.26 for infection (95% CI 0.22 to 0.30), 0.34 for hospitalisation (95% CI 0.11 to 1.05), 0.57 for ICU admission (95% CI 0.04 to 9.02) and 0.19 for mortality (95% CI 0.01 to 2.95).

People who are homeless and staff in homeless facilities

Considering all ages, documented outbreaks involving residents and staff of settings for people who are homeless were associated with 89 cases up to 27 February 2021.

The CIDR database captures outbreaks associated with congregated homeless facilities including hotels, B&Bs, hostels and shelters. Data for the week of the 25 January 2021 from the Department of Housing indicate that 5,987 homeless adults availed of state-funded private emergency accommodation (n = 3,276), supported temporary accommodation (n = 2,677), or temporary emergency accommodation (n = 121), with the vast majority (n = 5,861) aged 18 to 64 years.[52] Collective counts of the number of staff across homeless, hostel, and addiction settings has been cited at 3,000 individuals; with a growing number of cases among staff of such facilities.[9, 12] For all ages, these population estimates infer an infection rate of 1.0% (n = 89). Of these cases, 6.7% (n = 6) were hospitalised, 3.4% (n = 3) were admitted to ICU and 2.3% (n = 2) died. Relative to the general population, this represents a crude RR of 0.22 for infection (95% CI 0.18 to 0.27), 1.14 for hospitalisation (95% CI 0.53 to 2.48), 5.72 for ICU admission (95% CI 1.88 to 17.43), and 1.24 for mortality (95% CI 0.32 to 4.90). For those aged 18-64 years, an infection rate of 0.8% (n = 73) is presented of which 5.5% (n = 4) of cases were hospitalised, 2.7% (n = 2) were admitted to ICU and 1.4% (n = 1) died. Relative to the general population this represents a crude RR of 0.15 for infection (95% CI 0.12 to 0.19), 1.62 for hospitalisation (95% CI 0.62 to 4.20), 6.24 for ICU admission (95% CI 1.59 to 24.54), and 7.98 for mortality (95% CI 1.14 to 56.09). Of note, when crude RR is assessed as a proportion of the population affected for outcomes of severe disease rather than by case, these findings are not maintained (see Appendix 2).

Additional data from the Dublin Region Homeless Executive highlights 220 additional cases in people who are homeless, which are cited as not currently captured within the CIDR data and awaiting reconciliation.[12] Factoring these cases into the data captured by CIDR maintains the lower risk findings for infection presented above, with an infection rate of 3.4% (n = 309) for this cohort, and a crude RR of 0.77 (95% CI 0.69 to 0.86).

Addiction service users and staff in addiction services

Considering all ages, there were 98 documented cases from outbreaks involving addiction service users up to 27 February 2021, with three (3.1%) associated hospitalisations and one death (1.0%). Amongst those aged 18 to 64 years, there were 82 documented cases associated with outbreaks, with three (3.7%) hospitalised cases and one death (1.2%) in this age bracket.

The majority of these outbreaks were associated with residential settings for people with addictions, including staff of these facilities, with three small outbreaks associated with non-residential settings. Reliable estimates of the potentially exposed population size captured within this case data (both addiction service users and staff of addiction services) could not be validated and hence overall risk of infection and severe disease, relative to the general population, are not presented. There are 47 residential units funded by the HSE with approximately 800 beds for people with drug and alcohol addictions, for which reliable occupancy estimate or staffing levels could not be sourced. Furthermore, there was an estimated 11,449 individuals in receipt of opioid substitute treatment (OST) in Ireland at the end of January 2021.[12]

People working in food processing plants

For individuals who work in food processing plants, data within the CIDR system is categorised for those working in meat processing and those working in food processing excluding meat.

For meat processing, there were 2,796 cases associated with outbreaks up to 27 February 2021. An assumption was made that almost all of the individuals working in these settings are aged 18-64 years, with industry estimates of 16,000 people working in primary processing and 3,600 in secondary processing across the sector, representing an infection rate of 14.3%. Of these cases, 1.6% (n = 44) were hospitalised, 0.5% (n = 13) were admitted to ICU, and there were no associated deaths. Relative to the general population this infers a crude RR of 3.22 for infection (95% CI 3.11 to 3.34), 0.27 for hospitalisation (95% CI 0.20 to 0.36), 0.79 for ICU admission (95% CI 0.46 to 1.36), and 0.01 for mortality (95% CI 0.001 to 0.157). Of note, when crude RR is assessed as a proportion of the population affected for outcomes of severe disease, notably elevated risks for ICU admission are presented for this cohort (see Appendix 2).

Food and beverage processing, excluding meat, was associated with 444 cases across documented outbreaks up to 27 February 2021, of which 2.5% (n = 11) were hospitalised, 0.9% (n = 4) were admitted to ICU, and 0.2% (n = 1) died. The CIDR

criteria for this categorisation includes egg production, confectionary, fruit processing, mushroom processing, fish processing, ready to eat and non-ready to eat production, dairy processing, frozen ready meals, beverage processing, and bakery. Industry estimates of 36,100 individuals working across all food processing excluding meat were provided. An assumption was made that almost all of individuals working in this sector were aged 18-64 years. These estimates represent an infection rate of 1.2% (n = 444). Relative to the general population, this infers a crude RR of 0.28 for infection (95% CI 0.25 to 0.30), 0.42 for hospitalisation (95% CI 0.23 to 0.75), 1.53 for ICU admission (95% CI 0.58 to 4.06) and 0.12 (95% CI 0.02 to 0.88) for mortality. It must be noted that the population size may not accurately align with the case data presented for this cohort, and may therefore underestimate the risk.

Residents and staff of Women's Refuges

Up to 27 February 2021, there were 15 documented cases linked to outbreaks in women's refuges, of which 14 were in individuals aged 18-64 years. There were no associated hospitalisations, ICU admissions, or deaths.

Of note, there is capacity for 140 women across 143 units in 20 facilities in Ireland.[12] However, reliable estimates of occupancy and turnover across the pandemic to date could not be obtained and hence risk relative to the general population, is not presented.

Religious communities

Data provided from the CIDR system highlighted outbreaks associated with residential religious settings including nursing homes, private houses, and residential institutions. Given the premise of this policy question, only those associated with residential institutions have been included. These institutions include convents, homes for religious orders and homes for retired members of religious orders.

Across all ages, there were 155 cases associated with outbreaks in religious institutions. Of these cases, 4.5% (n = 7) were hospitalised, 1.3% (n= 2) were admitted to ICU and 5.8% (n = 9) died. Restricting to those aged 18-64 years, there were 58 documented cases with no associated hospitalisations, ICU admissions or deaths. Reliable estimates of population size for the cohort captured within this case data could not be obtained and hence risk relative to the general population is not presented.

