Knowledge share workshop with PROTECT researchers: consolidating similarities and differences in findings from sector specific research.

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The PROTECT COVID-19 National Core Study on transmission and environment is a UK-wide research programme improving our understanding of how SARS-CoV-2 (the virus that causes COVID-19) is transmitted from person to person, and how this varies in different settings and environments. This improved understanding is enabling more effective measures to reduce transmission – saving lives and getting society back towards 'normal'.

Across the sectors, contributions from public transport, food processing and the energy sector appeared to have the most aligned mitigation measures. The most prominent overlap between sectors in relation to risk factors was public transport, construction, logistics and food. For barriers, public transport and the food processing sector was most aligned. The public transport, food processing and energy were the most aligned in relation to enablers. In contrast the care home sector and energy sector appeared to be least aligned.

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Knowledge share workshop with PROTECT researchers: consolidating similarities and differences in findings from sector specific research.

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KEY MESSAGES

Engagement with researchers during the workshop generated findings that were sector-specific[1], cross-cutting[2] and common[3] across the different sectors of interest. Across the four workshop sessions, there were more findings that were sector-specific than common. This may be due to the differences between subsector practices, work environments and workforce demographics, which was highlighted for many of the sectors of interest. For example, within the food sector COVID-19 risks and measures were said to likely differ between workers making sandwiches on a production line indoors in close proximity with colleagues compared to fruit pickers spaced out in an outdoor environment. There were also recurrent themes identified in the data across the four sessions in the workshop e.g. testing which was discussed as a mitigation measure, access to testing as a risk factor and also as a barrier and enabler to preventing viral transmission.

Mitigation measures:

- There were almost twice as many sector specific mitigations[1] identified than cross-cutting[2] mitigations and only a small number of common[3] mitigations.
- Common mitigation measures cited were: ventilation, face coverings, social distancing, enhanced cleaning regimes and testing.

Sector specific mitigations included on site mitigations, measures in place to protect staff and monitoring of workers. There were also some unexpected mitigation measures identified as sector specific e.g. one-way systems were only discussed relative to the food and energy sectors. However, the absence of this mitigation within the other sectors may indicate that this was outside of the project scope of sector specific research conducted, or indeed that this did not emerge as a finding on the day of the workshop.

Risk factors for transmission:

- There were more common[3] risk factors identified, than sector-specific risk factors[1] and cross-cutting risk factors[2].
- Themes in common risk factors discussed included: support, shared transport and accommodation, behavioural factors and work environment.
- Examples of sector-specific risk factors identified included: diverse cultural backgrounds/language barriers, correct use of PPE/face coverings, ease/ability to work from home, staff shortages, communication challenges, presenteeism and trust/distrust.

Barriers and enablers to preventing the spread of the virus:

- Two barriers were common across the sectors. Cost of control measures and communication of messages (including government guidelines causing confusion) were identified across all sectors as a barrier to controlling COVID-19 transmission.
- Testing was the only one enabler to controlling transmission identified to be common, in seven sectors. Examples of sector specific barriers[1] include behaviour compliance, access to testing, mobile population, nature of work, client demands/expectations and competing challenges outside of sector.

[1] Findings identified across one or two sectors
[2] Findings identified between three and six sectors
[3] Findings identified by seven or eight sectors

- Examples of enablers were found to be sector specific[1]: communication within and beyond sectors, technology, information and data gathering and sharing.

Gaps in COVID-19 knowledge:

- Knowledge gaps related to mitigation measures, such as: lack of clarity surrounding the effectiveness of individual mitigations; the continuation of specific mitigations moving forwards; relative cost-effectiveness, lack of understanding on the effects of ventilation, temperature and humidity, lack of guidance available about how to prepare for potential variants of the virus and surrounding the effectiveness of workplace risk assessments.
- Knowledge gaps also related to human behaviour and communication, including: understanding why certain workers are more likely to follow government guidelines and follow mitigation measures as opposed to others, changes in guidance throughout the duration of the pandemic meaning workers are unable to plan effectively for the future due to constant change in guidance, how to effectively communicate and plan responses moving forward, “at risk” groups/workers and lack of knowledge relating to COVID-19 rates in the local community.
- Examples of knowledge gaps surrounding longer-term issues related to COVID-19: the unknown effect of potential future variants, the virus’ transmission routes and symptoms and unknown future of the pandemic, “living with COVID-19” phase of the pandemic.

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1. INTRODUCTION

1.1 Background context & objective

The Partnership for Research in Occupational, Transport and Environmental COVID-19 Transmission National Core Study (PROTECT NCS) is a UK wide research programme which seeks to improve understanding of how COVID-19 is transmitted and aims to understand how measures work to reduce transmission. A number of sector-specific studies were conducted as part of the PROTECT project focusing on COVID-19 transmission in different sectors or by members of the PROTECT team as part of other relevant projects, namely: public transport, food processing, close contact retail, construction, higher education, logistics/delivery, energy and the care home sector.

When it comes to controlling workplace transmission of SARS-CoV-2, the virus that causes COVID-19, different workplace sectors face different challenges, both in terms of likely transmission routes and which control measures can be practically and effectively implemented. Theme 3 (Sector-specific studies) of PROTECT[4] has conducted targeted studies to improve understanding of specific risks associated with COVID-19 infection and support these sectors to return to more normal operation. Study findings are generating recommendations to help the government, and the sectors studied, respond more effectively to infectious disease outbreaks and keep services operating. They will also highlight gaps in information resources and where further research is needed.

This report summarises the findings of a cross-sector workshop conducted on April 29th 2022 at the University of Manchester. Fourteen researchers were in attendance, and four additional contributions were provided remotely within three weeks of the workshop (three of whom were attending researchers offering further reflections and one was a new contributor from the energy production sector not represented during the workshop). All contributing researchers (in person and remotely) were part of the PROTECT NCS research team from various institutions (UoM, IOM, LSHTM and HSE), having led or delivered empirical research into COVID-19 transmission within the UK as part of, or related to, the PROTECT NCS research programme. The primary objective of this workshop was to compare and contrast findings from sector-specific empirical research conducted by contributing researchers in order to:

a) Identify common themes in risk factors and preventive measures for COVID-19 infection; and
b) Identify key differences between sectors.

This was with a view to inform how COVID-19 measures could be better tailored to specific contexts to be applied effectively across a range of workplaces if a future need arose (e.g. new COVID-19 variants, other future health emergencies).

[4] Partnership for Research in Occupational, Transport and Environmental COVID-19 Transmission.

2 METHOD

2.1 Structure and coverage

The cross-sector workshop was five hours in duration and interactive in nature, with researchers encouraged to work both individually and within groups, to capture their reflections on flip charts and PostIt notes as well as through plenary discussion. While those facilitating the workshop took notes, two skilled administrative staff were also present to capture the detail of group and plenary discussions throughout the workshop in order to maximise the detail and accuracy of data captured. A topic guide was used to structure the coverage and timings for the workshop around four topic areas of interest (illustrated within **Figure 1**) in order to meet the project objective set out within section 1.1.

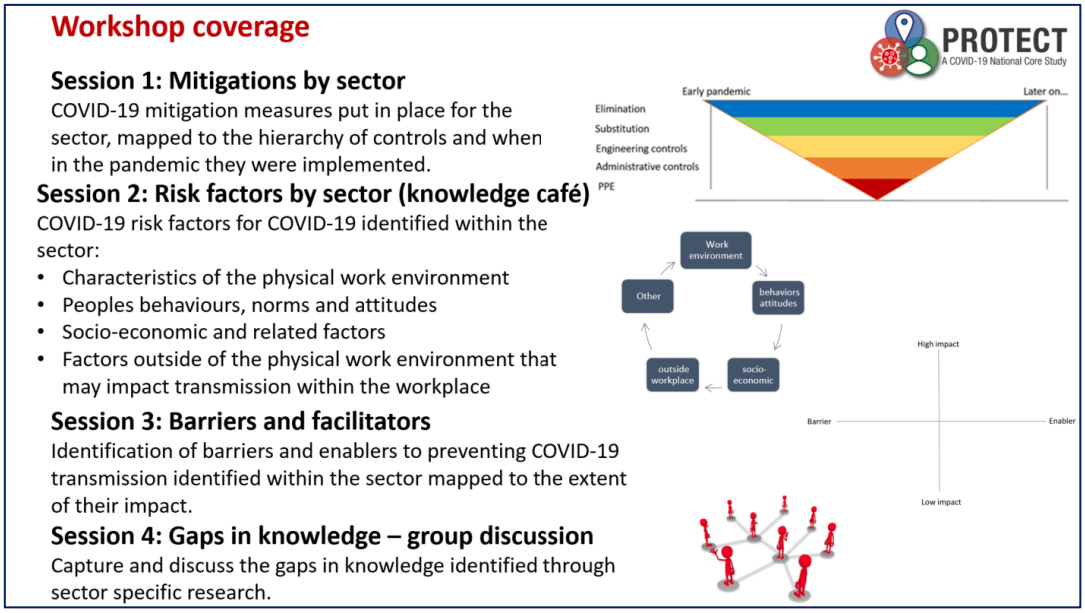

Figure 1: Illustration of workshop coverage

A detailed outline of each session is presented below. Each session included an interactive exercise followed by a facilitated plenary discussion to enable researchers to explain the reasoning behind their contributions, sharing of specific examples from their sectors of focus and enabling discussion of whether findings captured are distinct or similar across the work sectors. During the workshop, each sector was allocated a colour (post-it notes and pens) to allow subsequent identification and grouping.

Where applicable, reflections from the lead researchers for the cross-sector research are presented (within the subsequent blue boxes below). These reflections offer valuable insight into some of the challenges encountered by researchers during participation in the different workshop sessions and where applicable, impact on the data collected and subsequent findings.

2.1.1 Session 1: Mitigations by sector

Researchers were asked to categorise the COVID-19 mitigation measures put in place for the sector of interest, mapping them to the Hierarchy of Controls (HoC) specific to controlling exposure to the SARS-CoV-2 virus (Cornell University[5]).

[5] https://ehs.cornell.edu/campus-health-safety/occupational-health/covid-19/covid-19-hierarchy-controls

This HOC comprised of the following six levels (as illustrated in Figure 2):

- **Elimination**- completely eliminating exposure to the hazard;
- **Substitution**- in the context of hazardous substances substitution would entail replacing the hazard with a non-hazardous substance, however no substitution control measures have been found to be applicable in the context of COVID-19 by Cornell University, although this still remains a component of their model;
- **Engineering controls**- isolating the person from the hazard through physical or mechanical means;
- **Administrative controls**- changes made to the way that people work;
- **Personal Protective Equipment (PPE)**- equipment worn by the person to protect themselves from real or potential hazards, e.g. gloves, lab coats, safety glasses, respirators, etc.;
- **Community Protective Equipment (CPE)**-equipment worn by a person to prevent community spread from an asymptomatic carrier of COVID-19.

