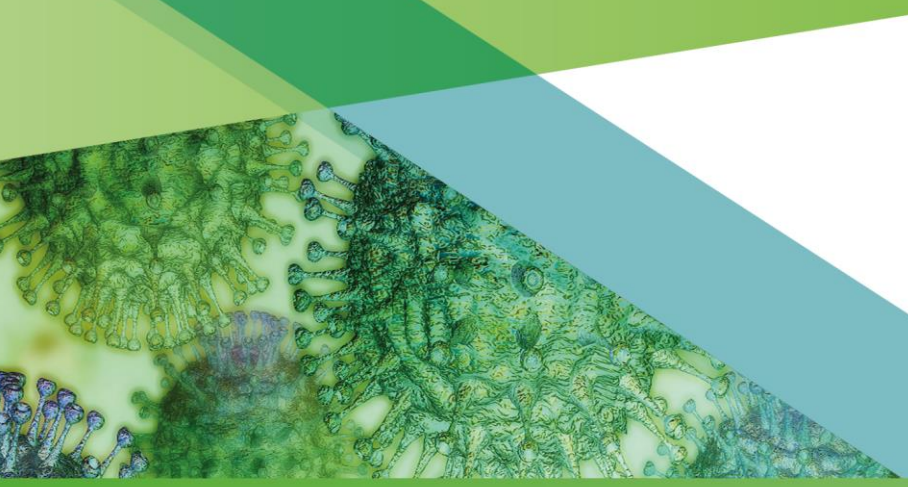


COVID-19 clusters and outbreaks in occupational settings in the EU/EEA and the UK

11 August 2020

Key messages

- Outbreaks and clusters of COVID-19 in a variety of occupational settings have been reported since the start of the pandemic in the European Union, the European Economic Area (EU/EEA) and the United Kingdom (UK). Fifteen EU/EEA countries and the UK reported 1 376 clusters of COVID-19 in occupational settings which occurred between March and early July 2020.
- Workers in occupations which bring them in close physical proximity to other people (co-workers, patients, customers, etc.), particularly when working in indoor settings or with shared transport or accommodation, are more exposed to and at higher risk of COVID-19 in the absence of mitigation measures.
- The majority of occupational COVID-19 clusters reported were from the health sector, however testing of healthcare workers has been prioritised in all EU/EEA countries and the UK. Large numbers of clusters were also reported from the food packaging and processing sectors, in factories and manufacturing, and in office settings. Fewer clusters were reported from the mining sector, however some of these clusters have been large.
- Occupations are commonly linked to socio-economic status which can also affect the individual's risk of COVID-19. Moreover, workers in many essential sectors cannot work from home, which may explain why certain occupations have been shown to have a higher risk of COVID-19 infection and mortality than others.
- Increased focus on testing for COVID-19 in workplace settings, combined with robust polices on physical distancing, hygiene and cleaning, appropriate use of personal protective equipment (PPE) where necessary and hand hygiene, particularly in closed settings and situations where workers have extended contact or share transportation and accommodation, will help prevent further COVID-19 outbreaks.
- Robust surveillance and contact tracing are essential, as are clear protocols on how to address outbreaks when they are detected.
- Within the EU there is a body of occupational safety and health legislation in place, including legislation on the protection of workers from biological agents at work. This legislation sets out technical and organisational measures to be implemented by employers at work places following a workplace risk assessment. Specific guidance is available at EU and national level on how to protect workers and this includes the sectors and occupations where clusters have occurred.
- Collaboration between public health and occupational health and safety agencies at local and national level will help with communication and mitigation of the spread of COVID-19 in occupational settings and communities in the EU/EEA and the UK.

Suggested citation: COVID-19 clusters and outbreaks in occupational settings in the EU/EEA and the UK. Stockholm: ECDC; 2020.

Scope of this document

The aim of this document is to describe COVID-19 clusters and outbreaks in the EU/EEA and the UK linked to occupational settings, including healthcare and non-healthcare settings, and to identify possible factors contributing to transmission in these settings.

Outbreaks or clusters in leisure settings (e.g. households, beaches, parties) or related to mass gatherings and social events (e.g. choir practice, church visits or funerals) are outside of the scope of this document. This report does not address all occupational groups, but takes a broad approach to describing COVID-19 clusters reported by EU/EEA countries and the UK to the European Centre for Disease Prevention and Control (ECDC) and information on relevant COVID-19 clusters gathered by ECDC's Epidemic Intelligence (see Methods chapter).

This document does not aim to provide guidance or recommendations on occupational health and safety measures for particular professions in relation to COVID-19 infection control, as this does not fall within ECDC's mandate. The European Agency for Safety and Health at Work (EU-OSHA) has published guidance specifically addressing issues related to workplaces during the COVID-19 pandemic [1,2], which also references national and international occupational safety and health guidance for a variety of sectors and occupations.

Target audience

The target audience for this report are public health authorities in the EU/EEA countries and the UK.

Background

Multiple outbreaks of COVID-19 have been observed in several occupational settings within and beyond the EU/EEA and the UK, including slaughterhouses, meat processing plants, mines and building sites [3-5]. If not prevented or quickly identified and controlled, local outbreaks in specific occupational settings may contribute to a local resurgence of COVID-19 cases [6].

The absence of an effective treatment or vaccine, combined with an exponential growth in infections, has led many EU/EEA countries to implement non-pharmaceutical interventions, such as 'stay-at-home' policies, alongside other community and physical distancing measures, including the closure of many work places and public spaces. However, in the EU, it is estimated that only 35% of jobs can be performed at home, potentially exposing individuals in some occupations to COVID-19 more than others [7].

Individuals working in occupations with tasks that require close interpersonal interaction, such as assisting and caring for others or working directly with the public or clients, are considered to be at greater risk of acquiring COVID-19. Furthermore, some of these jobs are considered essential and the services provided need to be ensured even when 'stay at home' policies are in place (e.g. healthcare services, food retail, pharmacies, transport, postal services, construction, agriculture, etc.).