Undocumented migrants

Estimates of rates of infection with COVID-19 and rates of severe disease were not obtained for undocumented migrants in Ireland as such a classification does not exist in the CIDR system. The Migrants Rights Centre Ireland (MRCI) estimate that there are approximately 17,000 undocumented migrants in Ireland currently, while noting the difficulty in obtaining reliable estimates for this population.[53]

Sex workers

Estimates of rates of infection with COVID-19 and rates of severe disease were not obtained for sex workers in Ireland as such a classification does not exist in the CIDR system. The Sex Workers Alliance Ireland estimate that there are approximately 1,000 sex workers in Ireland; however, the organisation noted that reliable estimates for this population are difficult to source.[54]

Seasonal harvest workers

Estimates of rates of infection with COVID-19, rates of severe disease, or reliable population size estimates were not obtained for seasonal harvest workers in Ireland as such a classification does not exist in the CIDR system.

Table 2. Documented cases, hospitalisations, ICU admissions and deaths in potentially relevant groups identified

	Age	Population Estimate	Number of cases (percentage population)	Number hospitalised (percentage cases)	Number ICU (percentage cases)	Number who died (percentage cases)
General population	All ages	4,977,400	221,189 (4.4)	13,031 (5.9)	1,305 (0.6)	3,994 (1.8)
	18-64	3,057,953	165,524 (5.4)	5,604 (3.4)	728 (0.4)	285 (0.2)
Travellers*	All ages	30,987	4021 (13.0)	185 (4.6)	20 (0.5)	10 (0.2)
	18-64	15,844	2,509 (15.8)	125 (5.0)	16 (0.6)	5 (0.2)
Outbreaks involving Roma community	All ages	4,500	214 (4.8)	24 (11.2)	8 (3.7)	5 (2.3)
	18-64	2,295	141 (6.1)	22 (15.6)	8 (5.7)	5 (3.5)
Outbreaks in Direct Provision centres^λ	All ages	8,252	670 (8.1)	19 (2.8)	0 (0.0)	0 (0.0)
	18-64	5,953	557 (9.4)	17 (3.1)	0 (0.0)	0 (0.0)
Outbreaks in prisons+ λ	All ages	12,919	149 (1.2)	3 (2.0)	0 (0.0)	0 (0.0)
Outbreaks in homeless settings λ	All ages	8,987	89 (1.0)	6 (6.7)	3 (3.4)	2 (2.3)
	18-64	8,861	73 (0.8)	4 (5.5)	2 (2.7)	1 (1.4)
Outbreaks addiction service users λ	All ages	Indeterminate¥	98 (not estimated)	3 (3.1)	0 (0.0)	1 (1.0)
	18-64	Indeterminate¥	82 (not estimated)	3 (3.7)	0 (0.0)	1 (1.2)
Outbreaks in meat processing+	All ages	19,600	2,796 (14.3)	44 (1.6)	13 (0.5)	0 (0.0)
Outbreaks in food processing (other) +	All ages	36,100	444 (1.2)	11 (2.5)	4 (0.9)	1 (0.2)
Outbreaks in women's refuges λ	All ages	Indeterminate¥	15 (not estimated)	0 (0.0)	0 (0.0)	0 (0.0)
	18-64	Indeterminate¥	14 (not estimated)	0 (0.0)	0 (0.0)	0 (0.0)
Outbreaks in religious residential institutionsλ	All ages	Indeterminate¥	155 (not estimated)	7 (4.5)	2 (1.3)	9 (5.8)
	18-64	Indeterminate¥	58 (not estimated)	0 (0.0)	0 (0.0)	0 (0.0)

*Notified cases linked to outbreaks reported as affecting Travellers OR whose ethnicity is reported as Irish Traveller;+Assumption that almost all of the individuals aged 18—64 years and all cases included;^ Assumed to include both Direct Provision centres and EROCs; ¥Reliable estimates of population size not found; λMay include staff as well as residents/clients.

Table 3. Crude relative risks compared with general population for groups with sufficient data availability

		Crude RR compared to general population (excluding population of interest)							
Group	**Age**	**RR Infection**	**95% CI**	**RR Hospitalisation**	**95% CI**	**RR ICU admission**	**95% CI**	**RR Mortality**	**95% CI**
Travellers*	All ages	2.96	(2.87 to 3.04)	0.78	(0.68 to 0.90)	0.84	(0.54 to 1.31)	0.14	(0.07 to 0.25)
	18-64	2.96	(2.85 to 3.06)	1.48	(1.25 to 1.76)	1.46	(0.89 to 2.39)	1.16	(0.48 to 2.81)
Outbreaks involving Roma community	All ages	1.07	(0.94 to 1.22)	1.91	(1.31 to 2.78)	6.37	(3.22 to 12.60)	1.29	(0.54 to 3.08)
	18-64	1.14	(0.97 to 1.33)	4.62	(3.15 to 6.79)	13.03	(6.62 to 25.65)	20.95	(8.79 to 49.93)
Outbreaks in Direct Provision centres^λ	All ages	1.83	(1.70 to 1.97)	0.49	(0.31 to 0.75)	0.13	(0.01 to 2.01)	0.04	(0.00 to 0.66)
	18-64	1.73	(1.60 to 1.87)	0.90	(0.56 to 1.44)	0.20	(0.01 to 3.25)	0.52	(0.03 to 8.30)
Outbreaks in prisons+λ	All ages	0.26	(0.22 to 0.30)	0.34	(0.11 to 1.05)	0.57	(0.04 to 9.02)	0.19	(0.01 to 2.95)
Outbreaks in homeless settingsλ	All ages	0.22	(0.18 to 0.27)	1.14	(0.53 to 2.48)	5.72	(1.88 to 17.43)	1.24	(0.32 to 4.90)
	18-64	0.15	(0.12 to 0.19)	1.62	(0.62 to 4.20)	6.24	(1.59 to 24.54)	7.98	(1.14 to 56.09)
Outbreaks meat processing+	All ages	3.22	(3.11 to 3.34)	0.27	(0.20 to 0.36)	0.79	(0.46 to 1.36)	0.01	(0.00 to 0.16)
Outbreaks food processing (other)+	All ages	0.28	(0.25 to 0.30)	0.42	(0.23 to 0.75)	1.53	(0.58 to 4.06)	0.12	(0.02 to 0.88)

*Notified cases linked to outbreaks reported as affecting Travellers OR whose ethnicity is reported as Irish Traveller;+Assumption that majority of individuals aged 18—64 years and all cases included;^ Assumed to include both Direct Provision centres and EROCs; λMay include staff as well as clients

Discussion

This report provides an assessment of potentially at-risk groups relevant to group nine of the provisional vaccine allocation priority list in Ireland; that is, individuals aged 18-64 years living or working in crowded accommodation where self-isolation and social distancing are difficult to maintain. This evidence synthesis considered the groups outlined within the policy question, those identified within Irish health sector documents examining socially excluded groups,[9, 12] and a review of international public health policy and guidance. Collectively, 12 groups were identified as potentially relevant to this policy question: Travellers, Roma community, residents and staff of accommodation centres for international protection applicants and programme refugees, prisoners and prison staff, people who are homeless and staff in homeless facilities, addiction service users and staff in these services, people working in food processing plants, residents and staff of women's refuges, undocumented migrants, sex workers, seasonal harvest workers, and religious communities. Where sufficient data was available, an exploration of Irish data on infection rates with COVID-19 and rates of severe disease (that is, hospitalisation, ICU admission, death) was conducted for each group identified, with estimates of crude risk compared with the general population presented.