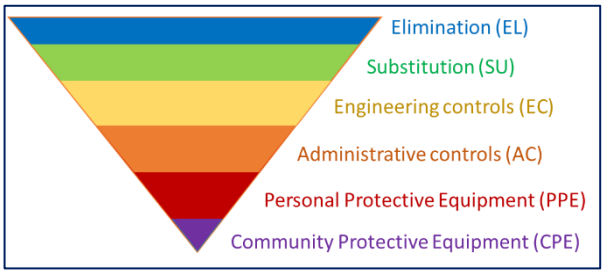

Figure 2: Illustration of Hierarchy of Control specific to COVID-19

Whilst substitution was retained as part of this HoC within the cross-sector workshop (in line with the model proposed by Cornell University[1]), as expected, no mitigations were categorised under substitution either during the workshop or subsequently through remote contributions provided. Many researchers also found it challenging to reflect upon the timing of when mitigations were implemented as well as categorise mitigations under the HOC levels, citing multiple variations of the HOC and no one version universally applied or established in the context of COVID-19.

The output generated by session 1 can be seen within *Figure 3*.

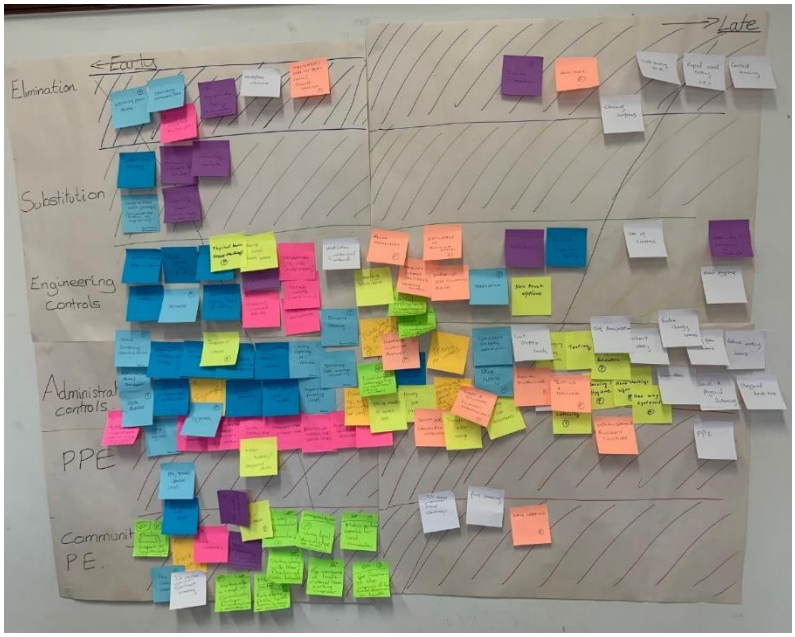

Figure 3: example output from group exercises looking at mitigations by sector.

2.1.2 Session 2: Risk factors by sector

During the second session, researchers were asked to identify the COVID-19 risk factors that emerged from their research for each sector of interest categorised by:

- Characteristics of the physical work environment;
- People's behaviours, norms and attitudes;
- Socio-economic and related factors;
- Factors outside of the physical work environment that may impact transmission within the workplace;
- 'Other' additional risk factors.

These chosen categories were informed by work conducted across the sectors before the workshop took place.

2.1.3 Session 3: Barriers and enablers

Researchers were asked to write down the barriers and enablers to preventing COVID-19 transmission by sector. They were then asked to provide each barrier and enabler with an impact rating (high, medium or low) and to position these barriers and enablers along a high-level timeline (early (2020) to late (2022) within the pandemic). Researchers were encouraged to capture the same item twice if this was considered to be both a barrier and enabler so that they could be assigned distinct impact ratings and positioning along the timeline if applicable.

Researchers focused their attention on capturing the barriers and enablers and explaining the context and nature of their impact. Perhaps unsurprisingly, most focused only on high impact issues during this sessions, with very few capturing barriers and enablers of moderate to lower impact. Furthermore, researchers tended to cluster the barriers and enablers they noted for each sector together, rather than along a timeline from early to late in the pandemic. Little insight could therefore be gathered in this regard.

The output generated by session 3 can be seen within Figure 4.

Figure 4: example output from group exercises looking at barriers and enablers to preventing COVID-19 transmission by sector.

2.1.4 Session 4: Gaps in knowledge

Researchers were asked to highlight the gaps in knowledge found in the sectors in which they had conducted their research. The extent to which the gaps identified were similar or different across the sectors were explored.

2.2 Research of interest and associated contributors to the workshop

There were eight key sectors of particular interest to explore the respective empirical research findings within the cross-sector workshop. A brief summary of each of these sectors is presented within Table 1 below, along with the number of researchers representing this sector who contributed to the workshop in person or remotely. In some instances, researchers led or contributed to research in more than one sector of interest and hence the total number of researchers presented below exceeds the 15 individuals in attendance to the workshop.

Most of these sector-specific investigations were carried out as part of the PROTECT study, to understand perception of the risk and the effectiveness of any risk mitigation measures. A number of other sectors were also included because members of the PROTECT Theme 3 team had been involved in other research activities. For example, the University of Manchester received funding from the NIHR as part of the Rapid Response Call to investigate the response from the delivery sector on the pandemic. The Higher Education sector was added as one of the PROTECT Theme 3 team member was closely involved in the response to the pandemic of the Universities in Greater Manchester. Finally, another member of the team was closely involved in providing evidence and advice based on statistical modelling within the care home sector in the UK. Only findings highlighted on the day of the workshop are reported within the document. Researchers reported from their sector specific work, which varied between researchers depending on the scope of the work, and therefore their objectives and participants were not aligned. This meant that, during the workshop, researchers could not always report on all mitigations, risks, barriers and enablers present in the sector as they could only report on their findings, this may have had an impact on the results. For example, the retail close contact study focused on face coverings so researchers could not report on other mitigations, which may have also been present within the sector e.g. cleaning regimes.

***Table 1**: Summary of existing research conducted within the eight key sectors.*

Sector	Prior research conducted	Link to prior research output	Researchers in attendance
Public transport (PT)	Qualitative semi-structured interviews with experts, organisational leaders, workers and passengers. Phase 1: 47 interviews (Jan – May 2021) Phase 2: 17 interviews (Dec 2021 – Feb 2022)	Phase 1: Coleman et al. (2022a) Phase 2: Coleman et al. (2022b)	2
Food processing (FP)	Literature review (October 2020- April 2022) and mixed methods empirical research (online baseline survey, a follow-up interview survey with UK-based food and drink processing businesses, and qualitative semi-structured interviews with sector experts).	Loh et al. (2022)	3
Higher education (HE)	Development of a bespoke model of data triangulation and sharing to reduce the risk of transmission in universities in	N/A	2

	2021, learning from the needs from the previous year.		
Logistics & delivery (LD)	Qualitative Evaluation of Covid-19 Non-Pharmaceutical Interventions in the UK Logistics Sector (July-August 2020 and May-June 2021). Modelling the Impact of Non-Pharmaceutical Interventions on Workplace Transmission of Sars-Cov-2 in the Home-Delivery Sector (July-August 2020 and May-June 2021).	Wei et al. (2022) Whitfield et al. (2022)	2
Close contact Retail (CR)	Mixed methods research (online survey and qualitative semi-structured interviews) conducted with workers and members of the public delivering/receiving close contact services within retail consulting rooms (e.g. within community pharmacy, opticians, hair and beauty salons (Jan-Feb 2022).	Canham et al. (2022)	2
Care homes (CH)	Statistical analysis and data informed modelling of COVID-19 within a care home setting to understand data needs, provide testing advice and consider vaccine thresholds.	Sage Social Care Working Group (2020a) Sage Social Care Working Group (2020b) Sage (Social Care Working Group (2021)	1
Construction industry (CI)	Phase 1: scoping study: pre-interview survey (n=8); qualitative semi-structured interviews with stakeholders from four participating construction companies (n=5) (Dec 2020 to Feb 2021). Phase 2: qualitative semi-structured interviews across construction settings / levels of management / job roles (n=22); quantitative survey (n=497). Nov 2021 to Feb 2022. Report submitted, not yet published.	Balmforth et al. (2021)	2
Energy production (EP)*	Mixed method research ongoing. Empirical research was initiated in this sector after the date of the workshop, hence the content for inclusion was provided by representatives of the energy sector business under study via remote contribution in the weeks following the workshop.	N/A	4 researchers who were due to work with this sector were present at the workshop.

*Work started with the Energy sector after the workshop, during May 2022. Researchers involved were present at the workshop. It was thought important to capture information as an 8th sector. However, it should be noted that data was collected slightly later and recall bias may have been a factor.

In addition to the above sector-specific representatives, the following researchers were also present at the cross-sector workshop:

- Two researchers who had conducted targeted research into areas of enduring prevalence (ED) for COVID-19 (UK local authorities that experience sustained high levels of COVID-19) attended the workshop. For this work, qualitative semi-structured interviews were conducted with 19 Directors of Public Health across the UK (9 in areas of ED and 10 in comparison areas) between June and November 2021. Report 1: Lewis et al. (2022) and Report 2: Hartwig et al, (2022).
- One researcher was also present from HSE who input information across the sectors at a more strategic level. Information from the HSE researcher also included input on a systematic review looking at risk factors for workplace outbreaks (Theme 1 Phase 2 with an extension). The interim report for the lit review has been published (Clayson et al. 2022).

The input from the above three researchers was grouped together for the purposes of this report, and is termed 'non-specific' throughout as their contributions were not sector-specific.

3 FINDINGS

3.1 Overview

The data gathered during the workshop and through remote contributions were thematically analysed for each of the four workshop sessions detailed above within section 2.1. A summary of contributions has been tabulated and appended for each of the sessions to facilitate efficient comparison of findings across the eight sectors. These are as follows:

- Annex 1: Mitigations by sector;
- Annex 2: Risk factors by sector;
- Annex 3: Barriers and enablers (for introducing mitigations).

These summary tables provide an indication of the prominence of findings gathered within each session relative to the eight sectors, with each researcher contribution categorised across the sessions as 'common', 'cross-cutting' or 'sector-specific' as follows:

- **'Common findings'** – identified across all or most of the sectors (i.e. seven or more sectors);
- **'Cross-cutting findings'** – identified by between three and six sectors included; and
- **'Sector-specific findings**' – identified by just one or two sectors.

Table 2 summarises the extent to which the overarching findings gathered within the first three workshop sessions were common, cross-cutting or sector-specific. It can be seen that many of the COVID-19 mitigations were considered sector-specific or cross cutting. Risk factors were identified to be common, cross-cutting and sector-specific across each of the categories explored, although far more sector-specific risk factors were identified relative to people's behaviours, norms and attitudes. Many sector-specific barriers and enablers were identified to preventing transmission of the SARS-CoV-2 virus, with comparatively few found to be common.

Table 2: *Prominence of findings within sessions 1, 2 and 3 across the sectors*

Session	Common findings	Cross-cutting findings	Sector-specific findings
Session 1: Mitigations by sector	**5**	**11**	**24**
Session 2: Risk factors by sector	**16**	**10**	**18**
Session 3: Barriers and enablers	**3**	**12**	**39**
Barriers	2	5	14
Enablers	1	7	25

The following section summarises the output from each of the four workshop sessions relative to the recurrent themes and sector-specific findings. The findings from session 4 (gaps in knowledge) have also been presented as a discrete section within this report.