Efforts have been made to determine what occupations are at increased risk of COVID-19 using modelling and mapping of physical proximity to others, as well as frequency of exposure to COVID-19 [8,9]. Evaluating the occurrence of clusters reported from each given occupational sector, as well as the factors potentially associated with transmission, can provide further information on risk of transmission in that particular sector. This information can be used to inform and strengthen public and occupational health and safety protocols for sectors where the risk of COVID-19 exposure is high.

Methods

This report details the occurrence of COVID-19 clusters in different occupational settings in the EU/EEA and the UK and the associated factors based on information from three sources:

Country-based data collection

On 5 July 2020, ECDC distributed a data collection sheet to the 30 EU/EEA Member States and the UK to gather information on COVID-19 clusters/outbreaks in occupational settings that had occurred during the course of the pandemic. The following information on clusters was collected: country; region; occupational setting; date of cluster identification; whether the setting was predominantly indoor or outdoor; number of confirmed cases; deaths; whether indications of onward transmission to the wider community exist, and probable contributing factors. In addition, countries were able to report aggregated data on clusters where more than five clusters had been observed in a particular occupational setting. Aggregated information included the occupational setting, number of clusters observed, number of confirmed cases and deaths, as well as probable contributing factors. For the analysis of this report, a cluster was defined as a minimum of two confirmed cases.

Epidemic intelligence activities

ECDC's Epidemic Intelligence collects and collates daily information from a variety of media and national sources, which is then validated and analysed. Relevant occupational clusters/outbreaks of COVID-19 identified between 1 May and 23 July 2020 were retrieved and included in the analysis. In addition, some ad-hoc searches were done to capture announcements of occupational-related outbreaks in the news and media.

Literature review

A rapid literature review was conducted to identify additional clusters or outbreaks that may have occurred in the occupational settings identified in the country-based data collection and in the epidemic intelligence activities. The main focus of the literature review was to identify possible factors contributing to these clusters/outbreaks. The searches were performed on 20 July 2020, in a COVID-19 EndNote reference library database which is maintained by the ECDC Library. The EndNote library database is designed to retrieve all new publications related to COVD-19 in PubMed from the start of the epidemic and it is updated daily. It is complemented by the monitoring of journal websites, COVID-19 specific publishers' portals for new publications and preprint portals for upcoming publications. Natural vocabulary (i.e. keywords) was used in title and abstract field search combination and truncation was applied. Keywords included descriptive terms for each of the occupational groups/sectors identified in the country-based data collection.

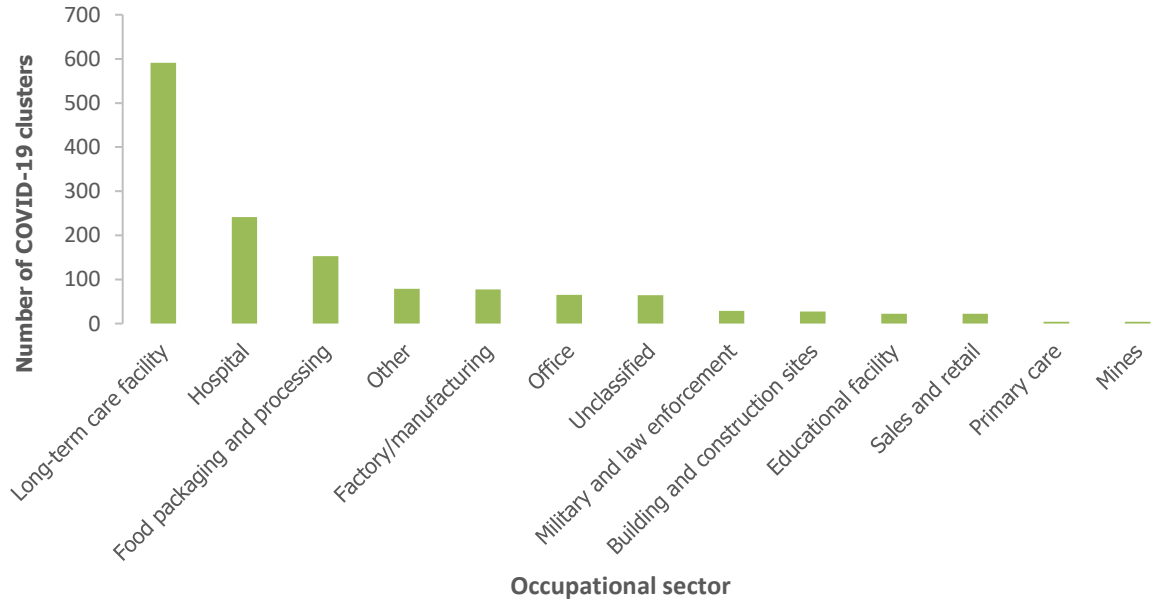
Results

Country-based data collection

Seventeen countries[1] had responded to the ECDC data collection survey by 24 July 2020. Of these countries, 13 reported data on specific clusters in occupational settings, three provided aggregated information on confirmed COVID-19 cases that occurred among different occupational settings or groups and one country reported not having had any outbreaks in these settings (Liechtenstein). A total of 1 377 clusters in occupational settings were reported, including 18 198 COVID-19 cases (Table 1).

The occupational settings where clusters were observed varied widely and included health and social care services, offices, construction sites, military and law enforcement institutions, industry, educational facilities and multiple other settings. Most clusters were reported in health and social care work settings, followed by food processing-related occupational settings, mines, and factories/manufacturing settings (Figure 1).

Figure 1. Number of reported clusters of COVID-19 in different occupational settings March–July 2020 (based on individual and aggregate data reported by 13 EU/EEA countries and the UK) (n=1 266)



Note: Clusters in 'other' occupational settings (n=79 clusters) and unclassified settings (n=63) are not included.

