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COVID-19 outbreaks in the food manufacturing sector

Dr Yiqun Chen

HSE Science Division

HSE

Theme 1:Outbreak investigations

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Evidence Sources

- News on outbreaks in workplaces
- Workplace inspections (HSE Spot Checks)
- Outbreak investigation records (HSE PHE)

Outbreak rates calculation

Research questions

Does the food manufacturing sector have an increase risk of COVID-19 outbreak?

- Systematic literature review
- Thematic review of outbreak investigation records (HSE)
- On-the-ground outbreak investigations (The COVID-OUT study)

Evidence synthesis

What are the contributing risk factors of COVID-19 outbreaks in the food manufacturing sector?

COVID-19 outbreaks in workplaces – PHE surveillance records England, May – October 2020

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- Total of 1,317 outbreaks analysed
- 117 (9%) outbreaks in the manufacturers and packers of food

Number and rate of workplace outbreaks by sector in England

PHE sector grouping	Number of Outbreaks	Number of Workplaces	Outbreak Rate (per 100,000)
Manufacturers and packers of food	117	6,998	1,672
Warehouses	58	15,058	385
Manufacturers and packers of non-food	195	63,312	308
Retailers	219	195,025	112
First responders/Military sites	57	67,257	85
Distributors and transporters	84	125,414	67
Restaurants and caterers	53	117,836	45
Offices	193	721,351	27
Close contact services	13	52,866	25
No setting type assigned	54	511,071	11
Primary producers	8	93,086	9
Other	266	-	-
Total	1,317	1,969,274	67

Yiqun Chen, Timothy Aldridge, Claire F. Ferraro, Fu-Meng Khaw. ***COVID-19 outbreak rates and infection attack rates associated with the workplace: a descriptive epidemiological study***
medRxiv 2021.05.06.21256757; doi: https://doi.org/10.1101/2021.05.06.21256757

COVID-19 outbreaks in workplaces – PHE surveillance records England, May – October 2020

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The top 10 outbreak rates by English region and sector combined

English region – PHE sector grouping	Number of Outbreaks	Number of Workplaces	Outbreak Rate (per 100,000)
West Midlands - Manufacturers and packers of food	23	647	3,555
Yorkshire and The Humber - Manufacturers and packers of food	28	894	3,132
North West - Manufacturers and packers of food	28	957	2,926
East Midlands - Manufacturers and packers of food	13	640	2,031
East of England - Manufacturers and packers of food	12	721	1,664
East Midlands – Warehouses	19	1,247	1,524
North East - Manufacturers and packers of food	4	312	1,282
North West - Manufacturers and packers of non-food	65	8,074	805
North West – Warehouses	15	1,891	793
South West - Manufacturer and packers of food	6	940	638
…			

Yiqun Chen, Timothy Aldridge, Claire F. Ferraro, Fu-Meng Khaw. ***COVID-19 outbreak rates and infection attack rates associated with the workplace: a descriptive epidemiological study***
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COVID-19 outbreaks in workplaces – PHE surveillance records England, May – October 2020

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Median attack rates of workplace outbreaks by sector

Sector	Individual Outbreaks			Workplaces	Attack Rate
	Total cases	Total sites	Cases per site	No. employed	Cases / 100 employed
			Median	Median	Median
Close contact services	22	6	3	16	16.5
Restaurants and caterers	49	14	4	38	10.3
Manufacturers and packers of non-food	270	29	8	122	6.7
No setting type assigned	99	15	4	56	5.4
Retailers	115	28	4	120	4.9
Offices	133	23	5	133	4.3
Manufacturers and packers of food	1,384	79	7	423	2.3
First Responders / Military sites	44	15	3	113	2.1
Other	109	24	3	169	2.0
Warehouses	104	12	3	579	1.6
Distributors and transporters	193	16	4	650	1.2
Primary producers	127	3	3	*	*
Total	2,649	264	4	176	3.4

Yiqun Chen, Timothy Aldridge, Claire F. Ferraro, Fu-Meng Khaw. ***COVID-19 outbreak rates and infection attack rates associated with the workplace: a descriptive epidemiological study*** medRxiv 2021.05.06.21256757; doi: https://doi.org/10.1101/2021.05.06.21256757

Outbreak investigation records - HSE in GB, April 2020 – January 2022

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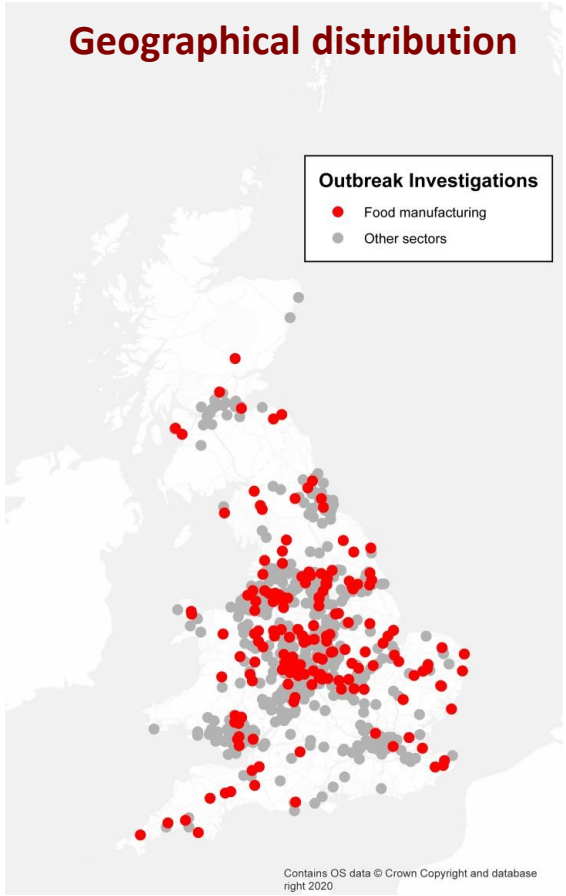
- Total of 770 outbreaks investigated
- 177 (23%) outbreaks within the food manufacturing sector