3.2 Session 1 findings: Mitigations by sector

3.2.1 Common mitigation measures identified for all or most sectors

Five mitigation measures were found to be common across all or most sectors, as illustrated within Figure 5. Each of these mitigation measures are discussed in turn below. The bigger font in the image indicates mitigation measures identified across eight sectors and the smaller font indicates mitigation measures identified across seven sectors.

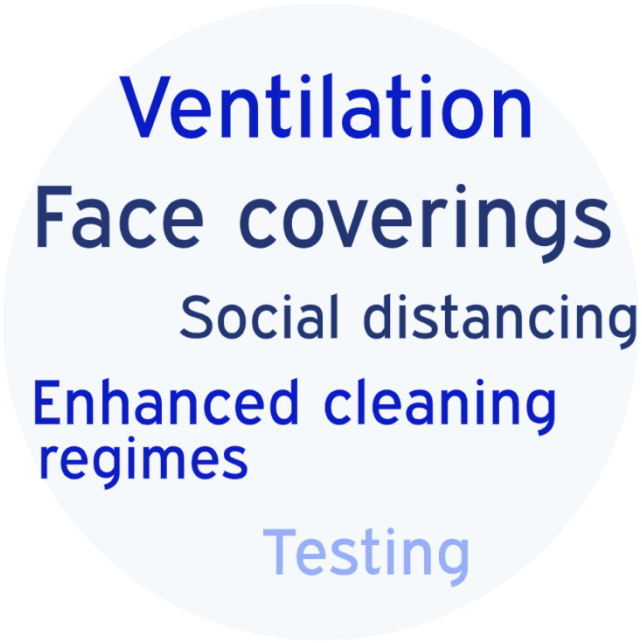

***Figure 5**: Common mitigation measures identified across seven or all eight of the sectors.*

The **use of face coverings** was identified to be common to all eight sectors and was said to have been implemented in both public facing (e.g. transport vehicles, retail) and closed settings (e.g. factories, offices). Researchers highlighted that in many cases, the wearing of face coverings was implemented early on in the pandemic to reduce the risk of SARS-CoV-2 transmission. Use of face coverings was not however mandated throughout the duration of the pandemic. Recommendations/ legislation was acknowledged to change in different countries within the United Kingdom, across different settings and at different times (e.g. use of face coverings were mandatory within health care settings, such as community pharmacies, at a time where they were not in other retail premises). This was said to have caused confusion amongst both workers and members of the public. Furthermore, communication challenges associated with the use of face coverings were raised by two of the eight sectors (discussed further within section 3.4 Session 3 findings: Barriers and enablers).

Ventilation was a mitigation measure also common across all eight sectors. This included enhanced ventilation and monitoring indoor air quality. This was generally reported to receive greater focus later on in the pandemic as the evidence base and knowledge on routes to transmission changed. Types of ventilation identified included natural ventilation, such as opening windows/doors and mechanical ventilation. As with social distancing (below), the physical design and age of the premises was acknowledged as a restricting factor to ventilation in some sectors/environments. This was along with considerations for food quality and cost of installation (for mechanical ventilation) within the food sector and the location of retail consulting rooms (e.g. community pharmacies within supermarkets where the consulting room is comprised of partition walls in the centre of the shop) were said to be prohibitive to achieving good ventilation. Within the public transport sector trains and trams were said to have good air circulation while on buses and taxis opening windows was the best 'quick fix' (not always acceptable, especially in the colder months). It was noted that in many settings, making changes to ventilation, were currently deemed inadequate, would take time and cost money.

Social distancing was identified across seven of the eight sectors (not within retail close contact services). This was said to have been implemented at the beginning of the pandemic for individuals to maintain a two-metre distance from others as a precautionary measure to prevent transmission of the SARS-CoV-2 virus. It was noted that some sectors (and indeed subsectors) had workplace characteristics which made social distancing difficult. Examples included food production lines that required workers next to or facing one another in close proximity; and retail close contact services and care homes where workers and members of the public/residents needed to be in close

proximity or physical contact with one another. Limiting capacity and/or closing off some seats, was implemented on public transport to ensure social distancing. Staggered working shifts also allowed for social distancing in some sectors to prevent bottlenecks in settings where large volumes of workers were otherwise entering and leaving the premises at the same time.

Enhanced cleaning regimes were identified across seven sectors (not close contact retail sector). Cleaning of surfaces, especially touchpoints, and equipment was conducted more regularly. Cleaning was implemented at the beginning of the pandemic to minimise viral transmission through touch and surface contamination. Enhanced cleaning regimes were implemented in public facing sectors such as care homes, as well as in factory settings such as food processing. In the food processing sector, it was found that they already had good cleaning regimes in place due to strict food hygiene requirements, something considered to make enhanced cleaning/hygiene practices easier for workers in the sector to continue during the pandemic. In some sectors, e.g. public transport, even when cleaning was found to be a less effective measure for preventing COVID-19 transmission than originally thought (as evidence seemed to indicate that COVID-19 was more likely to be spread via inhalation rather than fomite transmission) but this practice was maintained as a visible action felt to help workers and passengers to feel safer.

Testing for COVID-19 infection was identified as a mitigation measure across seven sectors (not close contact retail). Types of testing varied by sector and included:

- Lateral flow testing (LFT) - a self-administered test taking swabs from mouth and nose, results usually available in 10 to 30 minutes;
- Polymerase chain reaction testing (PCR) - a test for COVID-19 which is sent away to the lab to analyse, results are received within two days;
- Antibody testing - a blood test to check if you've either: had COVID-19 before or made antibodies to the virus after having the COVID-19 vaccine.

Testing evolved over the duration of the pandemic and included **NHS/community testing**, **site/workplace-based testing**, **home testing and sewage water testing**. Testing was also carried out asymptomatically to ensure that individuals with no symptoms were picked up, often at workplaces before workers were allowed on site (e.g. within the energy sector). Within several sectors including the food sector, the rapid changes in guidance and testing methods were said to be a source of frustration to some businesses who had invested a significant amount of time, resource and cost to set up site-based testing on their premises, only for free home testing to be made publicly available shortly afterwards. In other sectors, e.g. public transport, it was difficult to establish work- based testing due to shift patterns and extensions to the workers' day. In some sectors (e.g. energy and food) it was noted that testing was not consistently implemented across all subsectors or facilities and this was dependent on the site manager with respect to how often, where and how testing was done.

In some professions where staff members were public facing and came in to contact with many different people each day (e.g. staff in care homes, working on public transport) or sectors deemed essential (e.g. energy generation), staff members were reportedly required to test regularly (weekly in late 2020 and moved to be more frequent (e.g. daily) depending on prevalence in the community) as a precautionary and preventative measure. The outcomes of a range of modelling studies applied to care homes suggested frequent testing helped reduce ingress of disease from wider community. However, it was noted that daily testing can reduce adherence to testing due to test fatigue. In other sectors (e.g. logistics/delivery) it was reported that they did not test regularly, as they were concerned that it would potentially reduce adherence to other interventions, such as social distancing. As people shifted from testing under the supervision of a third party in the workplace to unsupervised in workers' own homes, there became a reliance on trust in the individuals to both test and report results accurately.

3.2.2 Cross-cutting mitigation measures identified across multiple sectors

Twelve mitigation measures were found to be cross-cutting (identified by between three and six sectors). These are presented within

Table 3 below and again within Annex 1: Mitigations by sector. It can be seen that the fewest cross-cutting mitigations were cited for close contact retail and construction. The greatest number of cross-cutting mitigations were reported within Public transport, followed by the food and energy sectors.

***Table 3**: Cross-cutting mitigation measured cited within session 1.*

Black shading indicates mitigation measures identified by sectors.

Mitigations	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting findings								
Vaccination	■	■				■	■	■
Screens/physical barriers	■	■	■	■				■
Work bubbles	■	■		■				■
Working from home	■	■	■				■	■
Signage	■	■	■		■			
Reducing external contacts		■		■		■		■
Enforcing self-isolation		■	■			■		
Transport restrictions	■			■				■
Restrictions on shared facilities	■						■	■
Hand hygiene	■		■					■
PPE (gloves and aprons)	■			■		■		
Training, information and instruction		■		■	■			

During plenary discussion within the workshop and subsequently following provision of remote contributions, further insight was gathered, as described below.

Whilst **vaccination** was prioritised nationally for the vulnerable and elderly, Public Health England (PHE) were said to have set up vaccination centres in larger companies to promote vaccine uptake and some companies were reportedly allowing workers time off to get vaccinated.

Working from home was said to have been enabled where possible to avoid unnecessary staff contact with others, although many roles, in particular within the logistic/delivery sector and care

homes, did not allow for this. Working from home was not covered by the study scope conducted within retail close contact services.

Restrictions on transport were reported, such as avoiding paired travel (e.g. for delivery drivers, and energy sector workers) and limiting capacity in vehicles.

Reducing external contacts such as external visitors, reducing footfall, restricting entering homes for food delivery and prohibiting site tours. However, it was established that care homes are also homes, not just workplaces, so there had to be some level of freedom of movement here. **Provision of training**, **information and instruction** was said to have helped staff to stay up to date with changing guidance/restrictions from their company/industry or government. Within the food sector however, this was not reported to be actively implemented in a lot of sites. Within retail close contact services, many workers were said to have received training on effective face covering usage practices such as donning, doffing and disposal.

3.2.3 Sector-specific mitigations identified

Although many mitigations were common or crosscut the various sectors, 22 were identified by just one or two sectors as illustrated within Figure 6 (also tabulated within Annex 1: Mitigations by sector) and **Table 8:** Tabulated mitigations by sector. It is important to note that these mitigations may apply to other sectors, however they were not mentioned in the workshop and hence are not included as sector-specific mitigations in this write-up. The sector-specific mitigations are discussed below by work sector. The larger font displayed in the image represents mitigation measures identified by two sectors whereas the smaller font indicates mitigation measures identified by only one sector.

Figure 6: *Sector-specific mitigations*

3.2.3.1 Public transport

Sector-specific mitigations implemented within the public transport sector were as follows. T**emperature screening** was implemented to check for staff with a high temperature (acknowledged early in the pandemic to be a symptom of COVID-19). **Food and drink provision restricted for passengers** to avoid unnecessary contact with staff**. Touch-free alternatives utilised,** such as contactless payment enabled with the use of technology. Some public transport organisations also

made sure **vulnerable workers were able to shield** and stay at home and therefore less likely to be exposed to COVID-19.

3.2.3.2 Food processing

The greatest number of sector-specific mitigation measures (six in total) were identified for the food processing sector. This included **the placement of marshals to monitor staff** and **encouraged or enforced COVID-19 safe behaviours**, something considered to be particularly important where workers were mixing/not following social distancing rules during work hours or in cases where face coverings weren't being worn properly.