The date of the identification of the cluster was available for 264 clusters reported by nine countries (Cyprus, Czechia, Finland, France, Latvia, Lithuania, Malta, the Netherlands and Romania), however 49 of these clusters occurred in July 2020, and were excluded from analysis given that countries reported the data mid-month. The

[1] Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France (for regions Provence-Alpes-Côte d'Azur, Corse and Occitanie), Ireland, Liechtenstein, Lithuania, Latvia, Malta, Netherlands, Romania, Spain, Sweden, United Kingdom (England)

largest number of clusters (n=59) were registered in May with a decrease in the number of clusters reported in June compared to earlier months.

Information was available for 447 clusters on whether the occupational setting was indoor or outdoor. Of these clusters 427 (95.5%) occurred in settings that were described to be fully or predominantly indoor, while 20 clusters were reported in predominantly or fully outdoor occupational settings.

Table 1 provides an overview of the number of reported clusters, number of reporting countries, total number of reported cases and deaths, and minimum/maximum number of cases within the clusters in different occupational settings.

Table 1. Summary overview of reported clusters of COVID-19 in different occupational settings, EU/EEA, March-July 2020

Setting		Number of clusters reported	Total number of cases reported	Number of reported deaths	Number of reporting countries	Number of cases within a cluster (min–max)[1]
Health and social care	Hospitals	241	3 298	82	10	2–571
	Long-term care facilities	591	5 670	46	8	2–342
	Primary care facilities	4	14	0	3	2–5
Food packaging and processing		153	3 856	4	14	2–117
Factory/manufacturing		77	1 032	0	4	2–96
Building and construction sites		27	402	0	9	2–69
Office		65	410	4	10	2–23
Educational facilities		22	143	1	5	2–35
Sales and retail		22	188	6	0	2–30
Military and law enforcement		29	269	0	8	2–50
Mines		4	1 538	1	1	4–704
Other occupational settings[2]		79	696	4	11	3–35
Unclassified		63	682	18	4	2–52
Total		**1 376**	**18 170**	**166**	**16**	**2–704**

[1] *Excludes aggregated data reported by three countries.*

[2] *Includes various settings such as packaging/mail distribution, transportation, bars and restaurants, churches and monasteries, fitness clubs and spas.*

Occupational sectors with reported COVID-19 clusters and outbreaks

The COVID-19 clusters reported by EU/EEA countries and the UK fall into several broad occupational categories and are outlined below. Each category presents information on the clusters reported through the country-based data collection, or identified through the media or literature. Possible factors contributing to the outbreak in this occupational sector gathered from the country-data collection, as well as from epidemic intelligence reports and the literature review are also presented for each occupational sector.

Health and social care

The majority of clusters and outbreaks reported by countries were from the health and social care setting. Clusters in these settings were reported by ten countries (Bulgaria, Cyprus, Czechia, France, Ireland, Latvia, Lithuania, Malta, Romania and Spain). Specific settings included acute-care hospitals, ambulatory clinics and emergency services as well as long-term care facilities (LTCFs) (e.g. homes for the elderly, rehabilitation clinics, residences for people with special needs and mental health facilities).

More than two hundred (n=241) individual clusters in acute care hospitals were reported by 10 countries (Bulgaria, Cyprus, Czechia, France, Ireland, Latvia, Lithuania, Malta, Romania and Spain). Sizes of clusters in acute-care hospitals varied from two confirmed cases to 571 (median=14). Among these clusters, a total of 3 298 healthcare professionals were reported to have been affected, including 82 deaths.

In LTCFs, 591 clusters were reported by nine countries (Bulgaria, Czechia, France, Ireland, Latvia, Lithuania, Malta, Romania and Spain). Sizes of clusters in LTCF ranged from two to 704 cases. One country (Spain) specified that affected individuals in LTCFs were among residents, and not healthcare professionals. In addition, Denmark reported that small clusters of healthcare professionals had been recorded in homes for the elderly. Countries did not consistently report whether cases related to healthcare professionals and staff in LTCFs and social-care institutions or their residents.

A small number of individual clusters in primary care settings (n=4) were reported by three countries (Czechia, Latvia and Lithuania), involving 14 healthcare professionals. It is important to note that during the spring of 2020 almost all the EU/EEA countries implemented strategies to discourage patients with COVID-19-compatible symptoms from presenting to primary healthcare providers, directing them instead to designated healthcare facilities.

In all types of healthcare facility, where information on the sex of the affected individuals was provided by the reporting countries, the majority of cases were reported to be female and the vast majority of healthcare professionals were working in an indoor environment.

Recent media reports, collated through ECDC epidemic intelligence activities, refer to an outbreak in the surgical department of a large tertiary hospital in Lisbon, Portugal, which necessitated the re-allocation of patients to other healthcare facilities [10].

Possible factors contributing to COVID-19 clusters in health and social care settings

Healthcare workers are known to be at greater risk of occupational exposure to biological agents, particularly infectious pathogens such as TB, influenza, SARS, measles etc. [11,12]. A number of factors contributing to the identified clusters and outbreaks of COVID-19 among health professionals were reported by countries including:

- close/direct contact with cases;
- insufficient or incorrect use of protective personal equipment (PPE);
- working in confined indoor spaces (e.g. radiology departments);
- shared canteen space;
- shared staff accommodation, transport and/or social activities.

Office settings

Sixty-five clusters of COVID-19 in various office settings were reported by 10 countries (Bulgaria, Cyprus, Czechia, France, Ireland, Latvia, Lithuania, Malta, Romania and Spain). Specific settings included banks, company headquarters, government buildings and call centres. Croatia reported only aggregate data, with offices accounting for 10.5% of the confirmed COVID-19 cases in the country.

Sizes of clusters reported by the 10 countries varied from two confirmed cases to 23 (median: seven cases). A total of 410 people were affected, including four deaths. In eight of the clusters, there was a link to onward community transmission.