Travellers were noted to be at an increased risk of infection, and severe disease in terms of hospitalisation for those aged 18-64 years. Of note, when outcomes of severe disease (that is, hospitalisation, ICU admission, and death) are expressed as a proportion of the Traveller population rather than as a proportion of cases, Travellers were noted to be at an elevated risk of severe disease across all included outcomes. Members of the Roma community were observed to have comparable rates of infection with the general population, but an elevated risk of severe disease across the outcomes assessed. However, the estimates of infection risk are heavily reliant on the estimated population size, for which there is much uncertainty, and the case data included only those linked to outbreaks in this community. Overall, the results presented for the Traveller and Roma communities are considered to underestimate the true prevalence given the reliance on outbreak data, limitations with the use of ethnic identifiers, and the hard to reach nature of these groups. Residents and staff of accommodation centres for international protection applicants and programme refugees presented with an increased risk of infection, but comparable rates of severe disease relative to the general population. A similar trend was observed for those who work in meat processing plants (however, an elevated risk of ICU admission was observed when results were considered as a proportion of the population rather than as a proportion of cases). Those working in food processing excluding meat were observed to have comparably low rates of infection

and severe disease; however, the categorisation presented is broad and may not reflect risk in certain subgroups. Rates of infection were noted to be comparatively low for those living or working in prison settings, and in people who are homeless and staff of services for these individuals. However, these rates are likely reflective of the measures taken to protect these groups rather than the inherent risks for these populations; this is discussed further below specifically for each group. People who are homeless were also noted to be at a potentially elevated risk of severe disease; however, there is considerable uncertainty with this finding due to the low numbers of infections overall.

Cases linked with outbreaks have been documented in settings for people with addictions, women's refuges, and religious institutions; however, reliable estimates of population sizes could not be obtained to enable comparison with the general population. Analyses were limited by an absence of case data for undocumented migrants, sex workers, and seasonal harvest workers as these groups are not classified in the CIDR data.

Travellers

Travellers were observed to be an elevated risk of infection, and severe disease, relative to the general population. It should be considered that the infection rates presented within this report are considered to represent an underestimation of the true prevalence given the reliance of these figures on access to, and attendance for, testing, engagement with contact tracing, as well as self-identification of ethnicity, all of which may be lower when considering the Traveller community.[55] Of note, results of testing sweeps completed by the Safetynet Primary Care mobile team indicate persistently high positivity rates in the Traveller community across the pandemic to date.[56] Despite representing less than 1% of the general population,[46] the results of this analysis indicate that 13% of all Travellers, and 15.8% of those aged 18-64 years have been infected with COVID-19; this compares with 4.4% and 5.4%, respectively, of the general population.

From the 2016 census, the demographics of the Traveller community reflect a pyramid shape, with 3% of the population aged 65 years or older (compared with 13% of the general population) and approximately 46% aged less than 18 years (compared with 25% of the general population).[46] Travellers are recognised as a group vulnerable to social exclusion,[11, 12] who are more likely to experience high burdens of disease and elevated mortality rates compared with the general population,[57] with a widening gap in health seen with increasing age.[58] This population are further considered to have advanced physiological aging beyond their chronological age, with estimates of up to a 20 year deficit in life expectancy, inferring that their position by age strata in vaccine sequencing may warrant

consideration.[12, 59] An October 2020 survey completed by the HSE National Social Inclusion Office indicated that 53% of respondents rated their quality of life as very poor to fair.[55] The inequities in health status seen likely centre on significant disparities in the social determinants of health, particularly those related to lifestyle and housing.[57, 60] The majority of Travellers live in houses with 2019 estimates of Traveller accommodation citing 8,895 families in standard housing, and 933 families sharing accommodation. In 2020, a total of 1,301 families were recorded as living in official halting sites and 475 in unauthorised sites.[61] Despite the majority of the Traveller community living in houses, 56% of the population are noted to live in overcrowded, often multigenerational, accommodation,[58] which is often cited as being substandard to needs and inadequate in terms of facilities and services.[57, 58, 60] Such conditions pose significant challenges to the basic public health measures for COVID-19 such as hand washing, social distancing, self-isolation, and cocooning. Furthermore, Travellers are noted to have lower access to, and engagement with, health services; with barriers such as waiting times, embarrassment, and a lack of trust in the system cited.[57] Travellers are also at risk of experiencing discrimination, with 65% reporting same in a recent EU survey,[62] which may again limit their engagement with services and self-identification as members of this group further compounding disparities.[55] Important cultural norms and traditions for the Traveller population (for example attendance at weddings and funerals) may present challenges during the COVID-19 pandemic in terms of public health guidance. Such cultural and behavioural factors may represent a risk within this community beyond that of living conditions alone.

The HPSC has outlined specific advice for Travellers in the COVID-19 pandemic,[60] and the HSE has utilised community measures to support this group including engagement through Traveller Health Units and Primary Healthcare for Travellers Projects, provision of facilities for cocooning, priority testing, education and awareness raising, and advocacy for reduction of overcrowded accommodation.[12, 55] In a September 2020 survey of Travellers, 57% of service-users highlighted that they were satisfied with the HSE response to the COVID-19 pandemic.[55]

Roma community

The Roma community in Ireland represent a vulnerable and marginalised group.[11, 12] The results of this analysis indicate that this group may have comparable rates of infection, but are more likely to experience severe disease compared with the general population. The rates presented are considered to represent an underestimate of true prevalence due to the reliance on outbreak data, uncertainty with population size estimates, the hard to reach nature of this community as a whole, reliance on self-identification, and barriers to healthcare access, testing, and contact tracing.[63] Results of testing sweeps completed by the Safetynet Primary

Care mobile team indicate persistently high positivity rates in the Roma community across the pandemic to date; with a reluctance to be tested noted for this population.[56] Official statistics of the Roma population in Ireland are difficult to obtain; however estimates of the population are between 4,000 to 5,000 individuals, with 80% having a Romanian origin, and second and third generations now living in the country.[47]

The Roma community typically experience a higher burden of chronic disease and poorer health outcomes overall compared with the general population.[47, 64] Considerable concerns exist for the Roma population in terms of accommodation and access to health services. In a HSE National Social Inclusion Office service-user survey of the Roma community published in December 2020, 64% rated their quality of life as very poor to fair.[63] The majority of the Roma community live in private rented accommodation which is frequently noted to be severely overcrowded and inadequate in terms of services and facilities,[47, 64] with up to 20% of the population noted to live in extreme poverty.[47] Such conditions restrict an individual's ability to comply with basic public health measures to protect against COVID-19. The Roma population are limited in terms of accessing healthcare with almost 50% reporting not having access to a GP or medical card.[47] Problems with access to healthcare are associated with language barriers, lack of structured access to the community, and the habitual resident condition (that is the requirement to demonstrate a close link to Ireland) limiting access to state support.[47, 63] These issues are further compounded by experiences of discrimination, fear of the state and a lack of trust in authorities.[47, 63, 64] Collectively, these issues may limit access to and engagement with testing and tracing strategies for COVID-19.[12] The HPSC has outlined specific guidance for the Roma community in the COVID-19 pandemic,[64] and the HSE has implemented a number of supportive measures such as engagement with advocacy groups to improve reach, provision of facilities for self-isolation and cocooning, priority testing, education and awareness raising, and advocacy for reduction of overcrowded accommodation.[63] Of note, 60% of respondents to a December 2020 Roma service-user survey highlighted that they were satisfied with the HSE response to the COVID-19 pandemic, though overall respondent numbers were low.[63]