Geographical distribution



Number and rate of outbreaks by essential infrastructure sector

Essential Infrastructure	No. Outbreaks	No. Workplaces	*Outbreak Rate* (per 100,000)
Food Manufacturing	177	8,020	2,207
Non-food manufacturing	264	85,814	308
Warehouses	9	16,706	54
Distributors and transporters	10	26,419	38
Construction Sites	48	212,095	23
Non-Essential	244	1,593,619	15
Primary producers	16	125,146	13
Supermarkets	2	35,531	6

Outbreak investigation records - HSE in GB, April 2020 – January 2022

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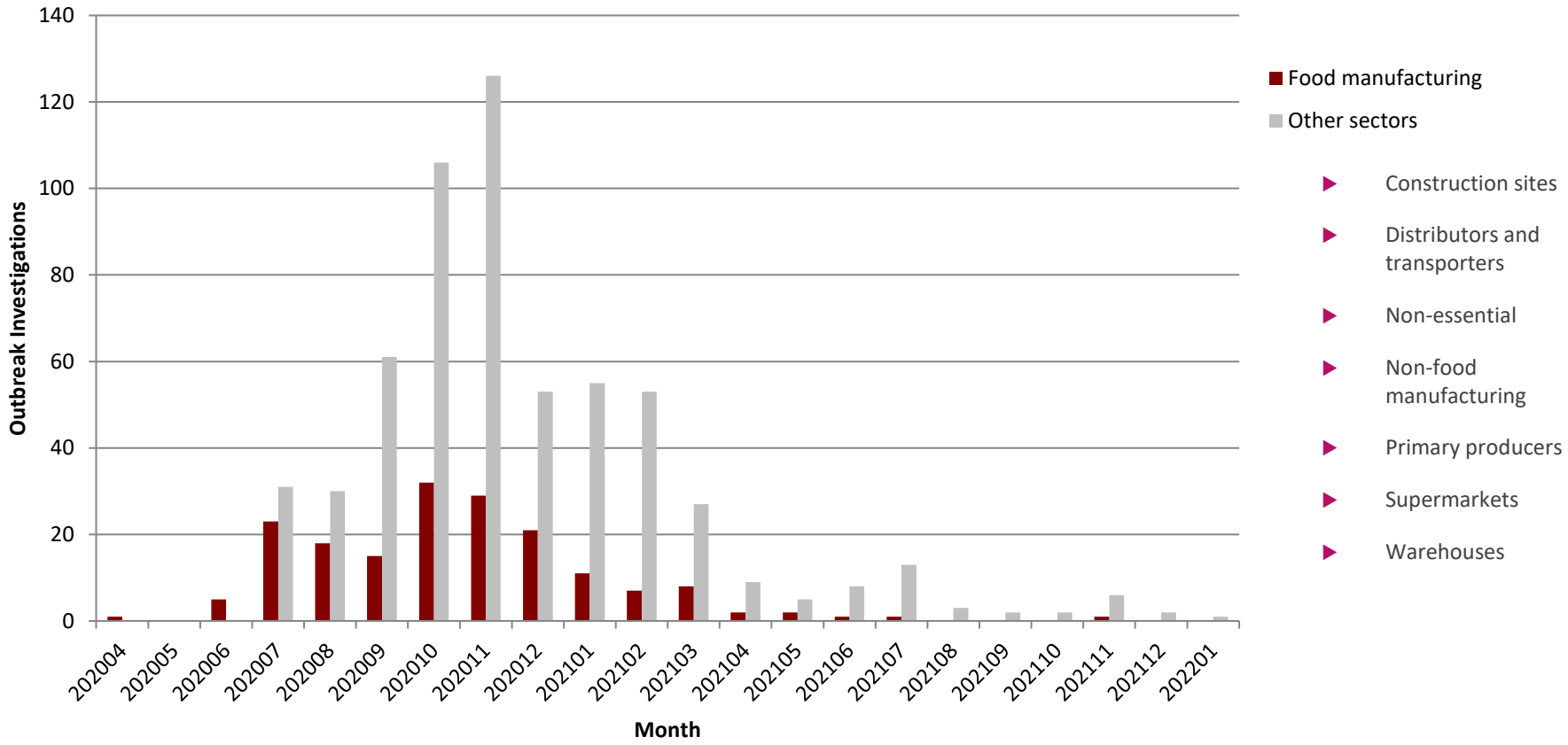
- Most of the outbreaks were before March 2021



News on outbreaks in workplaces in GB, July 2020 – January 2022

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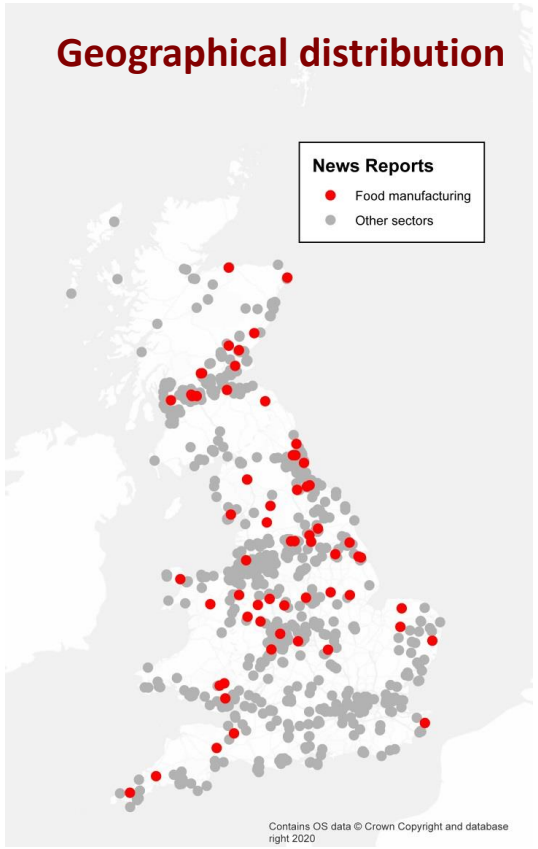
- Total of 1139 news reports analysed
- 72 (6%) outbreaks within the food manufacturing sector reported in the news