Possible factors contributing to COVID-19 clusters in office settings

Possible factors contributing to the identified clusters and outbreaks in office settings reported by countries include:

- sharing the same office space;
- sharing the same canteen space;
- meetings with multiple persons in the same room;
- staff socialising together in the community.

Participating in meetings and sharing the same office space has been reported in literature as a risk factor for contracting COVID-19 [13,14].

Educational facilities

Five countries (Bulgaria, Czechia, France, Latvia, and Romania) reported 22 clusters in educational facilities, in the form of 143 confirmed cases and one death. Countries did not consistently report whether the confirmed cases were in teachers/staff or in children/students, making it difficult to understand the occupational risk for the teachers/staff. The cluster sizes in kindergartens were smaller than in schools with older children: the number of cases in these clusters ranged from two to six and two to 35, respectively. The reported rates of individuals infected ranged from 7–31% in the outbreaks reported in kindergartens. In one secondary school cluster, three secondary cases in two families were identified.

There is limited evidence in the peer-reviewed literature documenting transmission between adults within the school setting. In Sweden, where schools for children under 16 years remained open during the spring of 2020, the Public Health Authority analysed occupational groups within the school and concluded that teachers in Sweden were not at greater risk of COVID-19 than the general public (relative risk: preschool teachers (0.7), compulsory school teachers (1.1), senior high school teachers (0.7), recreation staff (0.8), student assistants (1.1), other educators (1.0), and childcare providers (1.0) [15]. Swedish schools recommended social distancing, that those with mild symptoms stayed at home, that no mass gatherings were held within the school setting, and that hand hygiene should be adhered to while in the school setting.

Possible factors contributing to COVID-19 clusters in educational facilities

Shared spaces were identified by one country as a possible factor contributing towards transmission in educational facilities. One country identified shared accommodation during a work-related meeting as a possible factor. Further description of COVID-19 transmission dynamics and possible factors relating to transmission school settings in the EU/EEA is provided in a dedicated ECDC technical report on this topic [16].

Food production, including agriculture

Several outbreaks or clusters in the food production sector were reported by countries responding to the survey and in the literature. In this setting, two main categories were identified: i) food processing (e.g. meat and fish processing and packaging; dairy production; bread and pastry production) indoors, and ii) agricultural food production (e.g. fruit picking and other mainly outdoor processes).

Thirteen countries reported a total of 153 clusters and 3 820 cases. In addition, one country reported 36 cases without specifying the number of outbreaks, bringing the total number of cases to 3 856. The countries with the highest number of cases in this sector were Ireland (1 154), Spain (1 016), the UK (450), the Netherlands (406), France (306), and Romania (275). Of the 153 clusters, 114 were in the food processing category (2 529 cases), while 26 were linked to agriculture, where a total of 1 016 cases were reported. Thirteen outbreaks were not classified.

Information on clusters/outbreaks of COVID-19 in the food packaging and processing sector were also frequently reported in the media and identified by ECDC's Epidemic Intelligence unit and in the literature. Many of these were in slaughterhouses or meat processing plants, including reports from Belgium, Denmark, France, Germany, Ireland, Italy, Norway, Poland, Spain, the Netherlands, and the UK [17].

In June 2020, an outbreak in a slaughterhouse with 1 500 cases detected in Germany led the German regional public health authorities to quarantine 7 000 employees and implement local lock-down measures [18].

In July 2020, media reported several outbreaks linked to seasonal migrant farm workers employed in fruit picking in Spain [19]. In the region of Catalonia, 12 outbreaks leading to 900 cases were reported, while in the region of Murcia an outbreak with 38 cases was reported [19]. In addition, in the region of Valencia one outbreak was reported in a meat packing company [19,20].

At the beginning of July in Italy, six outbreaks and 68 cases were all detected in the same province in five slaughterhouses and at a plant producing sausages. The majority of cases were asymptomatic or with mild symptoms [21]. In Austria, four outbreaks and 39 cases in slaughterhouses and one outbreak and three cases in a sausage-producing plant were reported [22-24]. In Poland, an outbreak with 12 COVID-19 cases was detected in a pastry production plant [25].

In an analysis by the Italian National Institute for Insurance against Accidents at Work (INAIL), looking at injuries and deaths from COVID-19 reported until 15 June 2020 in Italy, the agricultural sector registered 1.1% of the total COVID-19 reported deaths in the country [26].

A study in Sweden looked at cases of COVID-19 diagnosed in different occupations among people aged 25–65 years, during the period 13 March – 27 May 2020. The study found that people in several occupations had a higher risk of being diagnosed with COVID-19; pizza bakers were the group with the second highest relative risk (RR 4.5, 95% CI 3.2-6.3) [15].

Possible factors contributing to COVID-19 clusters in food production settings, including agriculture

The possible risk factors identified by the reporting countries and epidemic intelligence data include:

- working in confined or close spaces and lack of social distancing;
- workers (mainly referring to migrant workers) sharing accommodation sometimes described as being overcrowded and with poor hygiene conditions;
- shared transport;
- employing seasonal workers from areas with a higher incidence of COVID-19 [20].

Factory/manufacturing sector

Clusters in various factory and/or manufacturing settings have been reported by the following countries: Bulgaria, Latvia, Lithuania, Romania and Spain. Specific settings included factories producing car parts, toys, garments and chemicals, as well as power plants.

Fifty-eight individual clusters in a factory or manufacturing setting were reported, with clusters of between two and 96 confirmed cases (median: seven cases). A total of 661 persons were affected, including four deaths. In addition, Bulgaria reported 19 clusters in various factories in aggregate form, involving 371 persons.

An analysis by the UK Office of National Statistics (ONS) of deaths from COVID-19 between 9 March and 25 May 2020 in England and Wales among male factory workers aged 20 to 64 years involved in the cleaning of industrial machines and the packing of goods, found that this category of workers had statistically significantly higher mortality rates from COVID-19 than the general population (73.3 deaths vs 39.7 per 100 000 men) [27].