3.2.3.3 Higher education

Some sector-specific mitigations implemented within the higher education sector focused on hand hygiene, such as **hand sanitiser** or **hand wash instructions**. Other mitigations identified included **organisational business culture** and active **management of staff and student sickness.**

3.2.3.4 Logistics/delivery

Sector-specific mitigation measures identified within the logistics sector included the use of **gloves** to avoid transmission of COVID-19 through physical contact and **compliance monitoring** to ensure workers were testing regularly.

3.2.3.5 Close contact retail

Sector-specific mitigations implemented within close contact retail included **placement of bins** for workers to dispose of their face coverings when needed and **modified practices** in order for workers and customers to spend less time in close proximity within the consulting room.

3.2.3.6 Care homes

Four mitigation measures were identified for the care home sector, these included **aprons** for staff members, **staff accommodation**, **providing anti-virals** and **quarantine.**

3.2.3.7 Construction

Sector-specific mitigation measures identified by the construction sector were the **reduction of worker numbers** for specific tasks to allow for social distancing and a **positive organisational safety culture** where workers were already aware of health and safety hazards at work and hence, used to complying with safety rules on a regular basis. It was noted by workshop attendees that this existing focus on safety already prominent within the construction sector had helped them build in COVID-19 rules.

3.2.3.8 Energy sector

Sector-specific mitigation measures identified by the energy sector in isolation included use of **one-way systems**, **a pre-prepared pandemic response plan** that allowed rules to be implemented straight away, **dormitory arrangements**, **site COVID-19 hubs, proximity control monitors.**

3.3 Session 2 findings: Risk factors by sector

Researchers were asked to identify the COVID-19 risk factors that emerged for each sector of interest.

The following categorised (informed by work across the sectors before the workshop took place) were offered up to prompt researcher thinking during this session:

- Characteristics of the physical work environment;
- People's behaviours, norms and attitudes;
- Socio-economic and related factors;
- Factors outside of the physical work environment that may impact transmission within the workplace;
- 'Other' additional risk factors.

Input was collated relative to the prominence of risk factors cited to be relevant across the different sectors. Findings are presented below relative to whether they were common, cross-cutting or sector-specific.

3.3.1 Common risk factors identified for all or most sectors

Sixteen of the risk factors identified were found to be common, five of which included all eight sectors and a further 11 across seven sectors. These are illustrated within Figure 7 and discussed in turn below. The bigger font in the image indicates risk factors identified across eight sectors and the smaller font indicates risk factors identified across seven sectors.

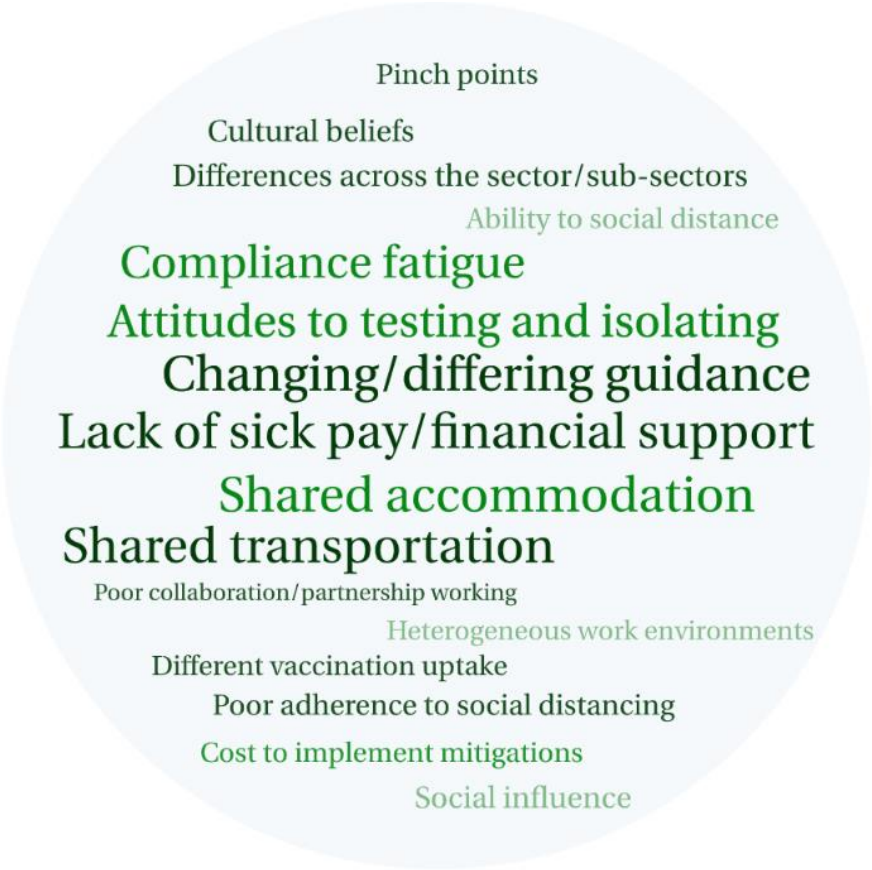

***Figure 7**: Common risk factors identified across seven or all eight of the sectors.*

Across the different sectors, workers and members of the public were said to be experiencing **compliance fatigue** (in particular with measures such as social distancing and the wearing of face coverings) having implemented a variety of mitigation measures since the start of the pandemic.

Poor collaboration and partnership working between government agencies at both a local and national emerged as a common risk factor as did a **lack of clear guidance and the frequency of changing guidance** over time. This was believed to have had a detrimental impact on people's trust

in the advice being given and subsequently people's **attitudes and practices towards testing, isolation** and other mitigation measures. Workshop attendees also highlighted **differences in vaccination uptake** across workers within seven of the eight sectors (all but energy production).

The sharing of transportation and accommodation were both said to be common risk factors across all sectors, though believed to be more prevalent within sub-sectors likely to employ low skilled/low paid staff, such as sandwich making within the food processing sector. With respect to shared transportation, this included workers traveling together using company arranged transport for employees (e.g. mini-bus) or car sharing private or company vehicles in order to travel to and from the workplace or move between work sites. Insight shared from sector-specific research suggested that the practice of workers sharing transportation: a) was common within workplaces that were hard to access via healthy commuting (e.g. walking or cycling) or public transport; b) financial motivators for car sharing were prevalent amongst lower paid workers wanting to minimise travel costs; and was prevalent amongst workers traveling to the same or neighbouring sites, family members and residents in a shared road/postcode for reasons of ease, cost and convenience. It should be noted that using public transport to travel to/from work was also seen as a potential risk factor in its own right, which many employers across different sectors advised against, especially early in the pandemic.

With regards to the **sharing of housing/accommodation**, this was said to encompass crowded living conditions and living within a shared permanent or temporary residential property. Reasons for sharing a residential property were most commonly cited as accommodating family arrangements, including fulfilment of caring responsibilities (e.g. children, elderly, vulnerable others) and staff accommodation onsite (specifically cited within food processing and care homes).

Adherence to social distancing was highlighted as a risk factor across the different sector-specific studies (said to be associated with compliance fatigue as mentioned above). Ability to socially distance was also a common finding, with sector-specific research finding that it was not always possible for staff to socially distance within the workplace. Furthermore, **pinch points** (such as entrances/exits) were said to present risk factors for transmission, in particular within larger businesses/sites employing larger numbers of people.

The **heterogeneity across different workplaces** and **differences across the sectors and indeed subsectors** were reportedly very diverse. This included infrastructure, operations, practices and environments for example care homes, building sites, transport vehicles and retail units. This was said to make it challenging to implement mitigation measures consistently, with a "one size fits all" approach believed to be too simplistic across all sectors with the exception of energy production.

The **cost of implementing mitigations**, either to the employer (e.g. installing mechanical ventilation or setting up site-based testing) or directly to workers themselves (e.g. not using shared transport to get to and from work) was cited as a common risk factor. Cost of implementing mitigations is also discussed within section 2.1.1, with respect to ventilation and site based testing, and as a barrier to preventing transmission of COVID-19 within section 3.4.

Lack of sick pay/financial support in the event of COVID-19 related absence, to enable staff to take sickness absence and/or self-isolate, was also reported for all sectors. This included the absence of financial support from Government, particularly early on in the pandemic, as well as variation across sub-sectors and employer and contract types (e.g. contractor, staff directly employed and those on zero hour contracts).

Differing cultural beliefs/organisational culture was highlighted as a common risk factor in all sectors. Workshop attendees made reference to existing organisational/sectoral cultures, safety, norms and practices prior to the start of the COVID-19 pandemic. In many cases this was said to have supported businesses and workers to prevent transmission and remain safe, for example: familiarity and conduct of health and safety risk assessments and working closely to keep each other

safe were reportedly commonplace within the construction industry; handwashing and hygiene practices already accepted and established within the food and care sectors. Elsewhere however (e.g. within close contact retail or office base environments), where such practices were less established and embedded within organisational culture, it was felt that the impact on productivity as a result of COVID-19 secure adaptations may lead to shortcuts, subsequently increasing transmission risk.

Social influence (i.e. other people's behaviour) was identified as a risk factor for transmission within seven of the eight sectors (all except energy production). In the context of retail close contact services, it was found if the professional conducting the consultation was wearing a face covering, then the customer was considered to be more likely to wear one. Researchers speculated that the type of role and relative power/seniority may also affect people's behaviours (front of house, security, pharmacist, shop assistant).

3.3.2 Cross-cutting mitigation measures identified across multiple sectors

Ten risk factors were found to be cross-cutting (identified by between three and six sectors). These are presented within

Table 4 below and again within Annex 1: Mitigations by sector. It can be seen that the fewest cross-cutting mitigations were cited for the energy production sector. The greatest number of cross-cutting mitigations were reported within Public transport, followed by the food processing.

***Table 4**: Cross-cutting risk factors cited within session 2.*
Black shading indicates mitigation measures identified by sectors.

Risk factor	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting findings								
Duration and proximity of close contact working	■	■		■	■		■	■
Insecure contracts/ gig work/ multiple jobs	■	■	■	■		■	■	
Contact with the public / service users	■		■	■	■	■		
High risk / high exposure activities	■	■		■	■		■	
Ventilation of indoor spaces	■		■		■	■	■	
Access to interventions (PPE , testing, antivirals) not always consitent	■	■		■	■	■		
Socialising outside work (with colleagues/outside of worker bubbles)	■	■	■	■			■	
Lack of access to data / sharing data	■		■	■		■		
Loud machinery/noise prompting workers to shout		■					■	■
Temperature/humidity		■			■			■
Profile of workers (eg ethnicity, age, underlying health)	■	■					■	

During plenary discussion within the workshop and subsequently following provision of remote contributions, further insight was gathered, as described below.

Insecure contracts, gig work and people working multiple jobs were identified as a cross cutting risk factor within six of the eight sectors. Researchers highlighted that workers moved between different work areas on site, between sites or indeed between more than one businesses. Researchers reported that it was difficult for businesses to monitor and conduct contact tracing amongst these more flexible and transient worker populations, whom in many cases were not directly employed by the business in which they work. Furthermore, contract terms and policies were said to differ between these worker populations and staff directly employed by the business, for example access to sick pay (discussed above within section 3.3.1).