Geographical distribution



Number and rate of outbreaks by essential infrastructure sector

Essential Infrastructure	No. Outbreaks	No. Workplaces	*Outbreak Rate* (per 100,000)
Food Manufacturing	72	8,020	898
Supermarkets	70	35,531	197
Warehouses	22	16,706	132
Non-Essential	910	1,593,619	57
Non-food manufacturing	48	85,814	56
Distributors and transporters	4	26,419	15
Primary producers	7	125,146	6
Construction Sites	6	212,095	3

News on outbreaks in workplaces in GB, July 2020 – January 2022

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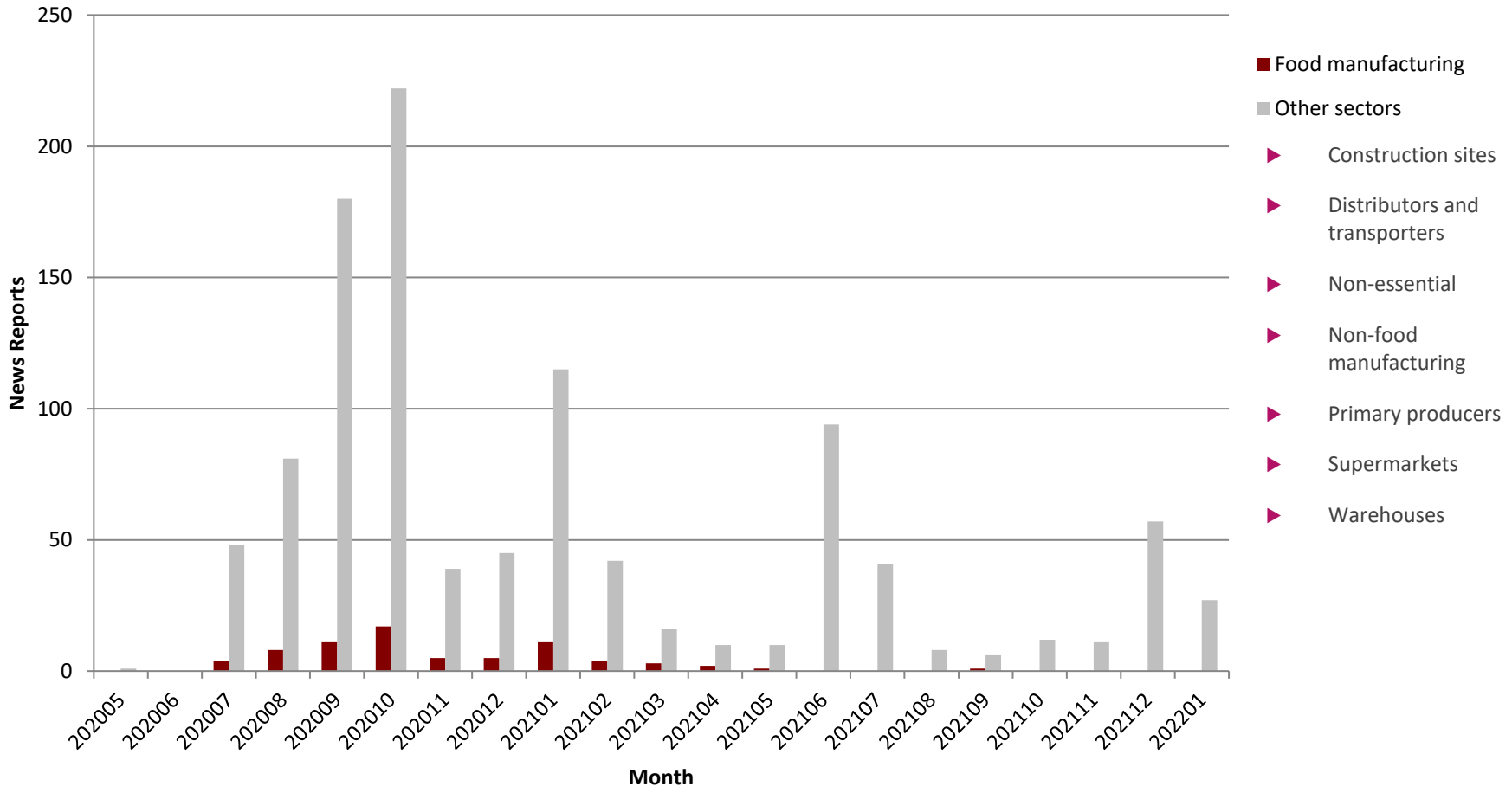
- Most of the reports were before March 2021



Comparing the number of outbreaks investigated or in the news with the population infection prevalence, April 2020 – January 2022