Possible factors contributing to COVID-19 clusters in factories

Factors contributing to the identified clusters and outbreaks in office settings by the reporting countries include:

- sharing the same production line or working space;
- sharing the same canteen space;
- sharing the same dressing rooms;
- shared transport.

Building and construction sites

Although no COVID-19 outbreaks have been reported in the literature in relation to building and construction sites, several countries have reported small and medium-sized outbreaks in these settings. Nine countries (Bulgaria, Czechia, Finland, Ireland, Latvia, Lithuania, Malta, Romania and Spain) reported between one and eight outbreaks or clusters, with a total of 27 cases, occurring both indoors and outdoors. The total number of COVID-19 cases in each outbreak ranged from two to 69, with an overall total of 402 cases. No deaths were associated with these clusters.

Possible factors contributing to COVID-19 clusters in building and construction sites

The possible factors identified as contributing to the identified clusters and outbreaks in these settings were:

- shared and overcrowded accommodation;
- lack of facilities to wash hands;
- language challenges among migrant workers;
- shared transport.

Sales and retail

Seven countries (Cyprus, France, Latvia, Lithuania, Ireland, Romania and the UK) reported a total of 18 clusters of COVID-19 linked to sales and retail, with 188 confirmed cases and no deaths. Cluster sizes varied from two to 30 cases (median= 3). Where specified, settings included pastry shops/bakeries (n=5), shopping centres (n=4), food retailers (n=3), pharmacies (n=3), supermarkets (n=2), and a travel retail shop (n=1). There were also indications of an onward transmission to the wider community in one cluster in a supermarket. It is worth noting that this cluster was the largest of the reported clusters.

Not many studies have been published on this occupational setting, but some cases have been identified in this group of workers [27,28]. A study from England and Wales described sales and retail assistants as having higher mortality rates of COVID-19 than in the general population [27]. However, according to the report, the analysis does not prove conclusively that the observed rates of death involving COVID-19 were caused by differences in occupational exposure.

Possible factors contributing to COVID-19 clusters in sales/retail settings

Factors reported by countries as possibly contributing to these clusters included:

- working with clients (in a pharmacy);
- working on the same production/sales line;
- shared dressing/rest rooms;
- staff meetings;
- sharing the same office space;
- sharing the same transport.

Military and law enforcement, including prisons and security guards

A total of 29 outbreaks in military and law enforcement occupations were reported by seven countries (Bulgaria, Cyprus, France, Ireland, Latvia, Lithuania, Romania), accounting for 221 cases. Additionally, one country (Croatia) reported only the number of cases (48), bringing the total to 269. Of the 29 clusters, seven occurred in prisons. The majority of outbreaks occurred indoors. There were no reported deaths associated with these clusters.

In an analysis by the UK ONS looking at deaths from COVID-19 during the period 9 March to 25 May 2020 in England and Wales among males aged 20 to 64 years, male security guards and those in related occupations were found to have statistically significantly higher mortality rates from COVID-19 than the general male population (74.0 deaths per 100 000 population) [27].

In an analysis by the Italian National Institute for Insurance against Accidents at Work (INAIL) looking at injuries and deaths from COVID-19 declared by 15 June 2020 in Italy, rental and support services, including security guards, registered 4.3% of the total COVID-19 cases and security workers represented 2.8% of COVID-19 reported deaths [26].

Possible factors contributing to COVID-19 clusters in military and law enforcement settings

The possible contributing factors reported by countries for these settings included:

- working in close proximity where physical distancing is challenging;
- shared canteen;
- shared facilities and accommodation;
- staff meetings and training.

Mines

Mining sites around the world have been affected by outbreaks of COVID-19 [4]. In the country-based data collected, four clusters totalling 1 538 cases were reported by Czechia among people working in mines, ranging from four cases to over 700. One death was reported as being linked to one of these clusters. No information on whether these outbreaks led to wider community transmission was available. In Sweden, COVID-19 cases have been reported in relation to mines, although these cases were linked to repair work (rather than mining) undertaken by a crew of workers who had been flown to the mine site. It was not possible to determine whether the transmission of SARS-CoV-2 among the affected individuals actually occurred inside the mine, or outside (e.g. in connection with a visit to a restaurant.)

Several media sources reported that in Poland more than ten mine sites were closed after COVID-19 outbreaks in early June 2020 [29,30]. On 19 July 2020, there were approximately 6 600 cases of COVID-19 in mines in three companies in the Silesian Voivodeship [31], while on 21 July 2020 media reported that 6 636 employees from three mining companies controlled by the Polish Treasury had been infected with COVID-19 since the beginning of the epidemic [32].

Possible factors contributing to COVID-19 clusters in mining settings

In the ECDC survey, no specific factors in mining settings were reported by countries as contributing to the COVID-19 clusters. One potential contributing factor discussed in personal communication with countries was the close contact of workers (e.g. while using the mine lift and in shared bathroom facilities.)

Other occupational settings

The country-based data collection provided information on 79 clusters in various other occupational settings comprising a total of 696 confirmed COVID-19 cases and four deaths. Eleven countries (Bulgaria, Czechia, Finland, France, Ireland, Latvia, Lithuania, the Netherlands, Romania, Spain and the UK) reported outbreaks and clusters in a variety of settings, such as packaging/mail distribution centres and other logistics services, the transportation sector (long-distance transport, taxis and private car services), churches and monasteries, fitness gyms, a spa and customs warehousing. Where information was reported, all clusters occurred predominantly in indoor settings.

Onward community transmission was reported in three outbreaks, two in transport companies and one at a fitness centre, involving nine community cases. Across all settings, the reported attack rate ranged from 3% to 22%.