High risk/high exposure activities were cited for five of the eight sectors, with researchers citing close contact working with co-workers, and working within confined spaces as examples during discussion. Six sectors highlighted **contact with the public/service users** as a risk factor for transmission, over which organisations and workers themselves had very little control, for example delivery and care workers entering customers' homes to fulfil their role. Within three of these sectors (public transport, higher education and care homes, a **lack of access to data/sharing data** was also highlighted as a risk factor due to the inability to monitor or implement contact tracing, for example amongst members of the public (e.g. passengers utilising public transport) or as a result of the sector being under-researched during the pandemic (e.g. care homes) and therefore not having as much COVID-19 data to inform decision making. Sectors that did have access to data had often collected the data themselves.

During workshop discussion, it became apparent that **access to interventions** was considered inconsistent across the different sectors. The timeliness of access to interventions, such as personal protective equipment (PPE), anti-virals and testing was highlighted as a risk factor within for example care homes, logistics and close contact retail. While shortages of PPE were found to be a barrier at the beginning of the pandemic, it was also suggested that access to testing and PPE may be limited moving forward, particularly now that [at the time of the workshop – April 2022] access to (free) testing, PPE etc. was no longer being provided to fit the "Living with COVID-19"[6] narrative set out by Government.

Researchers reported **temperature/humidity** as a risk factor for COVID-19 transmission identified within three sectors. Within the public transport and food processing sectors this was acknowledged to be a knowledge gap, with prior research suggesting a lack of understanding of the relative effects of temperature and ventilation on transmission, or that not enough emphasis was placed on these factors throughout the pandemic. For example, researchers from the food processing sector found that COVID-19 risk was often higher in factories with cold and/or humid environments, yet noted the difficulty in implementing the appropriate measures in such settings due to the different health and safety requirements already in place prior to COVID-19 (e.g. many meat/poultry facilities have certain temperature and ventilation requirements for food safety). Within the public transport sector variations were found across the different modes of transport (rail, bus, tram, taxi).
Noise/loud machinery was identified as a cross-cutting risk factor for transmission by four sectors. Within the food sector, this was said to lead workers, in particular managers, to move closer to one another and to shout in order to communicate.

3.3.3 Sector-specific risk factors identified

Twelve sector-specific risk factors were identified by just one or two sectors as illustrated within Figure 8 (also tabulated within Annex 2: Risk factors by sector) and **Table 8:** Tabulated mitigations by sector. It is important to note that these risk factors may apply to other sectors, however they were not mentioned in the workshop and hence are not included as sector-specific risk factors in this

[6] UK Government, (2022) COVID-19 Response: Living with COVID-19. Available at: https://www.gov.uk/government/publications/covid-19-response-living-with-covid-19

write-up. The sector-specific mitigations are discussed below by work sector. The larger font displayed in the image represents risk factors identified by two sectors whereas the smaller font indicates risk factors identified by only one sector.

Figure 8: *Sector-specific risk factors*

3.3.3.1 Public transport

The greatest number of sector-specific risk factors (five in total) were identified for the public transport sector. **Staff shortages** (also reported for the food production sector) were reportedly due to Britain leaving the European Union ('BREXIT'), 'pingdemic' (issues with the contact tracing app identifying the proximity of phones as opposed to people), and staff illness or self-isolation requirements. **Difficulties in policing mitigations** included a lack of clarity regarding who was responsible for enforcement of the measures, **distrust** in the public 'doing the right thing' and implementing mitigations as they should be, as well as conversely too much **trust** between colleagues (both of which were also reported for the construction sector). Trust between colleagues was said to make following rules and subsequent enforcement more difficult (e.g. passengers considered to pose a greater transmission risk and hence workers relaxed measured and reduced enforcement amongst fellow colleagues).

Some public transport organisations were reported to make sure that vulnerable workers were able to shield and **work from home** and therefore be less likely to be exposed to COVID-19. Researchers representing non-specific sectors (e.g. research into enduring prevalence of COVID-19) also echoed the ability to work from home as a factor affecting transmission risk, although this was considered to be more reflective of the workers role rather than the sector in which they worked. As already discussed within section 3.2.2 of this report, the ability to work from home was a mitigation measure reportedly implemented (where possible) across a number of sectors, however this was only cited as a risk factor for transmission within the research into the public transport sector during the second session of the workshop.

One risk factor isolated to the public transport sector alone was the **financial instability of the sector**, following reduced footfall and revenue which required propping up by Government in the form of grants.

3.3.3.2 Food processing

Three sector-specific risk factors were identified for the food processing industry. **Presenteeism** was identified as a risk factor for transmission within the food production and logistics/delivery sector, something echoed by non-specific contributors. The food production sector (and logistics/delivery sector) was said to have a large number of migrant, temporary and/or agency workers, from **diverse**

cultural backgrounds and amongst whom **language barriers**, i.e. the ability to read and/or understand spoken English, was identified as a risk factor. For this reason, it was speculated by participants within the sector-specific research undertaken that awareness of the pandemic may have been more limited. Language barriers were also reported to pose communication challenges between managers and workers who did not speak English as a first language.

3.3.3.3 Higher education

No sector-specific risk factors were identified by researchers representing COVID-19 research within higher education sector.

3.3.3.4 Logistics/delivery

Two sector-specific risk factors were reported for the logistics/delivery sector – both of which (Presenteeism and diverse cultural backgrounds) were echoed within the food production sector, discussed within section 3.3.3.2 above.

3.3.3.5 Close contact retail

Two sector-specific risk factors were identified for retail close contact services (both of which were shared with the care homes sector). Firstly, a need for workers to raise their voice/shout in order to overcome **communication challenges**, with colleagues and customers, when wearing face coverings (already discussed within section 3.2.1). Secondly, **correct use of PPE** was also cited as a risk factor for transmission within these sectors that require considerable close contact working with others. A lack of disposal facilities was specifically highlighted within close contact retail settings as something that may impact safe and hygienic disposal of face coverings amongst members of the public.

3.3.3.6 Care homes

Three sector-specific risk factors were identified for care homes. In addition to communication challenges and correct use of PPE (both disused above under section 3.3.3.5), **having a safe space for visitors** was reported as an isolated risk factor for this sector alone.

3.3.3.7 Construction

Three sector-specific risk factors were identified for the construction sector. In addition to difficulties in policing mitigations and excess trust amongst colleagues (discussed above within section 3.2.3.1), **extremes of differing risk perceptions** were cited amongst construction sector workers, including fear of illness and apathy/no concern for catching COVID-19.

3.3.3.8 Energy sector

Only one sector-specific risk factor was identified by the energy production sector in isolation, this being **burnout of key COVID-19 leads**, identified as a risk factor given the instrumental role this relatively small number of worker played in managing the organisational response to the COVID-19 pandemic, often alongside their 'day job' role and responsibilities.

3.4 Session 3 findings: Barriers and enablers

Researchers were asked to write down the barriers to preventing COVID-19 transmission by sector, and to provide each barrier with an impact rating (high, medium or low). In the main researchers cited only high level impact issues during this task and hence no differentiation between impact levels have been reported. Many of the barriers and enablers identified have already been discussed during earlier sections of this report, relative to contributions made in earlier workshop discussion sessions, and hence content has not been duplicated within this section. It is also worth noting that a

number of factors were identified as both barriers and enablers of preventing SARS-CoV-2 transmission, for example communication, testing, and financial support to enable sickness absence. In some cases, researchers describe the same factor but from a different perspective however in other cases, this reflects differences between the sectors, or indeed subsectors, of interest.

3.4.1 Common barriers and enablers identified for all or most sectors

Only two common barriers and one common enabler was identified across all/most of the sectors.

Barriers

Researchers across all sectors noted that the **communication of messages and confusing government guidelines** as a barrier to preventing transmission. This was particularly the case for workplaces which had to continue updating their mitigation measures to meet changing government guidelines, which were noted to vary across the UK (devolved government), as well as particular mitigations such as face coverings, social distancing and isolation requirements, where government guidelines changed quite frequently and often at short notice.

The **cost of control measures/financial challenges** was a common finding across all sectors. This was described as the cost to implement measures to either the employer or workers themselves (discussed within 3.3.1). A lack of funding also emerged through workshop discussion as a financial challenge in many sectors often with reference to funding being prioritised for other competing interests/priorities (e.g. BREXIT) during this time period. As such, researchers noted that it was difficult for companies and managers to receive the funding needed to implement COVID-19 mitigation strategies. Financial instability within the public transport sector (cited within 3.3.3.1) meant that the Government reportedly had to take many franchises back under public control for periods of time and use large subsidies in order to compensate for footfall decrease with associated reduction in fare revenue.

Enablers

Testing was the only common enabler to preventing SARS-CoV-2 transmission, identified by seven of the eight (all but close contact retail) sectors. As discussed within section 3.2.1, testing was identified as a common and effective mitigation measure, which included LFT, PCR, antibody testing and sewerage water testing delivered in a range of settings from NHS/community settings, site/workplace and home**.** The energy sector specifically identified antibody testing as an enabler, allowing workers to find out whether they have previously had COVID-19, and if they had not, they could be more careful and continue to test regularly for COVID-19. It should be noted that access to testing was however identified as a sector specific barrier (discussed below within section 3.4.3).

3.4.2 Cross-cutting barriers and enablers identified across multiple sectors

Barriers

Five barriers were found to be cross-cutting (identified by between three and six sectors). These are presented within Table 5 below and again within Annex 3: Barriers and enablers (for introducing mitigations)

***Table 5**: Cross-cutting barriers cited within session 3.*

Black shading indicates mitigation measures identified by sectors.

Barrier	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting findings								
Poor mitigation enforcement	■	■			■			
Communication/language problems	■	■		■	■			
Heterogeneity across different workplaces	■	■				■	■	
Shortage of PPE		■		■		■		
Movement between sites / different regions	■			■			■	

Four of the five cross-cutting findings have already been discussed in depth elsewhere in the report and hence, are not discussed further here to avoid duplication. This includes:

- **Communication and language problems**, particularly in relation to ensuring the use of face coverings once government guidelines no longer mandated their use within public settings (see section 3.3.3.5)and language barriers between different worker groups, for whom English was not often not their first language (see section 3.3.3.2).
- **Heterogeneity across different workplaces**, said to make it challenging to implement mitigation measures consistently, with a "one size fits all" approach believed to be too simplistic - see section 3.3.1.
- **Poor mitigation enforcement,** across different sub-sectors and companies associated with changing guidance, lack of clarity regarding who was responsible for enforcement and issues related to trust in the public and fellow colleagues (as discussed within section 3.3.3.1).
- **Shortages of PPE**, both at the start of the pandemic and relative to concern for the future as the government continues to implement their "Living with COVID-19" strategy and removes free and open access (discussed further under 'access to interventions' within section 3.3.2).
- **Movement between sites** and across different regions for work was also reported to be across-cutting barrier in three sectors, particularly those where workers are having to travel between several sites or to and from work/home using shared transport/vehicles.