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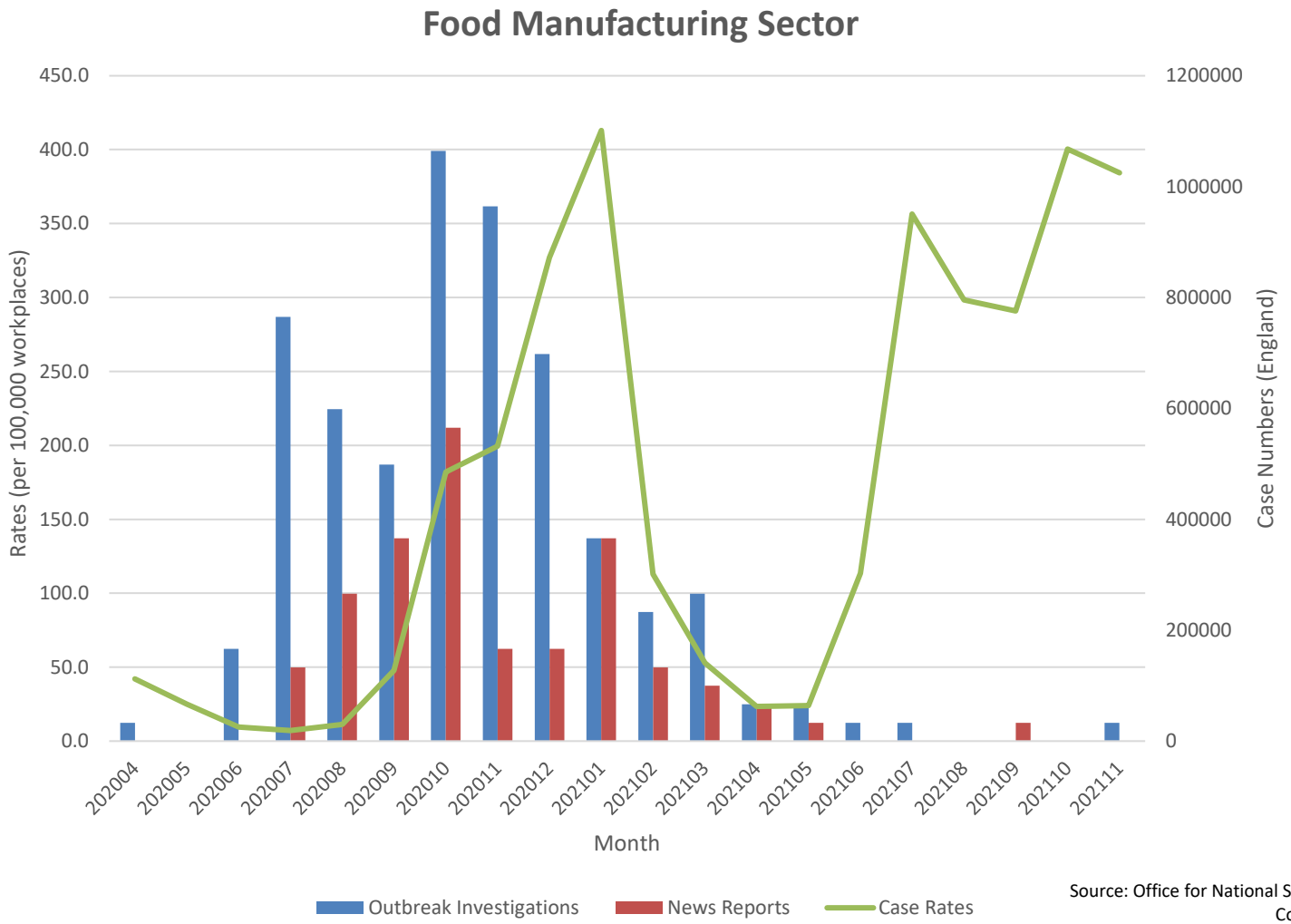
- Most of the outbreaks were related to the first wave and before mass vaccination



HSE COVID-19 Spot Checks of workplaces in GB, May 2020 – July 2021

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- 578,593 spot checks attempts for all sectors, covering about a quarter of workplaces in GB, with 47% overall response rate

Fail rates of spot checks by sector

Sector group	Spot check count	Outcome rate (%)	Fail rate (%)
Food Manufacturing*	15,171	51.3	**2.65**
Water/Waste Management	12,420	51.0	**1.91**
Agriculture	11,364	39.4	**0.94**
Non-food Manufacturing*	133,084	54.5	**0.87**
Services	291,173	47.8	**0.66**
Construction	84,025	30.4	**0.11**
Extractive Utilities	872	52.3	**0.00**

* HSE sector grouping “Manufacturing” divided into food and non-food

HSE COVID-19 workplace Concerns data in GB, March 2020 – June 2021

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Number of COVID-19 related concerns per 100 workplaces by HSE sector

HSE Sector	No. Workplaces	Concern count	Concerns per 100 workplaces	Covid-related concern count	Covid-related concerns per 100 workplaces	Amber or red covid-related concern count	Amber or red covid-related concerns per 100 workplaces
Extractive Utilities	5,953	1,303	21.89	498	8.37	150	**2.52**
Manufacturing	103,094	8,627	8.37	5,049	4.9	2,371	**2.30**
Water/Waste Management	8,767	615	7.01	196	2.24	97	**1.11**
Construction	212,095	13,224	6.23	2,734	1.29	1,380	**0.65**
Services	1,650,011	17,662	1.07	11,072	0.67	2,504	**0.15**
Agriculture	123,430	1,223	0.99	229	0.19	97	**0.08**

Systematic review of international scientific literature
January 2020 – October 2021

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- 6/69 paper found were related to outbreaks in the food sector (all in meat processing and before Feb 2021)

Author	Country	Outbreak period	Risk factor	Workplace intervention
Steinberg et al	South Dakota, U.S.	Mar-Apr 2020	High employee density and prolonged close contact, particularly for those on the production line, as well as contact between employees in common areas, inside and outside of work	(Symptomatic) testing, tracing, isolation, optional mask-wearing, physical barriers, social distancing, cohort working, and temporary closure
Waltenburg et al	23 states, U.S.	Apr-May 2020	Vulnerable populations at work	Screening on entry, face covering, hand hygiene, education, physical barriers, staggered shifts, testing, reduce processing rate, reduce crowding of work transportation, and temporary closure.
Gunther et al	Germany	May 2020	An unfavourable mix of factors including low temperature, low fresh air exchange rates, recirculated air and demanding physical work that could promote the virus transmission through the aerosol route over distances.	Social and physical distancing, sentinel as well as workplace PCR testing, contact tracing, and to quarantine all workers in a radius around an infected individual that may significantly extend beyond 2 meters
Pokora et al	Germany	Jun-Sept 2020	Less than 1.5m between workers was the norm, low temperature condition (3.9˚C—8.9˚C), low outdoor air flow (OAF), temporary and contract work, and potentially multiple risk factors in the work environments	Testing, ventilation, physical barriers, universal face covering
Porter et al	Alaska, U.S.	Sum – Fall 2020	(Out of state) migrant workforce,	Quarantine and complete isolation off-site, reduce quarantine group size (<=10), pretransfer testing, serial testing, daily symptom screening.
Hou et al	Harbin, China	Jan-Feb 2021	Working closely with asymptomatic colleagues, sharing dressing room or other confined spaces at work, sharing commuter buses	Screening (population testing), early detection of asymptomatic, isolation, quarantine and vaccination.