Residents and staff of accommodation centres for international protection applicants and programme refugees

Analysis of data relating to residents and staff of accommodation centres for those entering Ireland seeking asylum or as programme refugees indicated an increased rate of infection within these groups relative to the general population, with comparable or potentially lower rates of severe disease. These settings were highlighted for priority vaccination in a number of countries within the review of international guidance. Additionally, results of testing sweeps completed by the

Safetynet Primary Care mobile team indicate considerably high positivity rates in a number of centres, with a noted persistence in case detection and challenges in eradicating the virus once it has entered these settings.[56]

In Ireland, international protection applicants are offered accommodation in direct provision centres (and where necessary emergency accommodation), while programme refugees under the relocation and resettlement programme are offered accommodation in EROCs, with occupancy rates of approximately 7,000 and 300 respectively in centres across Ireland.[11, 12, 65, 66] Such centres represent congregated settings and shared spaces in which adherence to public health measures may be challenging.[12, 67] In particular, direct provision centres have previously been noted by the Oireachtas Joint Committee on Justice and Equality to not be fit for purpose, and to possess inadequate supports and services for residents.[68] A survey on experiences of COVID-19 in Direct Provision conducted by the Irish Refugee Council in August 2020, noted that 50% of respondents highlighted that they were unable to socially distance, while 42% shared a bedroom with a non-family member and 46% shared bathroom facilities.[65] Of note, residents of these centres who are eligible to work may work in areas with higher risk of outbreaks (such as in healthcare, residential care facilities and meat factories) increasing the potential for cross site transmission between at risk groups.[12] Centres for asylum seekers and refugees internationally have experienced considerable outbreaks including in Greece, Germany, Portugal and the US, though the direct transferability of such findings are uncertain given contextual differences in these settings from the Irish perspective.[69] The ECDC further highlight these centres as being at substantial risk of experiencing outbreaks and provide infection prevention and control (IPC) guidance for staff and residents.[70] The staff of such centres should be considered alongside residents for vaccination given their increased risk of infection from occupational exposure and in terms of reducing the likelihood of the virus entering such facilities.[12, 70]

The finding of this report in terms of potentially lower rates of severe disease for this cohort compared with the general population may reflect the typically younger age demographic seen in these centres or the detection of mild and asymptomatic cases through widespread testing.[49] However, it is recognised that there is a higher prevalence of comorbidities, such as chronic diseases and obesity, in this cohort that are associated with an elevated risk of severe disease. Therefore, the low risk of severe disease presented in this report may be attributed to the state supported measures implemented to protect these groups in Ireland such as testing, provision of facilities to reduce crowding and for self-isolation or cocooning where required. However, results of the Irish Refugee Council survey of COVID-19 in Direct Provision centres highlights that residents are impacted by the restrictions in place in these settings overall with feelings of reduced freedom.[65] It should be noted that not all

individuals under the respective programmes opt to take up accommodation in designated centres, though estimates on how many people this encompasses and the types of settings in which they live are not readily available.[65]

People who are homeless and staff in homeless facilities

The results of the analysis indicate that there have been a limited number of cases associated with outbreaks of COVID-19 in people who are homeless and staff of homeless facilities. Overall, the results indicate a potentially lower risk of infection in this group relative to the general population, with a potentially elevated risk of severe disease; however the limited numbers overall means these findings should be interpreted with caution. This group were highlighted extensively within the international review for consideration for priority vaccination.

Approximately 70% of Ireland's homeless population are in the Dublin region and the vast majority are aged under 65 years.[52] The finding of potentially lower rates of infection relative to the general population should not be conflated with this group being a low risk population as a whole, and is likely attributed to the concerted effort and interagency collaborations to protect this population in Ireland including the HSE, Department of Health and funded organisations such as Safetynet primary care.[12, 71, 72] These measures have included the provision of accommodation for self-isolation, shielding and cocooning, additional accommodation to reduce crowding and for those who are rough sleepers, accessible testing and tracing, additional medical support and facilitated access to healthcare services where required.[12, 72] The sustainability of these measures, alongside the impact of such restrictions on the quality of life of service users (for example, the closure of communal facilities such as canteens contributing to social isolation) are important considerations in the face of ongoing requirements. A clear and prominent risk remains for this group due to their living conditions, and working conditions in the case of staff, that would likely be exacerbated in the absence of these measures. The analysis presented may also represent an underestimation of the true prevalence in this cohort given the challenges that exist in identifying and monitoring this group.

Considerable outbreaks have been documented in homeless settings in the US, affecting both staff and residents, and some evidence of transmission across homeless settings.[73-76] A cross-sectional seroprevalence study of 818 homeless people in Paris found a 52% prevalence rate across 14 sites, with overcrowding the strongest predictor of the number of people exposed to SARS-CoV-2 across sites,[77] while a seroprevalence study in Rhode Island noted variable rates across homeless shelters with prevalence ranging from 0% to 35% highlighting the unpredictable nature of transmission in these settings.[78] Furthermore, these groups are likely to

be more vulnerable to severe disease and poorer outcomes overall if infected given they are more likely to have chronic diseases, experience a higher burden of disease, are more likely to have addiction problems, and, in the US, have been reported to have an all-cause mortality 5-10 times higher than the general population of a similar age.[76] In Ireland, people who are homeless have been noted to have poor general health, early onset multimorbidity and advanced physiological aging relative to their chronological age with those over 45 years considered aged.[12, 79, 80]

In terms of the population size for this group, an estimate of 3,000 staff was included; however, this is a considerable proportion of the overall population size and may dilute the risk for the population as a whole if infections in staff are infrequent. The HSE National Social Inclusion office highlights the importance of staff who work with people who are homeless being included in vaccination strategies given the exposure risk they face. They also highlight the transmission risk staff may pose to service users who may experience poor outcomes, and recent notable rates of infection amongst staff with instances of staff being the index case in outbreaks within these settings in Ireland.[14, 56]

Prisoners and prison staff

There have been a limited number of cases relating to outbreaks in prisoners and prison staff in Ireland to date, with the results of this analysis indicating that these populations may present with a lower risk of infection and severe disease compared with the general population. This group were further highlighted as being a priority group for vaccination in a number of countries within the international review.