Enablers

Seven enablers were found to be cross-cutting (identified by between three and six sectors). These are presented within **Table 6** below and again within

Annex 3: Barriers and enablers (for introducing mitigations**)**.

***Table 6**: Cross-cutting enablers cited within session 3.*

Black shading indicates mitigation measures identified by sectors.

Enabler	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting findings								
Allowing remote/home working where possible	■	■	■					■
Support for workers individual needs	■	■		■				■
Internal communication	■	■		■				■
Provision of face coverings	■	■			■			■
Existing safety/hygiene culture	■			■			■	
Signage	■				■			■
Taking steps to facilitate sickness absence where necessary for COVID19		■		■				■

Support for workers individual needs was identified as an enabler in four of the eight sectors. This included identifying staff who were vulnerable and therefore more likely to be critically ill if they caught COVID-19 or staff who cared for vulnerable people at home. This allowed tailored support to be put in place, such as workers being furloughed, allowed to amend roles and remote/home working (discussed further within sections 3.2.2 and 3.3.3.1).

Research within the energy and public transport sectors also identified provision of wellbeing support through an external provider for workers (both onsite and working remotely) during the pandemic as an enabler, with many such schemes reported to continue after the height of the pandemic.

Allowing remote working where possible was carried out in sectors where there was the ability to adapt to a remote setting and the work could still be conducted from home, such as lessons being taught online in higher education, meetings held remotely in many sectors etc. helping to limit contact with other people. This was not possible in some sectors, such as the close contact retail sector, food manufacturing or certain roles in public transport where workers provided a service that needed to be carried out in person.

Internal communication as an enabler included employers/workplaces keeping workers informed about the COVID-19 guidelines in the workplace and the expectations placed upon them. Workshop attendees reported that the quality of communication from employers played an integral role in messaging, as government guidelines were often confusing, so employees relied upon their workplace to inform them of the guidelines. Some workers rated communications pre-pandemic as low, but this was said to improve during the pandemic, with staff reportedly grateful for updates.

The energy sector also implemented an exclusive intranet page for COVID-19 information for workers to receive regular updates and remain informed about guidance. They also ensured that there was regular engagement with the company doctors throughout the pandemic.

The **provisions of face coverings** was cited as an enabler within three of the eight sectors. This included a plentiful supply of face coverings being made available to workers within the energy sector and retail close contact settings. Within public transport, some modes of transport (e.g. taxi drivers), workers that came into direct contact with the public were provided with face coverings.

Existing safety/hygiene culture, already discussed within section 3.3.1 (under 'differing cultural beliefs/organisational culture') was seen as an enabler, where workers were already very aware of safety hazards at work and were used to accommodating safety rules and regulations on an ongoing basis. This made rules brought in for mitigating COVID-19 spread easier to introduce and was perceived to positively impact compliance.

Signage reminding members of the public and workers of the COVID-19 rules, such as wearing a face covering and to social distance, allowed customers within public facing sectors (public transport and retail close contact services) to understand exactly what was expected from them in a given setting, as this was sometimes unclear to the public due to the constant changes in government guidance. The energy sector identified extensive control signage such as the site risk status, one way systems and posters to be helpful in supporting workers to follow the guidelines. Many sectors reported use of additional signage to help manage one-way systems (e.g. arrows on floors) as can be seen within Table 6.

Some sectors reported **taking steps to facilitate sickness absence where necessary for COVID-19**. Within the food sector, the government isolation payment was cited to be accessible to workers, introduced relatively late into the pandemic. Within the energy production sector, normal sickness policy arrangements were suspended for COVID-19 related absence. In both cases these steps were taken to remove the financial detriment for those required to isolate in order to encourage workers to remain away from the workplace when testing positive for the virus and prevent transmission to colleagues.

3.4.3 Sector-specific barriers and enablers identified across one or two sectors

Barriers

Fourteen sector specific barriers were identified by two or less sectors, as illustrated within Figure 9. These are also presented within Annex 3: Barriers and enablers (for introducing mitigations). The larger font displayed in the image represents barriers identified by two sectors whereas the smaller font indicates barriers identified by only one sector.

Figure 9: *Sector-specific barriers*

Many of the sector specific barriers have already been explored elsewhere within the earlier sections of this report, additional barriers cited during session three of the workshop are discussed below.

Behaviour compliance amongst workers or service users was noted as a challenge attributed to the changing guidance over the course of the pandemic. This was more likely to cause confusion and difficulties for workers in sectors which tried to implement mitigation measures which were not required by the government. For example, ensuring the use of face coverings on public transport and within retail premises sectors may have been more difficult to implement once the government guidelines removed masks as a mandatory measure.

The **nature of work** was identified as a barrier to preventing transmission within two sectors. The nature of construction work may include constant changes between indoor and outdoor environments, and frequent interaction with different individuals, suggesting a higher risk of transmission. Similarly, individuals working in public transport may have to work in tightly enclosed spaces (e.g. training in cab for train drivers or signal boxes) in close proximity to others. The nature of the work was also identified as an enabler (below), although by an alternative sector of interest, discussed within this section as a sector specific enabler within the food sector.

Lack of **research data on mobile populations** was highlighted relative to students/staff attending and working in higher education settings. This was particularly an issue for individuals who may sometimes attend university in person, but who also attend courses/meetings etc. remotely. Given that these factors may vary considerably between institutions and sites, it could be suggested that findings on transmission may be more difficult to generalise and therefore more difficult to apply adequate COVID-19 mitigation measures in place for this sector.

Fear of offending colleagues was raised from research into public transport. This was particularly an issue surrounding peer-to-peer encouragement for mitigation measures such as face coverings and social distancing. Workers either did not want to offend their colleagues by suggesting that they had COVID-19, or they generally felt very comfortable around colleagues and hence did not think it was as necessary to follow COVID-19 guidelines.

Findings from the non-specific sector researchers included some additional barriers, such as problems associated with the national control of COVID-19 from the beginning of the pandemic, along with barriers surrounding the lack of IT capability for many employers. For example, researchers noted that the lack of IT capabilities across certain industries and/or sites made it difficult to provide remote-working as an option for employees. This could be due to the lack of IT services in the sector, sourcing IT equipment when there was a huge demand, or because work in certain sectors could only be conducted in person.

Enablers

Twenty three sector specific enablers were identified by two or less sectors, as illustrated within Figure 10. These are also presented within **Annex 3: Barriers and enablers (for introducing mitigations).** The larger font displayed in the image represents enablers identified by two sectors whereas the smaller font indicates enablers identified by only one sector.

Figure 10: Sector-specific enablers

Many of the sector specific enablers have already been explored elsewhere in earlier sections of this report, additional enablers cited during session three of the workshop are discussed below.

The greatest number of sector-specific enablers (12) were reported for the energy production sector, followed by the public transport sector (eight). Both Logistics/delivery and close contact retail sectors cited the least amount of sector specific enablers, with only one identified for each.

Mandating **reduced ridership** was isolated to the public transport sector alone and involved limiting capacity on public transport to reduced numbers to enable social distancing. **Data gathering**, reported for public transport and energy production sectors, involved monitoring all COVID-19 absences (positive cases and self-isolations) for staff and contractors, and conducting mitigation reviews. Data gathering was also reported for the energy production sector, although relative to assessing data in local areas as well as internal data analysis.

Continuation of mitigations was an enabler identified by the public transport and close contact retail sectors. Mitigations, such as wearing face coverings and cleaning surfaces, were implemented to help customers feel safe and continue to use or return to using the service. For example, hair and beauty salons reported still mandating face coverings even though it was not mandated by the government, to help the customers feel at ease when receiving a service from the salon. The public transport sector reported enhanced cleaning regimes ('Hygiene theatre'), even when it was acknowledged that COVID-19 could be transmitted via both airborne means and fomites. Customers felt more at ease when they could see that the surfaces had been cleaned and therefore more likely to use public transport. Both were examples of visible mitigations.

The energy sector was said to apply a conservative two-week **lagging approach to relaxing mitigation measures** (thus giving time to assess the impact of Government relaxations in the community before adopting them within the organisation). Furthermore, other sector-specific enablers reported for the energy sector was **emergency preparedness prior to the pandemic**, this included a pandemic response plan (which was already in place following previous bird/swine flu) and a command and control structure e.g. Crisis Management Team, Company Pandemic Working Group, Generation Incident Management Team, Generation Pandemic Working Group and a site based COVID-19 response team. This enabled prompt action following changes to the guidelines in order to minimise COVID-19 transmission in the workplace. The energy sector also identified **establishing a tiered risk ratings mechanism with supporting controls** as an enabler.

Use of **technology** within public transport and retail close contact settings included non-touch payment methods (cited within section 3.2.3.1) and use of video consultation methods as alternative to in person assessments.

Financial help from the government was identified by public transport and the food processing sector. This included grants to allow services to keep operating and money to allow staff to be furloughed.

As discussed within section 3.4.3, **the nature of work** was identified as a barrier to preventing transmission within two construction and food production sectors, though it was also highlighted as an enabler for the food production sector. This was due to differences between subsectors and work environment. For example, fruit pickers in the food processing sector work outside and avoid close proximity working, in comparison to workers making a sandwich who would be in close proximity to others inside a factory. This was also identified as a barrier (see above).

The introduction of seasonal agriculture workers scheme was implemented by the food-processing sector allowed workers from overseas to come to the United Kingdom and take part in seasonal work, such as fruit picking, for a certain period of time.

3.5 Session 4: Gaps in knowledge

Researchers were asked to highlight the gaps in knowledge found in the sectors with which they had been working. There were some similarities and differences found across the sectors, and findings covered overarching factors, mitigations, human behaviour, communication, longer-term issues etc.

3.5.1 Cross-cutting gaps in knowledge

3.5.1.1 Knowledge gaps about mitigation measures:

Findings regarding knowledge gaps and future concerns often covered factors relating to mitigation measures. Amongst these, individuals noted the confusion faced by sectors regarding the effectiveness of individual mitigations (due to their being introduced at pace and all at once during the early stages of the pandemic). Researchers also noted that sectors outlined some knowledge gaps surrounding the **continuation of specific mitigations moving forward** and knowing which would be most cost-effective. This was specifically mentioned for mitigation measures such as enhanced cleaning regimes, which were emphasised more during the beginning of the pandemic (before the role of aerosol transmission was understood) but started to decrease in terms of effectiveness as further research emerged surrounding other measures (such as ventilation, temperature etc.). However, in some sectors, enhanced cleaning was continued due to it being a visible mitigation measure which helped workers and the public (e.g. Public transport) to feel safer, despite less evidence of its effectiveness (Hygiene theatre).

Furthermore, researchers noted that it was difficult for workplace managers to know which mitigation measures to continue using once the government guidelines changed to reduce the number of mandatory COVID-19 related mitigation measures, such as ensuring face coverings, social distancing etc. Another knowledge gap surrounding mitigation measures was found to be the lack of understanding on the topics of **ventilation, temperature and humidity**. While these environmental measures were not mentioned across all sectors, they appeared to be a prominent theme to emerge in the food processing sector and public transport sectors. In particular, respondents in both these sectors found that either little information was provided to them regarding the effects of temperature and ventilation, or that not enough emphasis was placed on these factors throughout the pandemic. Some respondents also suggested that it was difficult to implement adequate ventilation systems due to financial constraints.