Packaging/mail distribution centres

Eight clusters of COVID-19 were reported from the country-based data collected on packaging or mail distribution centres, with a range of three to 27 cases. Furthermore, media sources identified a cluster of 40 cases in workers at a distribution centre in Bologna, Italy and a couple of clusters in Austria and Germany [33-37].

Bars and restaurants

Five clusters of COVID-19 were reported among employees in bars or restaurants, four from Spain and one from Ireland, involving a total of 32 individuals and no deaths. Media reports of a restaurant-based outbreak of COVID-19 in British Colombia, Canada, detailed four or five workers testing positive, but no onward transmission to restaurant patrons was reported [38].

Transportation sector

Three clusters of COVID-19 were reported from country-based data collected among employees in the transportation sector, including a taxi/private car service and two long-distance transportation companies (bus and rail). These clusters consisted of three, four and eight individuals, respectively. A study from Sweden that looked at cases of COVID-19 diagnosed in different occupations found the highest risk among taxi drivers, with a relative risk of being diagnosed with COVID-19 that was 4.8 times higher than in all other professions (95% confidence interval 3.9-6) followed by bus and tram drivers (RR 4.3, 95% CI 3.6–5.1) [15]. In an analysis by the UK ONS of deaths from COVID-19 between 9 March and 25 May 2020 in England and Wales among males aged 20 to 64 years, male taxi drivers and chauffeurs and bus and coach drivers were found to have statistically significantly higher mortality rates from COVID-19 than the general male population (65.3 deaths per 100 000 males vs 39.7 per 100 000 men for the general male population) [27].

A study in New York City found that being older was a risk factor for COVID-19 mortality in transit workers, with 60–69 year olds working in the transport sector having higher mortality rates than adults of a similar age working in other sectors [39].

Other sectors

In the country based-data collected there were also reports of clusters of COVID-19 in fitness gyms (two clusters), churches and monasteries (six clusters, all from Romania), a spa, a customs warehouse, and other logistics services. According to media reports, Spanish health authorities ordered the culling of 93 000 minks due to COVID-19 infection in seven employees on a mink farm in the region of Aragon. Similar reports of cases among both employees and minks were received from the Netherlands and Denmark [40,41]. There is no evidence of animal-to-human transmission at these mink farms, and thus the mode of transmission for the employees remains undetermined [42]. A study from Sweden, which looked at cases of COVID-19 diagnosed in different occupations, found a higher risk among translators, interpreters and linguists, who had a relative risk of 2.9 (95% CI 1.8-4.7) [15].

Possible factors contributing to COVID-19 clusters in other occupational settings

Several countries cited the following factors as contributing to COVID-19 transmission in these settings:

- close proximity while working or in living quarters, where interpersonal contact between workers was unavoidable;
- reported lack of compliance with preventive measures.

Discussion

The data collated above, as reported by the EU/EEA countries and UK responding to the ECDC survey, together with existing literature and media reports present particular patterns in terms of COVID-19 clusters and outbreaks in occupational settings.

The vast majority (95%) of outbreaks in occupational settings have been reported in indoor settings in all the professional categories, pointing to the significance of confined indoor spaces as a risk for occupational transmission. However, studies have shown that in Europe >80% of working time is spent indoors and that variations in the socioeconomic and demographic status lead to different work-day patterns indoors [43]. As discussed in recent articles, the significance of the roles played by various transmission routes in human-to-human transmission of SARS-CoV-2 remains unclear [44]. Although large droplets definitely play a significant role in COVID-19 transmission, it is also becoming increasingly clear that in confined spaces aerosol transmission plays some role, possibly a significant one, particularly for people sharing the same space for extended periods of time [45]. For this reason, lack of sufficient physical distance is the most important contributing factor to any COVID-19 outbreak, including those in occupational settings. If physical distance cannot be ensured due to limitations at the workplace or the nature of the work, the risk of COVID-19 transmission and infection increases. The literature

describes different workplaces where outbreaks have occurred where there were difficulties maintaining the recommended distance of at least two metres [46]. Confined spaces and shared workplaces, both associated with a lack of physical distance, have also been reported by countries as being probable risk factors for the outbreaks observed in certain occupational settings. For example, workers in meat and poultry processing plants, factories or other manufacturing companies often work very close to one another on processing lines, and often in noisy conditions which may require them to shout, possibly leading to greater droplet dispersal. In addition, the duration of contact (work shifts) provides prolonged exposure to a potentially infectious co-worker and facilitates transmission. Moreover, workers may also have close contact in canteens, during breaks, in changing rooms or when clocking in and out [47].

Poor ventilation in confined indoor spaces is associated with increased transmission of respiratory infections and COVID-19 in particular [48]. When well-maintained, heating, ventilation, and air conditioning systems may help to reduce transmission in indoor spaces by increasing the rate of air exchange, decreasing recirculation of air and increasing the use of outdoor air [48]. It remains to be clarified whether the temperature and humidity controls in food processing plants are particularly suited to the survival of the SARS-CoV-2 virus and aerosol formation.

The majority of the clusters described in this document refer to the health and social care sector. In a UK study of more than 120 000 employed persons, the risk of healthcare workers testing positive for COVID-19 was over seven times higher than for non-essential workers, and those in social care had a risk that was three times higher [49]. While healthcare and social workers are among the most exposed professions due to frequent and prolonged contacts with infected individuals, often exacerbated by staff shortages, the results may also be influenced by enhanced testing strategies implemented by EU/EEA countries and the UK for workers in healthcare and long-term care facilities. These results are also consistent with surveillance reports from the US [50]. A potential risk factor, indicating the continuing need to train and communicate with all healthcare workers, is the inappropriate use of PPE. In addition, insufficient access to PPE has been identified as an additional risk factor, and this was an important lesson learned from the first wave of the pandemic [51]. In preparing for a potential second wave of COVID-19, national health authorities in EU/EEA countries, and employers in general, should secure access to continuous supplies of appropriate PPE and enhance training of all levels and categories of healthcare professionals to avoid healthcare- associated transmission of COVID-19. Work stress due to prolonged working hours, wearing the same PPE to care for more than one patient, and shortage of staff are also possible factors.