The enclosed and congregated nature of prisons with the use of shared facilities, make them particularly vulnerable to outbreaks of SARS-CoV-2 should the virus enter a facility.[81] Additionally, although generally representing a younger population, prisoners may be more likely to have poorer health status and could be susceptible to poor outcomes if outbreaks are encountered.[81-83] Given the vulnerability of this population, detailed IPC guidance has been outlined by the WHO.[82] The low levels of outbreaks seen within these settings in Ireland is likely attributed to the extensive measures implemented to protect this population. Clarke et al.[83] details the robust contact tracing programme implemented in Irish prisons in collaboration with public health officials, while the Department of Justice outline the early establishment of a multidisciplinary team focusing on the prevention of the virus entering these facilities, early detection of possible cases, and prevention of spread if detected.[84] Additional restrictive measures have been implemented such as the 14 day quarantine of persons entering a facility, the suspension of physical visits during times of high disease prevalence, cocooning of those aged over 70 and

those who are medically vulnerable, curtailment of training or work activities where necessary, and limitation of movement between areas of a facility.[84] Despite the low levels of infection seen, and the concentrated preventative measures in place, the risk in these settings is evident within the international literature with the potential for high prevalence, rapid spread and prolonged outbreaks documented in prisons in Brazil,[85] Canada,[86] UK,[87] New York and Chicago,[88] and Saloner et al.[89] finding that the likelihood of infection in US federal prisons was five times higher than that of the general population up to June 2020. Of note, the largely closed nature of these settings emphasises the importance of staff as potential vectors for the introduction of the virus into a facility.[82]

Although the measures implemented have had a positive effect on infection rates in Irish prisons, the sustainability of these measures must be considered. Beaudry et al.[90] note that prolonged IPC measures must be weighed against any potential negative impacts such as prisoner mental health. A study of Scottish prisoners by Maycock et al.[91] found that prisoners have felt an increased weight of time in custody during the pandemic with challenges such as poor communication about COVID-19 and restrictive measures, feelings of isolation, and detachment from family and friends.

Addiction service users and staff in addiction services

Data relating to addiction service users and staff of addiction services were limited to documented outbreaks in addiction centres, and three small outbreaks in people with addictions in non-residential settings comprising eight cases in total. Accurate estimates of the population size which these cases reflect could not be obtained; however, the presence of outbreaks in these settings in itself highlights an existing risk and there were cases associated with severe disease in this cohort.

In terms of congregated settings, residential addiction services in Ireland for people with drug or alcohol problems are provided across 47 HSE funded facilities with 800 available beds.[12] People with addictions, in particular those with drug addictions, may present with an elevated risk of poor outcomes from COVID-19 secondary to a weakened immune system and a considerable burden of comorbid conditions such as chronic obstructive pulmonary disease, cardiovascular disease, HIV and Hepatitis C.[11, 12, 92-94] In particular, Europe has a notably aging cohort of opioid users who may be at predisposed risk of infection and severe disease given comorbid conditions, advanced physiological age, and lifestyle factors.[12, 93] This cohort are further associated with a high rate of admission to emergency departments in Ireland,[92] and further may have low levels of health literacy.[95] The settings in which people use drugs may further be associated with risk in terms of crowded or congregated environments, and drug treatment centres may be at risk of

crowding.[93, 94] Behavioural influences, stigmatisation, and fear of persecution may further compound the potential effects of COVID-19 in this cohort.[94] While a proportion of this group will be represented by other groups such as those in prisons, those who are homeless and or those with medical vulnerability, social inclusion groups in Ireland advocate for the inclusion of 11,449 individuals in receipt of OST under group nine of the vaccine allocation groupings given their social vulnerability and risk of severe disease.[11, 12] Data from the Health Research Board National Drug Treatment Reporting System in 2019 highlights that the majority of people undergoing treatment for drug addiction aged 18-64 years live with parents, families and partners, with approximately 10% documented as homeless.[96] Hence, although potentially socially and medically vulnerable, this cohort may not necessarily represent those living or working in crowded conditions.

People working in food processing plants

For individuals working in food processing, the results of this analysis indicated an elevated risk of infection for those working in meat processing plants relative to the general population, alongside a generally lower risk of severe disease (though an elevated risk of ICU admission is observed when expressed as a proportion of the population rather than as a proportion of cases). This cohort were further highlighted within the review of international guidance as a potentially at-risk group due to working conditions. The implementation of serial testing for this group in Ireland may introduce a degree of ascertainment bias for the analysis undertaken in which the relative risk of infection is amplified while the relative risk of severe disease is diluted. For food processing excluding meat, the results of this analysis highlight a generally lower risk of infection and severe disease compared with the general population. However, it must be considered that this categorisation represents a broad spectrum of foods, reflected in the accompanying high estimates of individuals working in this sector, which may not accurately reflect the risk within certain subgroups. That is to say, certain food processing may be an elevated risk compared to others; however, this was not readily discernible from the data.

Specifically for meat processing, the outbreaks noted within these settings in Ireland are not unique and extensive outbreaks have been documented in meat processing plants across Europe and internationally.[97, 98] The reasoning behind the elevated risk within these settings is likely multifactorial and context specific,[97] however environmental factors such as reduced ability to social distance, cold air, limited ventilation and loud work spaces have been noted to potentially facilitate the transmission of the virus.[97-100] Beyond environmental factors, elements such as shared accommodation, low wages, precarious contracts, sharing of transport and the high number of migrant workers within the industry have been highlighted as additional potential contributing factors.[97, 98] The Migrant Rights Centre Ireland

(MRCI) estimates that 59% of individuals working in these settings are migrant workers. However, the organisation disputes the contribution of sharing accommodation to the outbreaks seen with 69% of respondents to a survey completed in the context of COVID-19 indicating that they do not live with co-workers.[101] Furthermore, a report produced by the National Outbreak Control Team, investigating outbreaks in meat processing plants surmised that with moderately high confidence the amplification point for most outbreaks was within the facilities themselves. However, again the complex nature of potential external interactions was highlighted.[100] The finding of potentially low rates of severe disease likely reflects the age demographic of workers within these facilities. However, as previously noted, outbreaks within these facilities do precipitate the potential for cross site transmission with other groups based on living conditions (for example, Direct Provision centres).[12]

Extensive measures have been put in place in an attempt to mitigate the potential for outbreaks in these settings with specific IPC guidance provided by the HPSC and the rollout of serial testing programmes. And while the impact of such measures appears to have had a significant effect in protecting these environments compared with the initial stages of the pandemic, the sustainability of these processes in the context of resource use must be considered.

Residents and staff of Women's Refuges

A number of cases were noted to be associated with outbreaks in women's refuges with no associated instances of severe disease. However, a reliable estimate of occupancy and turnover over the course of the epidemic could not be readily obtained therefore comparison with the general population was not feasible. Consideration of this group for inclusion under group nine of the vaccine rollout has been put forward by the HSE National Social Inclusion Office given the notable social vulnerability of the residents in these settings;[12] citing that while cases in these settings have been limited, single cases are noted to require high levels of support given the vulnerability of the population.[12] There is capacity for 140 women across 143 units in 20 facilities in Ireland and these settings are noted to constitute congregated living conditions placing them at risk of potential outbreaks.[12]

The COVID-19 pandemic has been associated with a notable increase in the demand for services of this nature, and the social vulnerability of residents emphasised.[12, 102] Service users are frequently accompanied by their children and include individuals affected by domestic violence, substance abuse, and alcoholism.[12] In particular, rates of domestic violence against women have seen global increases with the COVID-19 pandemic, attributed to the restrictions in place alongside the social and economic impacts.[103, 104] The degree of support required by this cohort is

reflected in the estimates of staff for such services of approximately 100 individuals who are further highlighted for consideration under this vaccine allocation grouping by the National Social Inclusion office.[12]

Religious communities

Religious communities were highlighted as a potentially at-risk group relevant to this policy question from Italy within the international review of public health guidance and policy. From an Irish perspective, there have been documented cases linked to outbreaks in residential religious settings beyond those associated with nursing homes. This categorisation includes convents, homes for religious orders and homes for retired members of religious orders. Of note, nursing homes and residential care facilities for religious orders will be captured in preceding vaccine allocation groups before group nine. While there were associated cases of severe disease across all ages, when restricted to those aged 18-64 years there were no instances of severe disease documented.