Further knowledge gaps outlined by researchers across the different sectors included the lack of information and difficulty in preparing for other **potential variants of the virus**. This was particularly seen as a problem in terms of mitigation, given that different variants may require a different set of mitigation measures to be put into place, or may appear in the future once certain mitigation measures have been stopped. Similarly, researchers noted that there was a general lack of knowledge surrounding the effectiveness of workplace risk assessments, and that most sectors did not update their risk assessments accordingly enough.

Sectors wanted to know what the risk of COVID-19 (including new variants) is going forward and which, if any, mitigations would be appropriate and effective to continue with in order to control this risk. Sectors most concerned with this were the food processing and public transport sectors.

3.5.1.2 Knowledge gaps about behaviour, communication and people

Researchers noted that some forms of knowledge gaps existed in relation to human behaviour and communication across industries. For example, many found that **further research focusing on behavioural science** would help provide a better understanding of different groups and their attitudes, norms and behaviours across different sectors. In turn, this would help us understand, for example, why certain workers are more likely to follow government guidelines and follow mitigation measures as opposed to others, and how various sets of factors could influence this. It could also help target mitigation measures to specific groups for future pandemics and outbreaks of viruses/diseases.

Researchers across sectors also noted **changes in guidance** throughout the duration of the pandemic and its negative impact on many industries. This related to both the number of changes and pace of change of the guidance which, once issued, had to be interpreted by sectors and individual companies and communicated effectively with workers (and public where applicable). This was found to be an issue moving forward, and a knowledge gap for many managers in different sectors, **who may be unable to plan effectively for the future.** This was a particular issue mentioned in the food production and public transport sector, where findings indicated a high level of concern surrounding the uncertainty of future guidance provided by the government. Research in these sectors also found that companies found it difficult to keep up with guideline changes which often subtly differed between the different countries in the UK, noting that future measures may also vary again between companies in Scotland, Wales and England. This was also similar to another knowledge gap presented, which included the **uncertainty on how to effectively communicate and plan responses moving forward**.

Other knowledge gaps found across sectors included **the lack of knowledge surrounding "at risk" groups/workers** (which was mentioned in the food production sector and the care home sector) including workers who were more vulnerable or lived with vulnerable family members. It could be suggested that further efforts to learn about the workforce could help ensure better communication between managers and workers. This could be especially helpful to ensure vulnerable groups are receiving the help required.

The **lack of knowledge relating to COVID-19 rates in the local community** was also mentioned by the public transport and food production teams. This was noted to be an issue, given that many workforces consisted of individuals who lived in different cities and communities, a factor which could **determine the risk of COVID-19 transmission both inside and outside of the workplace**. This was also an issue for sectors which relied on service users hailing from across the country, such as those using public transport. Ensuring better understanding of local communities could help tailor the correct mitigation measures depending on factors such as community prevalence rates.

3.5.1.3 Knowledge gaps on longer-term issues

Knowledge gaps surrounding longer-term issues related to the COVID-19 pandemic were also raised by various researchers. Of these, the unknown effect of **potential future variants** and the

knowledge gaps surrounding the virus' transmission routes and symptoms were found to be a problem in many of the sectors. Similarly, the **unknown future of the pandemi**c as a whole was found to be an issue for the management of transmission and investment in suitable mitigations in the future.

Other questions surrounding this theme emerged from the researchers' findings, mainly emphasising that uncertainty remained for the current **"living with COVID-19"** (since restrictions were relaxed in February 2022) **phase of the pandemic**, which has **limited mitigation measures in place, free testing services have stopped and the track and trace system dismantled**. This was said to produce potential difficulties in knowing the current COVID-19 case rates in different locations, and could undoubtedly have a negative impact on workers who may still choose to go to work even when they are unwell (e.g. if no sick pay). It may also be a larger risk factor for certain groups of people, such as those who are clinically vulnerable (e.g. the care home sector) or those caring for vulnerable individuals. These changes that have been made have also been said to present challenges for **researchers conducting longitudinal research**, as the changes to COVID-19 guidelines may affect their current research or research which requires individuals to follow the same set of guidelines over a period of time. Similarly, some researchers raised issues surrounding the **availability and quality of data**, particularly at the present time, where COVID-19 cases are less likely to be reported due to the lack of testing available. Some researchers also found that there was a lack of clear information **surrounding emergency planning responses for the future**, in cases where the pandemic could escalate again (new waves), or sectors could be faced with further health emergencies in the future.

Further knowledge gaps that may be presented as a challenge in the future, such as the impact of long-term health problems associated with **long-covid-19 and strained health and care services**, were also identified by researchers. In particular, researchers noted the potential issues which may present themselves for individuals who experience **long-covid-19 symptom**s, and how this may affect businesses and employers whose workforce are severely affected. However, they noted that research surrounding long-covid-19 symptoms is currently under-researched and relatively less known.

Similar to above, another knowledge gap noted by researchers was the uncertainty surrounding the **impacts of wider agendas,** particularly the impact of **BREXIT and low carbon emissions** in the upcoming future. Certain sectors had already discussed the negative impact of such agendas at the current time (such as the food processing sector and the impact of BREXIT of production supply or public transport and the carbon neutral agenda), further emphasising that future challenges and knowledge gaps may arise.

***Table 7**: Cross-cutting gaps I knowledge cited within session 4.*

Black shading indicates mitigation measures identified by sectors.

Enablers	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting								
1. The impact of mitigation measures such as ventilation, temperature and humidity		■				■		
2. Not knowing the number of cases due to cuts to testing/track and trace etc.	■							■
3. Lack of knowledge surrounding virus transmission routes and virus symptoms		■				■		
4. Not knowing which mitigation measures to continue using and which are most effective	■					■	■	
5. Lack of availability of data	■	■				■		
6. Lack of understanding and research on human behavior and how this impacts mitigation	■	■						
7.Communication methods between employers and employees	■	■						
8. Lack of information regarding the local community		■						
9. Lack of effective communication and emergency plan responses	■			■				
10. Lack of knowledge surrounding “at risk” or vulnerable groups/workers		■				■		
11. Unknown future of pandemic		■						
12. Unknown effect of COVID-19 on long-term health (e.g. long-covid) and health services		■				■		
13. Lack of information regarding the impact of wider agendas, such as Brexit, carbon neutral	■	■						
14.Cconfusion due to different guidance amongst different nations	■	■			■			
15. Not knowing how to adjust to constant guideline changes	■	■						
16. Not knowing what an effective workplace risk assessment is		■						

Of those cross cutting knowledge gaps tabulated above, non-specific researchers in attendance at the workshop echoed six of the knowledge gaps cited above, these being:

1. The impact of mitigation measures such as ventilation, temperature and humidity
2. Not knowing the number of cases due to cuts to testing/track and trace etc.
4. Not knowing which mitigation measures to continue using and which are most effective
6. Lack of understanding and research on human behaviour and how this impacts mitigation

8. Lack of information regarding the local community
11. Unknown future of pandemic
12. Unknown effect of COVID-19 on long-term health (e.g. long-COVID-19) and health services
15. Not knowing how to adjust to constant guideline changes
16. Not knowing what an effective workplace risk assessment is

3.5.2 Sector-specific knowledge gaps

Although many knowledge gaps were similar between sectors; some were found to be specific to one sector only. Below provides a summary of the knowledge gaps which were identified for one specific sector.

3.5.2.1 Care homes

Researchers working in the care home sector found several knowledge gaps which appeared to only be evident in this sector. This included the **difficulty in collecting data for individuals living in care homes** due to a general lack of information and research on this group of people. Similarly, researchers expressed that not enough was known on the **specific mitigation measures** to look out for when preventing COVID-19 in this setting. This could again be due to the lack of research and data on this population/sector. Researchers also noted that findings from this sector **did not show seasonality in the COVID-19 cases and deaths**, which has presented some questions regarding the "expected" number of deaths in care homes.

3.5.2.2 Close contact retail

Researchers studying the close contact retail sector found that there was a **general lack of information surrounding familiar/simple language being used in workplaces**. They noted how this may impact communication between different staff members. They also stated that there was a lack of information surrounding the use of **face coverings** in the future, and if they should be legally mandated or not in this sector, despite government guidelines removing this as a mandatory rule in the UK.

3.5.2.3 Public transport

Work in the public transport sector found several knowledge gaps which appeared to be sector-specific. For example, they stated that there was a lack of information surrounding the **well-being of workers** during the pandemic, and that this would be vital to learn about moving forward in order to help provide the right services and support, particularly surrounding mental health. They also found that there was a **lack of information surrounding the fundamental changes** which may be relevant to the sector moving forward, such as changes to funding (Government subsidy vs funding via collected fares) and the number of passengers using public transport in general (which may have changed since the pandemic). They also found that it was **difficult to understand the acceptable level of risk to allow in the sector,** particularly now that mitigation guidelines have changed and as a society we are learning to "live with COVID-19".

3.5.2.4 Construction

The construction sector found that there was a lack of knowledge **surrounding adherence/risk to different job roles/companies**.

3.5.2.5 Higher education

Researchers focusing on this sector noted that there was no information on **high-risk activity taking place** in this sector, particularly because individuals in this sector are more likely to be from a broad range of backgrounds, and have different risks based on a range of factors.

3.5.2.6 Food production

Knowledge gaps which were specific to the food sector included an overall **poor knowledge of the workforce** and the lack of information on the impact of mitigation measures such as **ventilation, temperature and humidity.** For the former, researchers noted that findings indicated a lack of knowledge on the groups of people who worked in the sector, including their social background, ethnicity, living situation etc., which made it more difficult to know which mitigation measures to implement in the sector, and to ensure that there is effective communication between workers and managers. This seemed to be an issue, especially for the high number of temporary and agency workers in the sector, something which may go unnoticed by managers. For the latter point, researchers found that while ventilation, temperature and humidity were all said to be important factors in reducing SARS-CoV-2 transmission in the food production sector, there was a general lack of knowledge on the true efficacy of these measures, particularly from workers and managers, and that this would require more emphasis in future mitigation plans.

3.5.2.7 Non-specific sector contributions

Knowledge gaps which were found in other/general sectors also included not knowing the cost-effectiveness of rapid testing in preventing/controlling outbreaks.

4 CONCLUSIONS AND NEXT STEPS

The workshop brought together key experts on the PROTECT core study with important objectives of investigating the sector-specific mitigation measures; identifying sector-specific risks, mapping the key enablers and barriers; and understanding key knowledge gaps in different sectors. The overarching aim was to generate evidence on comparative sector-specific practices to enhance the understanding of COVID-19 transmission and inform recommendation for policy and action to be applied across a range of workplaces in the event of future variants or other health emergencies.