Further specific occupations which are probably at risk of exposure to COVID-19 include transport workers (taxi and bus drivers), sales people, postal/package delivery workers and domestic cleaners, due to the fact that they are exposed to multiple clients. Workers in these occupations therefore need to be provided with simple types of intervention and PPE [52].

A number of different outbreaks in occupational settings outlined above (e.g. slaughterhouses, farms, construction or mine sites) have been linked to migrant or seasonal workers, who live in dormitories or other types of crowded accommodation [50,53-55]. The living conditions of these workers therefore pose an additional risk factor, if they do not enable adequate physical distancing or proper personal hygiene measures, allowing COVID-19 to spread more easily. As mentioned above, a tailored culturally-sensitive approach should be used to provide health promotion information to these population groups and their employers [56,57].

It is common practice at workplaces such as factories or constructions to provide transportation for workers or for the workers to share transportation, such as ride-share vans or shuttle vehicles, car pools, and public transportation, to commute to work. This was also listed as a factor contributing to COVID-19 transmission in some of the clusters reported.

Finally, exposure to fomites (i.e. contaminated surfaces, tools or other frequently-touched objects) in the workplace may also contribute to the transmission of COVID-19. Some work sites where outbreaks have occurred have been slow to implement appropriate infection control and hygiene standards or have done so inadequately [58]. The extent to which workplaces emphasise hand hygiene and cleaning practices, or make available the appropriate PPE is unknown [58].

In addition to a lack of or an inability to implement physical distancing, 'presenteeism' (i.e. reporting to work despite being symptomatic for a disease), may also be a factor contributing to the occupational spread of COVID-19 in certain cases. However, a large percentage of the work performed by essential workers and workers in vulnerable jobs tends to be low-income and workers are also unable to work from home. Fear of losing their job or inability to reduce their working hours in order to stay home may lead to continued commuting and working, even when the employee or a family member are exhibiting symptoms compatible with COVID-19 [58]. Workers without access to paid leave or in dependent self-employment ('bogus self-employment') are more liable to continue working, even if ill, for fear of losing their income. This is common among workers in all sectors, including healthcare, public services and the educational sector [58].

Linked to the concept of presenteeism are socio-economic issues, associated in some cases with ethnicity and the migrant status of workers, with some groups over-represented in certain risk populations (e.g. taxi/bus drivers). As demonstrated by the clusters described above, one vulnerable group at risk of COVID-19 exposure are seasonal migrant workers. In many cases, those groups consist mostly of men, who have been shown to be at greater risk

of poorer outcomes when symptomatic with COVID-19. In addition, they may have reduced access to the healthcare system in the host country. They therefore comprise a population group that should be targeted with tailored approaches when communicating advice and information on protective measures during the pandemic. On the other hand, workers in health and social care, retail and education are mainly female, and women overall have been disproportionately affected by losses in working-hours in the service sector as a result of the pandemic, coupled with an increased burden in terms of unpaid care.

In the US it has been estimated that up to 28% of the workforce may be exposed to an infection at a frequency varying from once a week to once a month [59]. Another study in the US, highlighted that some individuals were more vulnerable to infection due to the nature of their employment, specifically those employed in essential sectors (e.g. healthcare and social assistance, hospitals, animal slaughtering and processing) and in occupations with frequent exposure to infections and close proximity to others [60]. Work is a social determinant of health, with a possible link between certain occupations and poor health status. This highlights the importance of understanding which populations are in vulnerable occupations during an emergency and reviewing existing policies in order to ensure that strong public health prevention policies are in place to address these vulnerabilities [58,61]. Moreover, it is increasingly obvious that a large number of people are employed in occupations with frequent exposure to infection, not only in the healthcare sector, but also in law enforcement, administrative support, education and social care.

However, it should also be noted that in areas where widespread community transmission of COVID-19 is on-going, the detection of cases in work places is to be expected. Moreover, it is difficult to differentiate the place of infection, unless a thorough outbreak investigation is undertaken, including molecular epidemiology studies. Consideration should be given to such investigations where possible.

There is evidence that workplace-based testing schemes may support the early identification of COVID-19 and prevent occupational transmission, however, testing in isolation is not enough to prevent workplace outbreaks. A modelling study on the frequency of routine testing in high-risk environments found that testing strategies with a less than daily frequency (e.g. weekly testing or testing once prior to return to work) are unlikely to prevent workforce outbreaks without additional interventions [62].

Health and safety at work

The health and safety of staff working in the occupations at risk identified in this document is important not only for their own protection but also to help prevent the further spread of the virus. There is a comprehensive body of EU legislation to protect workers' health and safety in the workplace. Therefore, workplace risk assessments need to be revised in accordance with occupational safety and health legislation and occupational health and safety measures adapted, in agreement with occupational safety and health services and workers, to take account of all types of risks (also taking into account the additional physical load when wearing personal protective equipment). Where there is a safety and health committee in place, it should be consulted. SARS-CoV2 has recently been classified as Risk group 3 in accordance with Directive 2000/54/EC[2] - biological agents at work, which stipulates specific measures and has been implemented into national legislation by the Member States.

Non-binding guidelines developed at EU level aim to help employers and workers to stay safe and healthy in a working environment that has changed significantly because of the COVID-19 pandemic. They give advice on workplace risk assessment and appropriate technical and organisational measures to minimise exposure, and also measures to take when resuming work, coping with absences and taking care of workers who have been ill. Guidance on workplace interventions to prevent and address COVID-19 are provided by EU-OSHA [1,2], with links to specific national guidance on the appropriate measures for the sectors and occupations mentioned in this document.