Beyond residential care facilities, this cohort may be at an increased risk of infection due to their congregated living conditions, and evidence of outbreaks in institutions such as convents and monasteries have been documented in the media internationally,[105-107] though no relevant scientific literature was identified.

Undocumented migrants

Estimates of COVID-19 cases and rates of severe disease could not be obtained for undocumented migrants in Ireland as this group is not classified in the CIDR data. The Migrants Rights Centre Ireland (MRCI) estimate that they are approximately 17,000 undocumented migrants in Ireland currently, while noting the significant difficulty in obtaining reliable size estimates for this population.[53]

Undocumented migrants may face particular challenges in the COVID-19 pandemic given their lack of legal status in the country in which they reside.[108] This lack of status impedes ability to engage with public health measures in the COVID-19 pandemic such as access to information and healthcare services, with a fear of identification potentially precluding presentation for testing or care.[108] Additionally, this population may be more likely to live in precarious or congregated living conditions in which the observance of social distance or self-isolation is challenging.[108] In Ireland, during the COVID-19 pandemic a no data sharing agreement is in place to ensure this population can access state support without fear of identification.[109, 110] The Safetynet Primary care team further provide medical support and testing for vulnerable groups such as undocumented migrants.

Sex workers

Estimates of COVID-19 cases and rates of severe disease could not be obtained for sex workers in Ireland. The Sex Workers Alliance Ireland estimate that there are approximately 1,000 sex workers in Ireland; however, the organisation noted that reliable estimates for this population are difficult to source.[54] Sex workers in Ireland constitute a group vulnerable to exclusion, and are considered under group nine of the vaccine allocation list presented by the Drug Policy and Social Inclusion unit of the Department of Health.[11] Sex work is not limited to females and the demographics of sex workers are diverse.[54] The clandestine nature of this activity limits their ability to engage with health and social care services.[111] The vulnerability of this population is compounded by often precarious living conditions, and the potential for addiction problems, mental health issues, poverty and experiences of violence.[111] Fear of stigmatisation and of the authorities may limit this population's engagement with services, and a proportion may also be migrants,[111] with migrant sex workers estimated to comprise the majority of the sex worker population in Western Europe.[112]

Seasonal harvest workers

Seasonal harvest workers were highlighted as a potentially at-risk group relevant to this policy question from Germany within the international review of public health guidance and policy. Estimates of infection rates with COVID-19, rates of severe disease, or reliable population size estimates could not be obtained for seasonal harvest workers in Ireland. A large proportion of these groups are likely to consist of migrant workers,[113] and were highlighted within the review of international public health guidance as they may live in cramped conditions and communal accommodation, share transport, and be employed on precarious contracts. Particularly with regards to transport, continental Europe may reflect scenarios in which workers are travelling long distances together (for example across borders). Tangible evidence of such was not found for the Irish context; however, companies have documented the sharing of accommodation by co-workers in the context of seasonal harvest workers, with emphasis on addressing such factors to ensure adherence to public health measures in the context of the COVID-19 pandemic.[114] The acknowledgement of such living conditions, such as the sharing of bedrooms, may warrant the inclusion of such groups under the context of living conditions which may not facilitate social distancing or self-isolation.

Additional considerations

There are a number of additional considerations that should be taken into account when interpreting the findings of this report, namely: the eligibility of individuals

identified for vaccination in other earlier allocation groupings, the accurate identification of individuals within a number of the groups outlined, the logistics and operationalisation of vaccine rollout for these groups, the extent to which the groups highlighted are mutually exclusive, and the impact of variants of concern.

A proportion of individuals within the identified populations identified in this report may be eligible for vaccination prior to the rollout reaching those aged 18-64 years living or working in crowded conditions.[12] For example, a cohort of individuals within each group may be more susceptible to chronic disease and fall under the criteria of medically vulnerable such as people who are homeless or those with addictions.

The identification of individuals within a number of the groups outlined may be more challenging than the general population, particularly for those who may be marginalised, socially excluded and or have limited interaction with health or social care services. The likely difficultly of attaining sufficient coverage when identifying members of these groups is reflected in the notable uncertainty acknowledged in the estimates of population sizes within this report.

There may be significant challenges in terms of the logistics and operationalisation of a vaccine strategy for a number of the groups identified within the report. For those in settings such as prisons or those working in food processing, a vaccination programme may be linked to their location; however, the identification, reach and implementation of a programme for other groups within this report, particularly those considered to be socially vulnerable, will require a cohesive interagency response. The National Social Inclusion Office has provided a detailed overview of the barriers likely to be encountered and recommendations to overcome these factors.[12] Of note, the use of vaccination strategies, such as ring vaccination, targeting outbreaks in certain vulnerable groups may prove advantageous in terms of access and engagement.[12] Pavee Point has further documented explicit considerations for the Traveller and Roma communities in Ireland.[115] The strategies outlined within these documents provide a structure to promote accessibility, engagement and participation in vaccination programmes for vulnerable groups in Ireland.

The social, behavioural and cultural diversities across groups denotes the need for a nuanced approach dependent on each individual population.[12] A tailored approach for each group identified, particularly for those highlighted as vulnerable, will be required to facilitate engagement, participation and uptake of vaccination. Within these processes, engagement and collaboration with community groups and non-governmental organisations will likely play a crucial role. In service user surveys completed in October 2020 and December 2020, the Traveller and Roma

communities both highlighted their respective project groups (such as Pavee Point) as their primary source of information about COVID-19.[55, 63] Access may further be facilitated for certain hard to reach groups by targeting the health services which they are likely to attend and consideration of opportunistic strategies with flexibility in terms of allocation sequencing may be warranted. Additionally, consideration will need to be given to measures to manage the vaccination process in the context of settings in which there is a high turnover of the population (such as people who are in homeless shelters), or where new individuals enter a facility on a relatively frequent basis (such as prisons or Direct Provision centres).

It should further be considered that many of the groups identified within this report are not mutually exclusive. For example, individuals living in Direct Provision may also work in meat processing plants, a person who is homeless may also have addiction problems, amongst other potential interactions across groups. Such interactions should be considered as they may further compound the risk of infection and the potential for cross site transmission.