Across the sectors, contributions from public transport, food processing and the energy sector appeared to have the most aligned mitigation measures. The most prominent overlap between sectors in relation to risk factors was public transport, construction, logistics and food. For barriers, public transport and the food processing sector was most aligned. The public transport, food processing and energy were the most aligned in relation to enablers. These similarities seen may not represent an absence of the mitigations, risks, barriers and enablers in other sectors. Rather, studies from other sectors may have only explore a select number of mitigations and therefore researchers could not report on these mitigations at the workshop.

In contrast the care home sector and energy sector appeared to be least aligned. A reason for this could be the difference in the nature of the two sectors. For example, the care sector is a predominantly person facing sector where workers spend the majority of their time in contact with the individuals they are caring for. In contrast, in the energy sector there is more opportunity for worker interactions to be restricted to a small number of necessary co-workers when required e.g. working on plant. These differences may have caused different mitigation measures to be put in place, different risk factors to be present in the work setting and may have presented different enablers and barriers when the two sectors were controlling the transmission of COVID-19. Additionally, as part of the nation's critical infrastructure, energy production sector needed to implement multiple stringent measures will all workers to maintain production, with reliance on a relatively small number of core staff (Suitably Qualified and Experienced Persons (SQEP) to deliver safety related work. Care homes have a less stable and more transient workforce (agency, 0 hours contracts, and multiple locations) with additional influential factors at play with staff interacting with multiple residents. In addition, the work environment of a power plant has greater space/larger environment to space people out and conduct 24 hour operations. Whereas within the care home sector, the design has the purpose of being a home with consideration for support needs so therefore it does not have large areas or lots of segregation which is needed for the prevention COVID-19.

Future primary data collection could revisit sectors of interest with a focus on the 'living with COVID-19' advice issued by the government in February 2022. The work could explore organisational leaders and/or sector experts' perspectives of; transmission of COVID-19, managing COVID-19, worker sickness and support, knowledge gaps, lessons learned and future challenges. Furthermore, ongoing work is being conducted by PROTECT researchers looking at COVID-19 transmission within the energy production sector, enduring prevalence and the Greater Manchester case study. This could be integrated in to the current work to provide further insights of relevance though not specific to any given sector. Additionally, the current work focused on sectors where research had been/was being conducted by PROTECT researchers. Future research could usefully focus on COVID-19 transmission and mitigation measures within different sectors which continued operation during the pandemic and or where compliance with recommended mitigation measures may have been particularly challenging such as primary schools, emergency services, essential retail (e.g. supermarkets), and leisure.

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Annex 1: Mitigations by sector

Table 8: *Tabulated mitigations by sector.*

Black shading indicates mitigation measures identified by sectors.

Mitigations	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Common findings								
Face covering	■	■	■	■	■	■	■	■
Ventilation	■	■	■	■	■	■	■	■
Enhanced cleaning regime	■	■	■	■		■	■	■
Social distancing	■	■	■	■		■	■	■
Testing	■	■	■	■		■	■	■
Cross-cutting findings								
Vaccination	■	■				■	■	■
Screens/physical barriers	■	■	■	■				■
Work bubbles	■	■		■				■
Working from home	■	■	■				■	■
Signage	■	■	■		■			
Reducing external contacts		■		■		■		■
Enforcing self-isolation		■	■			■		
Transport restrictions	■			■				■
Restrictions on shared facilities	■						■	■
Hand hygiene	■		■					■
PPE (gloves and aprons)	■			■		■		
Sector-specific findings								
Restricting food/drink for passengers	■							
Shielding vulnerable staff	■							
Temperature screening	■	■						

Mitigations	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Sector-specific findings								
Contact tracing		■						
Placement marshals to monitor staff		■						
Non touch options	■	■						
Risk assessment		■						
One way system		■						■
Providing staff with training		■			■			
Culture			■				■	
Staff and student sickness management			■					
Compliance monitoring				■				
Exclusion zones				■				
Relay out workplace				■				
Training, information and instruction				■				
Modified practices (spending less time in consulting room)					■			
Placement of bins for workers					■			
Quarantine						■		
Anti-virals						■		
Staff accommodation arrangements						■		■
Reduction of worker for specific tasks							■	
Site covid hubs								■
Pandemic response plan								■
Proximity control monitors								■

Non-specific contributions put forward from researchers not representing specific sectors echoed the mitigation measures that were found to be cross cutting findings across three or more sectors. These mainly included testing, enhanced cleaning regime, use of screens, vaccination programmes and accessible vaccine sites, restrictions on transport, work bubbles, social distancing and face coverings.

Non-specific contributions put forward from wider researchers also echoed some of the mitigation measures that were found to be sector-specific (mainly contact tracing, hand hygiene and reduction of numbers of workers). Additional mitigation measures that were cited in isolation by non-specific research contributions and did not reflect the mitigation measures that were found to be sector-specific were:

- Workplace closure;
- Extra changing rooms;
- Reduced working hours;
- Staggered break times;
- Using local knowledge to control transmission;
- Making guidance accessible for local communities;
- The importance of local and national teams working together;
- Working closely with other directors of public health (different geographic areas);
- Restructuring public health teams to focus on COVID-19;
- Working with a range of community partners.

Annex 2: Risk factors by sector

***Table 9**: Tabulated risk factors by sector.*

Black shading indicates risk factors identified by sectors.

Risk factor	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Common findings								
Compliance fatigue (staff / public)	■	■	■	■	■	■	■	■
Attitudes to testing and isolating (inc resistance to testing)	■	■	■	■	■	■	■	■
Shared transport (inc travel to work/movement of staff between locations)	■	■	■	■	■	■	■	■
Shared accommodation	■	■	■	■	■	■	■	■
Guidance/messaging over time (frequency of change, lack of clarity, national vs company rules)	■	■	■	■	■	■	■	■
Lack of sick pay/financial support from employer and/or Government/ statutory living wage	■	■	■	■	■	■	■	■
Heterogeneous work environments	■	■	■	■	■	■	■	
Pinch points	■	■	■	■	■	■	■	
Ability to social distance	■	■	■	■	■	■	■	
Different vaccination uptake	■	■	■	■	■	■	■	
Cultural beliefs (inc work closely to keep each other safe)	■	■	■	■	■	■	■	
Poor adherence to social distancing	■	■	■	■	■	■	■	
Cost to implement mitigations	■	■	■	■	■	■	■	
Differences across the sector/sub-sectors (no one size fits all)	■	■	■	■	■	■	■	
Social influence (Others behaiour)	■	■	■	■	■	■	■	
Poor collaboration/partnership working	■	■	■	■	■	■	■	

Risk factor	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Cross-cutting findings								
Duration and proximity of close contact working	■	■		■	■		■	■
Insecure contracts/ gig work/ multiple jobs	■	■	■	■		■	■	
Contact with the public / service users	■		■	■	■	■		
High risk / high exposure activities	■	■		■	■		■	
Ventilation of indoor spaces	■		■		■	■	■	
Access to interventions (PPE , testing, antivirals) not always consitent	■	■		■	■	■		
Socialising outside work (with colleagues/outside of worker	■	■	■	■			■	
Lack of access to data / sharing data	■		■	■		■		
Loud machinery/noise prompting workers to shout		■					■	■
Temperature/humidity		■			■			■
Profile of workers (eg ethnicity, age, underlying health)	■	■					■	
Sector-specific findings								
Staff shortages (due to external factors eg BREXIT, pingdemic,	■	■						
Communication challenges					■	■		
Presenteeism		■		■				
Correct use of PPE/face coverings					■	■		
Difficulties of policing mitigations (clarity of responsabuility)	■						■	

Risk factor	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Sector-specific findings								
Diverse cultural backgrounds/ language barriers		■		■				
Ease of working from home	■							
Safe space for visitors						■		
trust/distrust	■						■	
differing extreems of risk perceptions							■	
Burnout of key COVID management leads								■
Sector financially unstable (require propping up by Govt)	■							

Non-specific contributions put forward from wider researchers echoed heterogeneous work environments and ability to social distance as common risk factors and many cross-cutting risk factors tabulated within Table 9. A lack of trust for other people 'doing the right thing' was echoed by non-specific contributors as a sector specific finding. Three additional risk factors were cited by non-specific contributors to the workshop, these being: national guidance not being considered appropriate (to local context); community resistance; and deprivation.

Annex 3: Barriers and enablers (for introducing mitigations)

Table 10: Tabulated Barriers to the introduction of mitigations for reducing the spread of COVID-19 by work sector

Black shading indicates risk factors identified by sectors.

Barriers	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Common findings								
Poor communication of COVID messaging & government guidelines	■	■	■	■	■	■	■	■
Cost/financial challenges	■	■	■	■	■	■	■	■
Cross-cutting findings								
Poor mitigation enforcement	■	■			■			
Communication/language problems	■	■		■	■			
Heterogeneity across different workplaces	■	■				■	■	
Shortage of PPE		■		■		■		
Movement between sites / different regions	■			■			■	
Sector-specific findings								
Access to data/intelligence	■					■		
Behaviour compliance (workers or service users)	■				■			
Compieting challenges outside of sector		■				■		
Isolation rules/'Pingdemic'	■	■						
Nature of work (onsite, indoors, vehicles etc)	■						■	

Barriers	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Sector-specific findings								
Access to testing				■		■		
Staff or labour shortages/ demand for service	■	■						
Lack of sick pay/financial support		■						
Effect of long-covid		■						
Client demands/expectations							■	
Vaccine hesitancy/access						■		
Mobile population			■					
Feeling safe/unsafe with colleagues	■							
Fear of offending colleagues	■							

Table 11: *Tabulated enablers for the introduction of mitigations for reducing the spread of COVID-19 by work sector*

Black shading indicates mitigation measures identified by sectors.

Enablers	Public Transport	Food processing	Higher education	Logistics/ delivery	Close contact retail	Care homes	Construction	Energy sector
Common								
Testing	■	■	■	■		■	■	■
Cross-cutting								
Allowing remote/home working where possible	■	■	■					■
Support for workers individual needs	■	■		■				■
Internal communication	■	■		■				■
Provision of face coverings		■			■			■
Existing safety/hygiene culture	■			■			■	
Signage	■				■			■
Taking steps to facilitate sickness absence where necessary for COVID19		■		■				■
Sector-specific								
Organisational communication	■							■
Introducing/improving mechanical ventilation	■	■						
Financial help from the government	■	■						
Information sharing across industry	■	■						

Sector use of hierarchy of controls								
Risk profile of Service users								
Reduced ridership								
Strong external mandates(?)								
Introduction of seasonal agricultural workers scheme								
Emergency preparedness prior to pandemic								
Tiered risk rating mechanism with supporting controls								
Site based Covid teams								
Beyond sector communications								
Data gathering								
Adaptations to organisational structures and systems								
Lagging approach to relaxing measures								
preempting government controls								
Limiting staff contacts								
Stakeholder engagement								
Supported return to the workplace								

The PROTECT COVID-19 National Core Study on transmission and environment is a UK-wide research programme improving our understanding of how SARS-CoV-2 (the virus that causes COVID-19) is transmitted from person to person, and how this varies in different settings and environments. This improved understanding is enabling more effective measures to reduce transmission – saving lives and getting society back towards 'normal'.

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