Catherine Lewis, Anne Clayson, Sarah Daniels, Surakshya Dhakal, Janet Ubido, Paniz Hosseini, Damien Mcelvenny, Yiqun Chen, Martie Van-Tongeren.
What are the risk factors for workplace outbreaks of COVID-19?
PROSPERO 2021 CRD42021293677 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42021293677

Thematic analysis of HSE COVID-19 outbreak investigation records June 2020 – June 2021

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- 58/737 outbreak investigation records were reviewed to identify broad descriptive themes of risk factors
- 22/58 were in the food manufacturing sector, with the number of cases per outbreak ranging from 2 to 48.

Risk factor	Workplace practice
Risk assessments – Risk assessments were not available in most cases. Those that covered the main COVID-19 related regulations had trouble in implementing such measures and keeping consistency. 1/22 cases, risk assessment was deemed as "unsuitable". **Social distancing** – 18/22 cases mentioned issues in maintaining social distancing at work, including poor social distancing between workers in the work areas and in non-work areas (e.g. canteens, queues, locker rooms and smoking areas), lack of oversight by marshals, and some staff had to constantly be reminded of social distancing rules. **Face coverings** – In a number of cases, masks were not being used appropriately or that visors were being used instead. Face coverings seemed to be a central theme which was noted in most of the reports. **Cleaning regimes** – 9/22 cases mentioned insufficient frequency of cleaning. **Shared staff facilities** – 4/22 cases had information on shared staff facilities and highlighted the poor social distancing and cleaning regimes in cloak room areas and canteen spaces, lack of arrows/signage, and crowded smoking areas. **Shared commute/transport** – 10/22 cases had information on shared commute/transport to and from the workplace. Of these, 3 cases appeared to have traced their workplace outbreaks to car sharing arrangements. The documents also outlined that car sharing appeared to be a significant risk factor for transmission, but it was difficult to control given that many of these food production facilities are in rural areas. **Shared accommodation** –1/22 cases mentioned onsite accommodation. 6/22 outlined shared accommodation between workers off the site, a few of which showed COVID-19 cases amongst workers that lived in the same household. **Workforce** –A mix of permanent, temporary, agency and contract staff across the sites. **Sick pay** – 2/22 cases had information regarding sick pay where staff were made to work even if they tested positive for COVID-19. **Staff communications** – In some cases staff communications were provided in English, even though they had a large workforce of people who didn't have English as their first language. **Testing** – 1/22 cases did not provide mass workplace testing despite the hight number of cases at the site.	**Ventilation** –Appeared in 4/22 cases, all were in line with the ones detailed in HSE's risk assessments. Overall, not much emphasis/focus was placed on this theme in the reports. **Shared commute/transport** – Encouraging use of face masks and cleaning the vehicle after use. **Temperature check** – Mentioned in 2/22 cases, where temperature checks being conducted at the beginning of shifts for workers, and for visitors. **Contact tracing** – 8/22 cases mentioned contact tracing being provided at the workplace, some by the companies, while others had help from PHE and NHS Test and Trace. **Staff communications** – Some workplaces made sure to provide emails and other written communication regarding COVID-19 in a variety of languages. **Testing** – 7/22 cases mentioned mandatory workplace testing after an outbreak at the site.

The COVID-OUT study

COVID-19 Outbreak investigation to Understand Transmission

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- On-the-ground investigations of COVID-19 outbreaks associated with workplaces to identify outbreak causes, which will help prevent and control further outbreaks

We want to know:

What are environmental conditions associated with SARS-CoV-2 outbreaks?

What interventions and mitigation activities prevent SARS-CoV-2 transmission?

What are the risk factors for SARS-CoV-2 infection?

What are the potential transmission routes of SARS-CoV-2?

Chen Y, Atchison C, Atkinson B *et al.* The COVID-OUT study protocol: COVID-19 outbreak investigation to understand workplace SARS-CoV-2 transmission in the United Kingdom [version 1; peer review: awaiting peer review]. *Wellcome Open Res* 2021, **6**:201 (https://doi.org/10.12688/wellcomeopenres.17015.1)

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The number of workers

Employee type	Number
Permanent employee	1407
Agency staff	124
Contractor	<10

Work shifts

Shifts[1#]	Time period
Day shift	07:00 – 16.00 Monday - Friday
Production hygiene [2#]	15:30 – 22:00
Night shift	21.30 – 06.30 Sunday - Thursday

The number of permanent employees by age and sex

Age	Male	Female	Total
<20	14	9	23 (1.6%)
20-29 years	150	97	247 (17.6%)
30-39 years	208	161	369 (26.3%)
40-49 years	232	191	423 (30.1%)
50-59 years	154	100	254 (18.1%)
60+	39	47	86 (6.1%)
Total:	797	605	1,402 (100%)

Outbreak site workforce information

1# There were more personnel working on the day shift than on the night shift but the exact proportions are not clear. Some personnel have a combination of day and night shifts, e.g. 4 days on and 4 days off, such as those working in engineering and transport teams.

2# There were a combination of hygiene team shifts across the site, 24 hours/day, every day to provide continuous cover.