Lastly, this analysis did not consider a temporal aspect. The potential impact of the greater transmissibility seen with a number of variants of concern within the third wave (particularly of B.1.1.7),[116] is an important consideration given the congregated nature of the living conditions for a number of the groups identified within this evidence synthesis. Such transmissibility is likely to amplify the outbreaks seen in these settings, and add further challenges to the control of such outbreaks. As noted, a persistence in case detection and outbreaks has been noted by the SafetyNet team for a number of the groups within this report during the third wave.[56] In particular, the potential seeding of cases in the wider community is a concern when considering outbreaks in these groups.

Limitations

The findings of this report should be considered in light of its limitations. Firstly, the risk comparisons presented within the analyses represent crude measures and potentially confounding factors such age and sex have not been accounted for, therefore the risk estimates presented should be interpreted with caution.

The likelihood of bias in case identification should also be considered when interpreting the results. Firstly, with the exception of an ethnic categorisation for Travellers, the summary counts provided only consider cases linked to outbreaks and hence exclude sporadic cases, likely underestimating the risk overall. However, the presence of outbreaks themselves are indicative of disease transmission within a population group, likely due to living or working environments. In a similar vein, the analyses hinge on the appropriate coding of cases and in particular the subjective

reporting of ethnicity in certain groups. As noted, for various reasons, this may be omitted or may not be accurately reported, which again would lead to an underestimation for some groups (for example, approximately 28% of cases do not have an accompanying ethnicity in the CIDR database). Additionally, engagement with testing and tracing processes may be limited for some hard to reach groups therefore the data presented are considered to underestimate the true prevalence; in particular for Travellers and the Roma community.

Conversely, the introduction of serial testing in a number of settings, such as meat processing plants or Direct Provision centres, may introduce a form of ascertainment bias whereby cases are detected that may not be in the general population such as those who are asymptomatic. A potential means to assess for the presence of these biases would be to analyse the positivity rates of tests completed in these populations, or the rate of testing in these populations relative to the general population, which was outside the scope of this report. However, results of testing sweeps completed by the Safetynet Primary care mobile teams indicate considerably high positivity rates in vulnerable groups across the epidemic to date; in particular for Traveller and Roma populations,[56] with reports of ongoing transmission in these communities despite reducing case counts within the general population with the reintroduction of restrictive public health measures.

Challenges also exist with obtaining reliable estimates for population sizes for a number of the identified groups. Conservative estimates have been used, which again may understate the risk of infection overall. Additionally, the lack of mutual exclusivity between groups, as previously noted, may bias estimates; for example, if a case was detected in a worker of a meat processing plant who also lived in a Direct Provision centre, only one location would be categorised within the data.

As with the general population, there is likely a temporal aspect to the risk which has not been accounted for, with times of higher disease incidence in the community likely associated with higher risk in these groups of interest. This may be particularly relevant for settings in which there is a high turnover rate, such as prisons where approximately 75% of sentences are less than one year,[51] and the denominator considered to be exposed does not reflect an equality of exposure risk across individuals. Furthermore, as noted, the potential impact of the more transmissible variants of concern in the third wave is an important consideration which has not been accounted for within this analysis (for example, analysis could be conducted by wave of the epidemic however it would likely be underpowered for a number of groups).

The inclusion of staff in the population size within certain settings is an important factor given their potential risk and also when considering the number to vaccinate.

However, measures to mitigate risk such as personal protective equipment use, are not captured and may dilute the risks presented for the population as a whole. That being said, the presence of cases in staff across the groups identified justifies their inclusion overall alongside reports of the identification of staff as the index case in a number of outbreaks in homeless settings in particular.[56]

As contextualised within the discussion of this report, the findings of a lower risk of infection in certain groups, such as people who are homeless or those in prison settings, should not be conflated with these being low risk populations. The limited number of cases identified within these groups to date likely reflects the vigilance and rigorous effort of the individuals, teams and organisations working to protect these populations. Measures of such mitigating efforts were not included within the analyses. These efforts, although seemingly very effective, are unlikely to be sustainable in the longer term for the service providers or acceptable to the populations with whom they work.

The relative risk of individuals within the groups identified has not been explored, nor has the risk between groups or priority ranking between groups. This is not feasible given the limitations of the data available and such prioritisation would be limited to value judgements on where the greatest impact is likely to be seen considering the individual, the population of interest, and the wider community.

Lastly, it must be considered that particularly for the vulnerable groups included within this report, testing and contact tracing relies on voluntary participation and engagement. Therefore, if access to and engagement with the groups is limited, then the ability to determine a true prevalence is not possible. The noted strain on public health resources, most recently in the context of a high community incidence, poses particular challenges in terms of surveillance for these groups.

Conclusion

This evidence synthesis aimed to explore populations for consideration under group nine of the vaccine allocation list in Ireland; that is, individuals aged 18-64 years living or working in crowded accommodation, where self-isolation and social distancing are difficult to maintain.

National and international sources were examined, with the findings of this evidence synthesis outlining a number of potentially at-risk groups for consideration. Collectively, 12 groups were identified as potentially relevant to this policy question: Travellers, Roma community, residents and staff of accommodation centres for international protection applicants and programme refugees, prisoners and prison

staff, people who are homeless and staff in homeless facilities, addiction service users and staff in these services, people working in food processing plants, residents and staff of women's refuges, undocumented migrants, sex workers, seasonal harvest workers, and religious communities.

The populations identified typically presented an elevated risk of infection and or risk of severe disease relative to the general population, or were noted to have a plausible elevated risk in the absence of supporting data. A number of the groups identified represent potentially vulnerable individuals for which there are important ethical and equity concerns.

Of note, the analyses completed were crude in nature without adjustments for potential confounders such as age and sex; analyses for certain populations were further limited by the absence of case data and or reliable population size estimates, with some results considered to represent underestimates overall considering the hard to reach nature of some groups included. Furthermore, the estimates of risk may be influenced by the degree of testing in the populations included (for example, the use of serial testing).

Additional factors that may impact decision-making when considering these populations in terms of vaccination include the eligibility for vaccination in preceding allocation groupings, the accurate identification of individuals within certain populations, the logistics and operationalisation of vaccine rollout for each of these identified groups, the degree to which the groups highlighted are mutually exclusive, and the potential impact of the more transmissible variants of concern.