Additional interventions to address and prevent COVID-19 transmission in occupational settings include adherence to rigorous infection prevention and control routines, including the use of PPE and the promotion of policies that ensure workers are supported to self-isolate and stay home if they or family members exhibit symptoms compatible with COVID-19. Additional guidance on workplace interventions to prevent and address COVID-19 are provided by EU-OSHA [1,2].

[2] Directive 2000/54/EC of the European Parliament and of the Council of 18 September 2000 on the protection of workers from risks related to exposure to biological agents at work (seventh individual directive within the meaning of Article 16(1) of Directive 89/391/EEC)

Limitations

This technical report is undertaken based on information and data available to ECDC at the time of publication. A number of limitations need to be considered when interpreting the results. Firstly, the data presented in this report were reported to ECDC by a limited number of countries (17/31), or have been identified through literature searches and epidemic intelligence and media monitoring activities. Media sources, in particular, are not peer-reviewed and may contain inaccuracies. Consequently, this report does not provide a thorough overview of all occupational settings affected by COVID-19 outbreaks in the EU/EEA and the UK and could include errors introduced by the data sources used.

Secondly, occupation is not a routinely collected variable in case-based surveillance of COVID-19 (with the exception of healthcare workers and those working in long-term care facilities), and public health authorities must rely on the private and public sectors to voluntarily report cases, clusters, and outbreaks to prompt an outbreak investigation. This limits the ability of public health to detect potential outbreaks in all occupational settings. Detailed investigation of outbreaks from the countries are lacking due to the increased pressure of the COVID-19 pandemic. Information about the age, sex, and underlying conditions of the confirmed cases and deaths related to clusters in these occupational settings was not collected. This information might be relevant for the interpretation of the findings and the comparison of occupational settings.

Thirdly, there is no consistent definition of how occupational outbreaks are classified, investigated or reported by Member States in the EU/EEA and the UK. Results and details of outbreak investigations in occupational settings are generally not made public and therefore do not frequently appear in the peer-reviewed literature. In some cases, cluster sizes reported in this document may include all those affected and not just the number of affected workers. It is also often difficult to differentiate between transmission that occurred in the workplace setting and that which occurred within the community, particularly in settings with ongoing community transmission of SARS-CoV-2.

Fourthly, most clusters have been reported in health and social care-related occupational settings. This is probably because employees in this sector have been routinely tested at a higher rate than those in other occupational settings. This probably indicates an under-representation of COVID-19 clusters detected in other settings.

Finally, it is important to note the lack of detailed outbreak investigation data in occupational settings across the EU/EEA and the UK in the context of the COVID-19 pandemic, and the lack of case control studies to distinguish between the risk of infection and the risk of severe outcome in the different occupational settings. Information on probable risk factors associated with the clusters and outbreaks is limited and mostly anecdotal. It is known that many countries have carried out inspections in occupational settings, but data from the process of law enforcement is generally confidential. Under-reporting of infections in occupational settings is therefore a key issue, particularly from smaller businesses (e.g. hair and nail salons) that may be less likely to report incidents. Further information from detailed epidemiological investigations and qualitative studies will help to better understand the transmission dynamics of COVID-19 in occupational settings.

Conclusions

While data on the full spectrum of COVID-19 clusters in occupational settings in the EU/EEA and the UK remain limited, it is clear that the most common exposure relates to lack of physical distancing, particularly in indoor settings, including shared accommodation, canteens, rest rooms and transport. Factors associated with transmission also included face-to-face contact with clients in sectors such as transport and retail, lack of access to hand-washing facilities, the housing conditions of seasonal or migrant workers and appropriate communication of the recommended public health measures.

The number of clusters is probably significantly under-identified in occupational settings and at present it is difficult to investigate all clusters thoroughly. Many occupational clusters have been reported in the health and social care sectors, particularly in LTCFs and hospitals; however, these sectors are probably over-represented due to frequent testing in such settings.

Large numbers of occupational transmissions have been reported from the food packaging and processing sectors, in factories and manufacturing, and in office settings, indicating a link with work in an indoor environment and an inability to maintain physical distance. Fewer clusters have been reported from the mining sector; however, it is significant that some of these have been large clusters. Self-employed workers are at a greater risk, as well as those in occupations typically associated with a lower socio-economic status.

Increased focus on testing for COVID-19 in workplace settings, combined with robust and strictly enforced polices for physical distancing, hygiene and cleaning, appropriate use of PPE and hand hygiene (particularly in closed settings and in situations involving extended contact, shared transportation and accommodation) will help prevent outbreaks of COVID-19. Robust surveillance and contact tracing is essential, as are clear protocols for how to address outbreaks

when they are detected. Guidance is provided by EU-OSHA on some aspects of the prevention of COVID-19 in occupational settings, and general infection prevention and control guidance is provided by ECDC [2,48,63-67].

With COVID-19 outbreaks or clusters in occupational settings, there is a need for strong collaboration between public health and occupational health and safety authorities at the local and national level to address and prevent the spread of COVID-19. Strong inter-sectoral collaboration and the implementation of recommended public health measures in high-risk occupational settings will help to prevent a resurgence of COVID-19 in the workplace and in the wider community. While not a major factor in the clusters reported and presented in this report, special attention should be given to cooperation between national and international authorities if clusters involve seasonal workers or workers from other countries.

Consulted experts

ECDC experts (in alphabetical order): Cornelia Adlhoch, Leonidas Alexakis, Barbara Albiger, Agoritsa Baka, Jordi Borrell Pique, Orlando Cenciarelli, Stefania De Angelis, Helena de Carvalho Gomes, Erika Duffell, Margot Einoder-Moreno, Lisa Ferland, Tjede Funk, Ole Heuer, Lina Nerlander, Sabrina Nothdurfter, Pasi Penttinen, Anastasia Pharris.

External experts: Elke Schneider EU-OSHA

All external experts have submitted declarations of interest, and a review of these declarations did not reveal any conflicts of interest.

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