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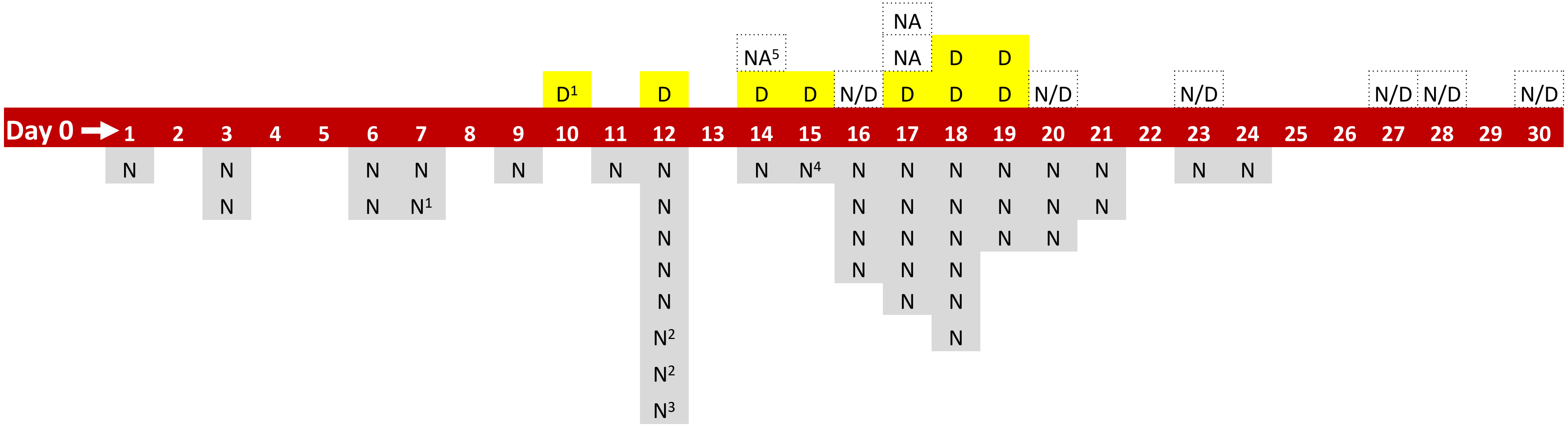
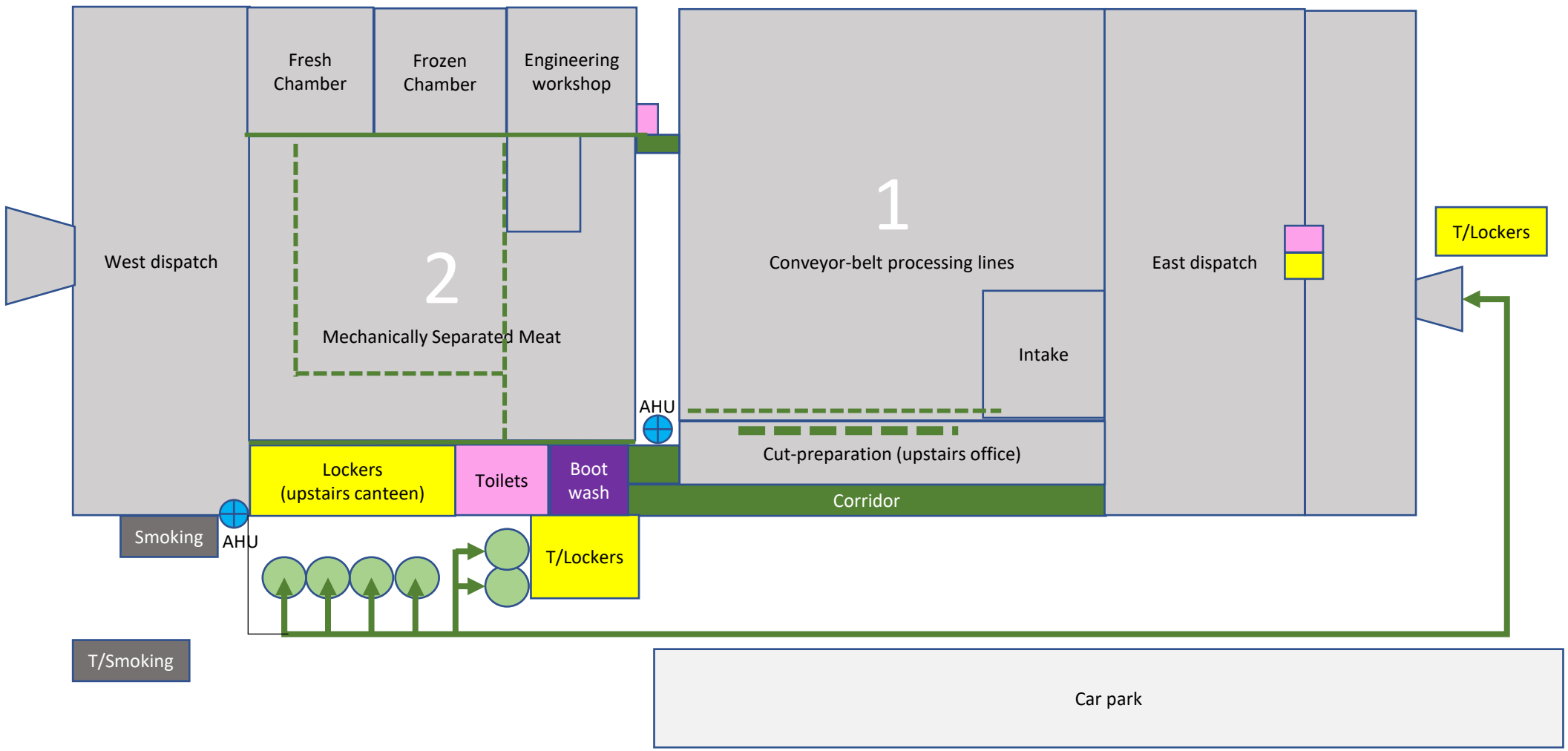
Timeline COVID-19 outbreak



D: Day shift worker
N: Night shift worker
NA: unclear Days or Nights
N/D: Rotating Days & Nights
N^1 and D^1 are partners
N^2 and N^2 are partners
N^3: Son diagnosed on the same day and the spouse diagnosed two days later
N^4: Niece diagnosed a day earlier
NA^5: A child diagnosed the same day and another child two days later

Overall attack rate for
Day staff = 1.8%
Night staff = 9.1%

Site map of the large meat processing plant



Size of site 42,900 m^2
Internal areas 15,318 m^2
Production areas 700 m^2, were generally open plan, with up to 450 production workers per shift.