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Appendix 1- International public health policy and guidance sources

Table 1.1 List of national organisations reviewed

Countries	Agency	URL	Language	Most recent update*
Austria	Ministry of Social Affairs	https://www.sozialministerium.at/Corona-Schutzimpfung/Corona-Schutzimpfung---Fachinformationen.html	Dutch	23 February 2021
Belgium	Federal Public Service: Health, Food Chain Safety and Environment	https://www.info-coronavirus.be/en/vaccination/	English	Not reported
Czechia	Ministry of the Interior	https://covid.gov.cz/situace/registrace-na-ockovani/jak-funguje-prioritizacni-system	Czech	5 March 2021
Denmark	Danish Health Authority	https://www.sst.dk/en/English/Corona-eng/Vaccination-against-COVID-19/Target-groups	English	9 March 2021
England	Department of Health and Social Care	https://www.gov.uk/government/publications/priority-groups-for-coronavirus-covid-19-vaccination-advice-from-the-jcvi-30-december-2020/joint-committee-on-vaccination-and-immunisation-advice-on-priority-groups-for-covid-19-vaccination-30-december-2020	English	6 January 2021
Finland	Finish Institute of Health and Welfare	https://thl.fi/en/web/infectious-diseases-and-vaccinations/what-s-new/coronavirus-covid-19-latest-updates/transmission-and-protection-coronavirus/vaccines-and-coronavirus/vaccination-order-and-at-risk-groups-for-covid-19	English	5 March 2021
France	National Authority for Health	https://vaccination-info-service.fr/Les-maladies-et-leurs-vaccins/COVID-19	French	4 March 2021
Germany	Robert Koch Institut	https://www.rki.de/DE/Content/Infekt/EpidBull/Archiv/2021/05/Art_01.html	German	29 January 2021
Greece	Ministry of Health	https://emvolio.gov.gr/proteraiopoiisi-emvoliasmoy-kata-tis-covid-19	Greek	19 February 2021

Countries	Agency	URL	Language	Most recent update*
Hungary	National Centre for Public Health	https://www.nnk.gov.hu/index.php/koronavirus-tajekoztato/932-a-covid-19-vedooltasra-jelentkezesi-hely-az-egeszsegugyi-es-egeszsegugyben-dolgozok-szamara	Hungarian	25 January 2021
Italy	Ministry of Health	http://www.salute.gov.it/portale/documentazione/p6_2_2_1.jsp?lingua=italiano&id=3014	Italian	10 February 2021
Malta	Ministry of Health	https://deputyprimeminister.gov.mt/en/health-promotion/covid-19/Pages/vaccines.aspx	English	3 March 2021
Netherlands	Ministry of Health, Welfare and Sport	https://www.rijksoverheid.nl/onderwerpen/coronavirus-vaccinatie/volgorde-van-vaccinatie-tegen-het-coronavirus	Dutch	11 March 2021
Northern Ireland	Department of Health	https://www.health-ni.gov.uk/publications/covid-19-vaccination-programme-phased-plan	English	12 January 2021
Norway	Norway Institute of Public Health	https://www.fhi.no/en/id/vaccines/coronavirus-immunisation-programme/who-will-get-coronavirus-vaccine-first/	English	12 March 2021
Poland	Ministry of Health	https://www.gov.pl/web/szczepimysie/narodowy-program-szczepien-przeciw-covid-19	Polish	December 2020 (no further information)
Portugal	Ministry of Health	https://covid19.min-saude.pt/vacinacao/	Portuguese	3 December 2020
Scotland	Department of Health and Social Care	https://www.gov.scot/publications/foi-202100144309/	English	8 March 2021
Slovakia	Ministry of Health	https://www.health.gov.sk/Clanok?Hlavna-sprava-COVID-19	Slovak	8 March 2021
Spain	Ministry of Health	https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov/vacunaCovid19.htm	Spanish	26 February 2021
Sweden	Public Health Agency	https://www.folkhalsomyndigheten.se/smittskydd-beredskap/utbrott/aktuella-utbrott/covid-	Swedish	16 February 2021

Countries	Agency	URL	Language	Most recent update*
		19/vaccination-mot-covid-19/rekommendationer-for-vaccination-mot-covid-19/		
Switzerland	Federal Office of Public Health	https://www.bag.admin.ch/bag/en/home/krankheiten/ausbrueche-epidemien-pandemien/aktuelle-ausbrueche-epidemien/novel-cov/impfen.html	German	12 March 2021
Wales	Department of Health and Social Care	https://gov.wales/vaccine-coronavirus	English	10 March 2021

* Refers to the national strategy document or applicable webpage where available.
Note: Non-English documents were translated using Google Translate and may be subject to error.

Table 1.2 List of non-European and international organisations reviewed

Organisation	Webpage/report title	URL	Language	Most recent update*
ECDC	COVID-19 vaccination	https://www.ecdc.europa.eu/en/covid-19/prevention-and-control/vaccines		17 February 2021
European Commission	Preparedness for COVID-19 vaccination strategies and vaccine deployment	https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1903	English	15 October 2020
WHO	WHO SAGE Roadmap For Prioritizing Uses Of COVID-19 Vaccines In The Context Of Limited Supply	https://apps.who.int/iris/handle/10665/334299 https://www.who.int/publications/m/item/who-sage-roadmap-for-prioritizing-uses-of-covid-19-vaccines-in-the-context-of-limited-supply	English	13 November 2020
US CDC	COVID-19 Vaccine Rollout Recommendations How CDC Is Making COVID-19 Vaccine Recommendations	https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations-process.html https://www.cdc.gov/coronavirus/2019-ncov/vaccines/recommendations.html	English	19 February 2021

Key: ECDC – European Centre for Disease Prevention and Control; WHO – World Health Organization.
* Refers to the national strategy document or applicable webpage where available

Appendix 2- Crude RR for severe disease by proportion of population affected

Table 2.1 Crude RR for outcomes of severe disease by proportion of population affected

		Crude RR compared to general population (excluding population of interest)					
Group	**Age**	**RR Hospitalisation**	**95% CI**	**RR ICU admission**	**95% CI**	**RR Mortality**	**95% CI**
Travellers*	All ages	2.30	(1.99 to 2.66)	2.48	(1.60 to 3.86)	0.40	(0.22 to 0.75)
	18-64	4.38	(3.67 to 5.23)	4.31	(2.63 to 7.08)	3.43	(1.42 to 8.30)
Outbreaks involving Roma community	All ages	2.04	(1.37 to 3.04)	6.82	(3.40 to 13.65)	1.39	(0.58 to 3.33)
	18-64	5.25	(3.46 to 7.96)	14.79	(7.38 to 29.66)	23.78	(9.83 to 57.52)
Outbreaks in Direct Provision centres^λ	All ages	0.88	(0.56 to 1.38)	0.23	(0.01 to 3.69)	0.08	(0.00 to 1.21)
	18-64	1.56	(0.97 to 2.51)	0.35	(0.02 to 5.63)	0.90	(0.06 to 14.39)
Outbreaks in prisons+λ	All ages	0.09	(0.03 to 0.27)	0.15	(0.01 to 2.35)	0.05	(0.00 to 0.77)
Outbreaks in homeless settingsλ	All ages	0.25	(0.11 to 0.57)	1.27	(0.41 to 3.95)	0.28	(0.07 to 1.11)
	18-64	0.25	(0.09 to 0.65)	0.95	(0.24 to 3.80)	1.21	(0.17 to 8.63)
Outbreaks meat processing+	All ages	0.86	(0.64 to 1.15)	2.55	(1.47 to 4.39)	0.03	(0.00 to 0.51)
Outbreaks food processing (other)+	All ages	0.12	(0.06 to 0.21)	0.42	(0.16 to 1.12)	0.03	(0.00 to 0.24)

*Notified cases linked to outbreaks reported as affecting Travellers OR whose ethnicity is reported as Irish Traveller;+Assumption that majority of individuals aged 18—64 years and all cases included;^ Assumed to include both Direct Provision centres and EROCs; λMay include staff as well as clients.

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