AHU

The two Air Handling Units (AHUs) were for the non-production areas.
A AHU serves the production area 1 is not shown. Two AHUs for the production area 2 were not operational, informed by the ventilation contractor for the production area system.

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Outbreak workplace environmental conditions

Work area	CO_2 level[1#] (ppm)	Temperature (°C)	Humidity (%RH)	Noise level[5#]
Intake				80 dB(A)
Cut-preparation by cutting bench beneath conveyor[2#]	2268 (400-5100)	4.5 (2.3-11.9)	95.9 (67.5-100)	
Main central area in-between conveyors				81 dB(A)
Packing area				83 dB(A)
Corridor linked to the cut-preparation area	Error	8.8 (5.5-12.0)	80.1 (59.1-98.2)	
Main washing area for production staff[3#]	605 (300-1800)	16.7 (13.7-19.4)	69.1 (55.0-83.2)	
Washing area above sinks (office-production entrance)[3#]	1126 (400-2500)	10.9 (8.9-13.4)	59.4 (49.6-77.9)	
Canteen (on top of vending machines)	388 (200-800)	20.7 (16.6-27.6)	65.1 (33.6-81.9)	
Main locker room near main entrance area[4#]	516 (200-1400)	18.6 (16.1-27.6)	Error	

1#: CO_2 level is a proxy measure for the adequacy of ventilation. The packaging process used CO_2. It is difficult to interpret the measurement results.

2#: This area was only separated from the main production area by flexible plastic drapes

3#: These areas were connected to the prodcution area.

4#: The relative high CO_2 readings (1400 ppm) in the locker area were related to the shift start and finish times.

5#: Noise survey undertaken by the company in Nov 2020 showed the noise levels up to 92 dB(A) in production area 1 (excluding despatch) and up to 112 dB(A) in production area 2. The noise level in the area did not enable easy communication which made it difficult to maintain <2m social distancing at all time during staff interactions. There were many personal who did not have English as their first language which also added to the (verbal) communication problems.

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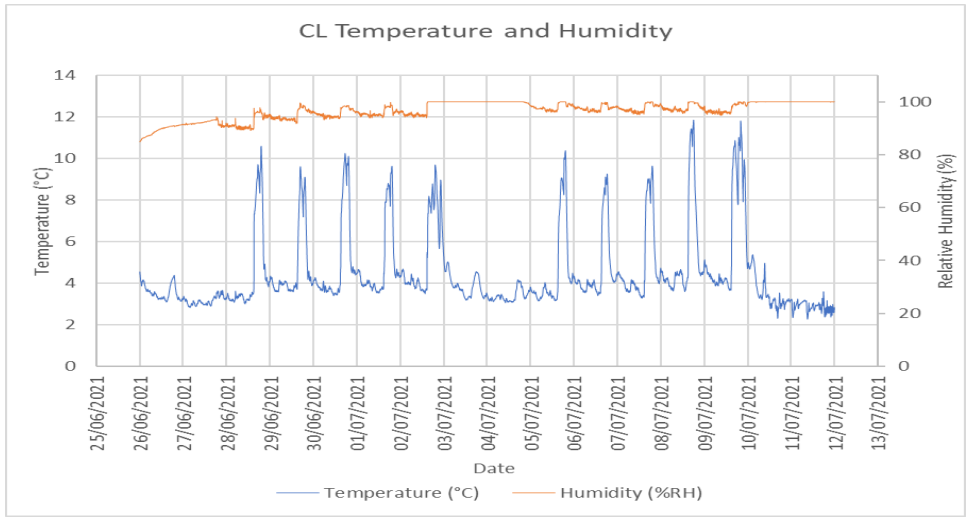
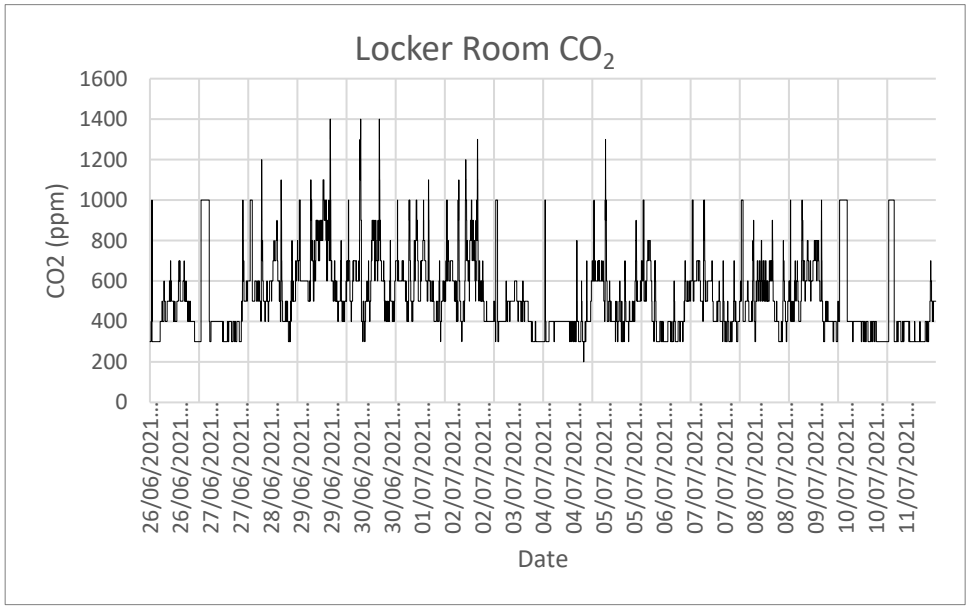


Cut-preparation area[1#]
Temperature 4.5°C (2.3°C-11.9°C)
Humidity % RH 95.9 (67.5-100)



Main locker room[2#]
CO_2 ppm 516 (200-1400)

Real-time measurement examples

Temperature and humidity, and CO_2 real-time monitors were left at various static locations for two weeks.

The vertical lines were for midnight.

1# In the Cut-preparation area, the raised temperatures occurred roughly between 15:15 and 20:15, which could be when hygiene team were operating between the shifts.

2# The relative high CO_2 readings in the locker area were related to the shift start and finish times.

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Positive and suspect positive samples

Sample	Area sampled	Ct (mean)	Interpretation
4	Chiller	[Suspect] 37.9	Very low-level RNA detected
17	Engineering workshop	34.0	Low-level RNA detected
18	Engineering workshop	39.5	Very low-level RNA detected
19	Engineering workshop	[Suspect] 36.5	Very low-level RNA detected
22	Production control area	[Suspect] 38.0	Very low-level RNA detected
36	Smoking Shelter	[Suspect] 37.5	Very low-level RNA detected
38	Outside vent	[Suspect] 39.3	Very low-level RNA detected
47	Canteen	[Suspect] 37.7	Very low-level RNA detected

SARS-CoV-2 environmental sampling

A total of 60 samples were collected for analysis. These samples were taken from both the factory and office areas of site including changing rooms, canteen, air ventilation equipment and high-touch points.

PCR analysis of samples taken from the facility showed a low level of SARS-CoV-2 RNA within the building. All positive environmental samples were in the low or very low category of contamination and are unlikely to represent a significant transmission risk.

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Risk factors

Social and physical distancing could not always be maintained because of the nature of the work, work practices, production line design, in a noisy environment or behaviours fatigue. There were a few pinch points in the production areas where lines were close together, and people walked past in close proximity to others (<2m apart). It was not always possible to place workers back-to-back or side-by-side rather than face-to-face when they worked closer than 2 metres due to the production line configuration. Screens had been erected between those working side by side, and those facing each other but then again these were not always possible either because of the production process or the production line design.

If personnel working < 2m apart, and not separated by a physical barrier, they were required to wear both a **face covering** and a visor, but on occasion it was observed during the site visit this was not the case.

The production area was a mandatory hearing protection zone, so communication at 2m distance with a mask was often an issue. There were many personnel who did not have English as their first language which also added to the (verbal) communication problems. Conversations were often seen by staff at close proximity (i.e. < 2m apart). Production staff regularly interacted with each other and with staff who were based in the office area (e.g. managers and engineers). 2m social distancing was not maintained at all times during these interactions, due to **noise levels** in the area not enabling easy communication

Additional pinch points, outside the production area, were at the entrances to areas such as changing/locker rooms and in stairwells; A one-way system had been trialled in many areas, but it was reported that this hadn't worked.

The **ventilation** to the main production area appeared to be minimal as there were numerous staff and few air vents. CO_2 levels were elevated in the production areas; however, no conclusions can be drawn about the adequacy of ventilation in the production areas, as CO_2 is used in the packaging process. Minimal information was received about the ventilation in the production areas so conclusions cannot be drawn on its adequacy.

Unfavourable environmental conditions such as **low temperature** and **high humidity** in production areas

Night-shift working

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Preventions and controls

Cleaning regimes – Continuous cleaning cycle of canteen/office/locker room/staircases/toilets etc by the hygiene team throughout the full shift. A dedicated hygiene team clean between the two shifts in the production area. Increased fogging after outbreak

Screening – Temperature check at the entrance. Notification to employer of anyone (workers, their household and close contacts) with COVID-19 symptoms, follow-up test and trace. The process panel is made up of a cross functional team of **senior managers and directors** and met once a day and are on hand 24/7 for critical situations.

Social distancing – The company had installed additional locker/changing areas to improve social distancing between staff at the start and end of shifts. An "open-sided" tent/marquee had been installed in the car park for an additional smoking shelter. To limit the occupancy in the canteen, measures had been introduced to limit capacity to 50 % of normal levels. Day & night shift patterns changed to eliminate crossover of staff.

Shared commute/transport – The company provide coach transport to the site for some workers as required. Since the outbreak, additional coaches had been put so to enable social distancing to be undertaken. Temperature checks are undertaken prior to boarding the coach plus face covering on the coach.

Staff communications –Senior staff were located at entry doors at the start of shifts. The **senior staff** supervise the taking of temperatures of all staff on arrival. Signs on social distancing and hygiene were in place throughout the factory and non-production areas. This included posters and written information in different languages. All staff were encouraged to remind others about the control measures, including the wearing of face coverings, social distancing and hygiene. Verbal reminders from staff to others were witnessed during the site visit.

Testing – On-site test centre, regular LFT (twice/week, risk-based and voluntary with 100% take up), workplace mass daily PCR for a week after the outbreak. It was voluntary with 70% uptake.

Vaccination at the workplace after the outbreak

Theme 1:Outbreak investigations

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Research question

1. Does the food manufacturing sector have an increase risk of COVID-19 outbreak?

Summary findings

- The food manufacturing sector has an increased rate of COVID-19 outbreaks, particularly at the early stage of the pandemic, where the sector kept operating with no vaccine, lack of testing resources and limited knowledge about the effective prevention and control measures.

Research question

2. What are the contributing risk factors of COVID-19 outbreaks in the meat processing plants?

Summary findings

- The key risk factors that could contribute to outbreaks in meat processing plants include:
    1) High employee density in production and common areas, sharded transport for work commute, difficulties in maintaining at all time social or physical distancing (including wearing face covering);
    2) Unfavourable mix of environmental conditions, such as low temperature, high humidity, and high noise levels;
    3) Lack of understanding, utilisation and maintenance of suitable ventilation system;
    4) Shift working, particularly night-shift work;
    5) Links to high infection rates in the community
- Outbreaks in meat processing plants could still occur even with a range of control measures in place. Leadership, early identification of COVID-19 cases through regular testing and contact tracing, and population vaccination are critical in the emergency response to control outbreaks in the workplace.

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