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A COVID-19 National Core Study

Environmental surface sampling for SARS-CoV-2 in food manufacturing workplaces

Rob Johnston
Food, Water and Environmental Scientist

Barry Atkinson
Senior Virologist

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@PROTECT_NCS

February 2020 – March 2021

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Reactive response

UKHSA provided environmental sampling as part of public health response

- Quarantine facilities
- Hospitals

Expanded response

Transition to wider testing as virus becomes endemic

- Public transport
- Workplace outbreaks
- Households
- Core infrastructure sites

Early workplace responses

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Rationale for Field Investigations and Sampling

- Initial request from the Incident Management Team (IMT) following large increase in cases associated with chilled food workplace
- Support the Food Business Operator and the IMT to assist in considering the impact of air handling systems on potential to recirculate virus
- Observational overview of air handling systems serving chilled food manufacturer
- Assistance in identifying key contact points and management procedures

ID	Sector	Date
Site A:	Food Sector	Aug 2020
Site B:	Food sector	Nov 2020
Site C:	Food sector	Nov 2020
Site D:	Distribution	Feb 2021
Site E:	Core Infrastructure	Mar 2021
Site F:	Food sector	Apr 2021
Site G:	Core Infrastructure	May 2021
Site H:	Core Infrastructure	Dec 2021

Food Sector Investigations

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Initial concerns due to percentage of recirculated air to chilled high care areas

Investigations into air handling units and chilled air distribution

Air Handling Units – for chilling air and recirculation to high care production areas

Filters for Air Handling Units – part of maintenance schedule but found to be absent in one site

Food Sector Investigations

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Initial concerns due to percentage of recirculated air to production areas

Investigations into air handling ducting

Swabbing of (filtered) chilled air distribution systems

Air Handling and Contact Points

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Initial concerns due to total staff number and number of positive cases

Investigations into air handling and key contact points – showing pre-moistened sponge swabs in use

Air handling and ceiling ventilation

Swabbing of key contact points

Swabbing – Staff Welfare and Non-Production Areas

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Swabbing and review of cleaning processes and procedures to optimise actions and interventions

Swabbing in canteen areas and contact points, eg clocking-in and/or biometric sign in

Swabbing key contact points in staff welfare areas; underside of chairs

Swabbing of key contact points; clocking-in point

The PROTECT study

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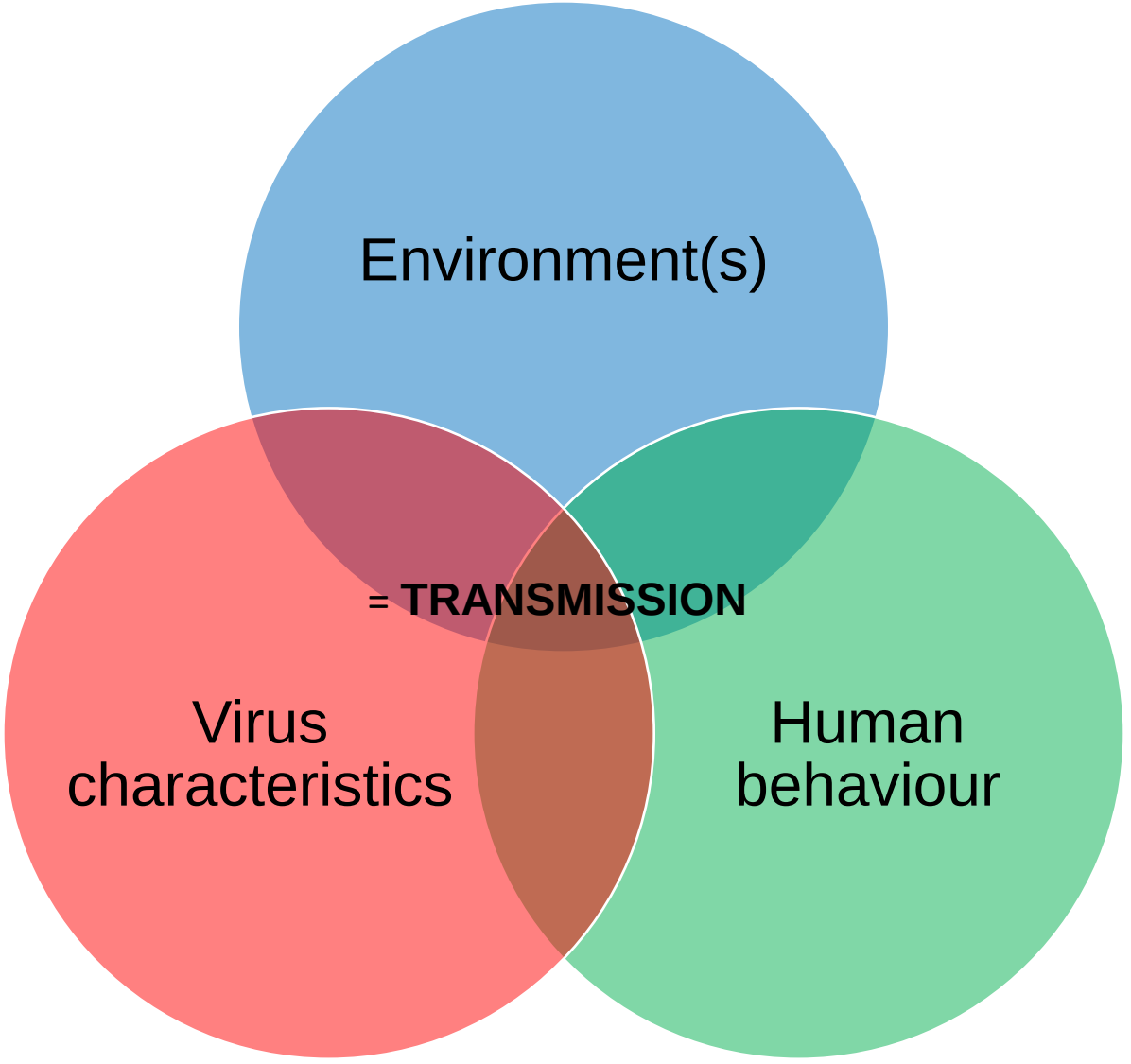
Purpose

- Understand ‘real world’ transmission
- Inform policy and practice
- Rapid and responsive
- Legacy impact

Context

- Three routes of SARS-CoV-2 transmission: surface (fomite), airborne (aerosol), and person-to-person (droplet)



PROTECT Themes

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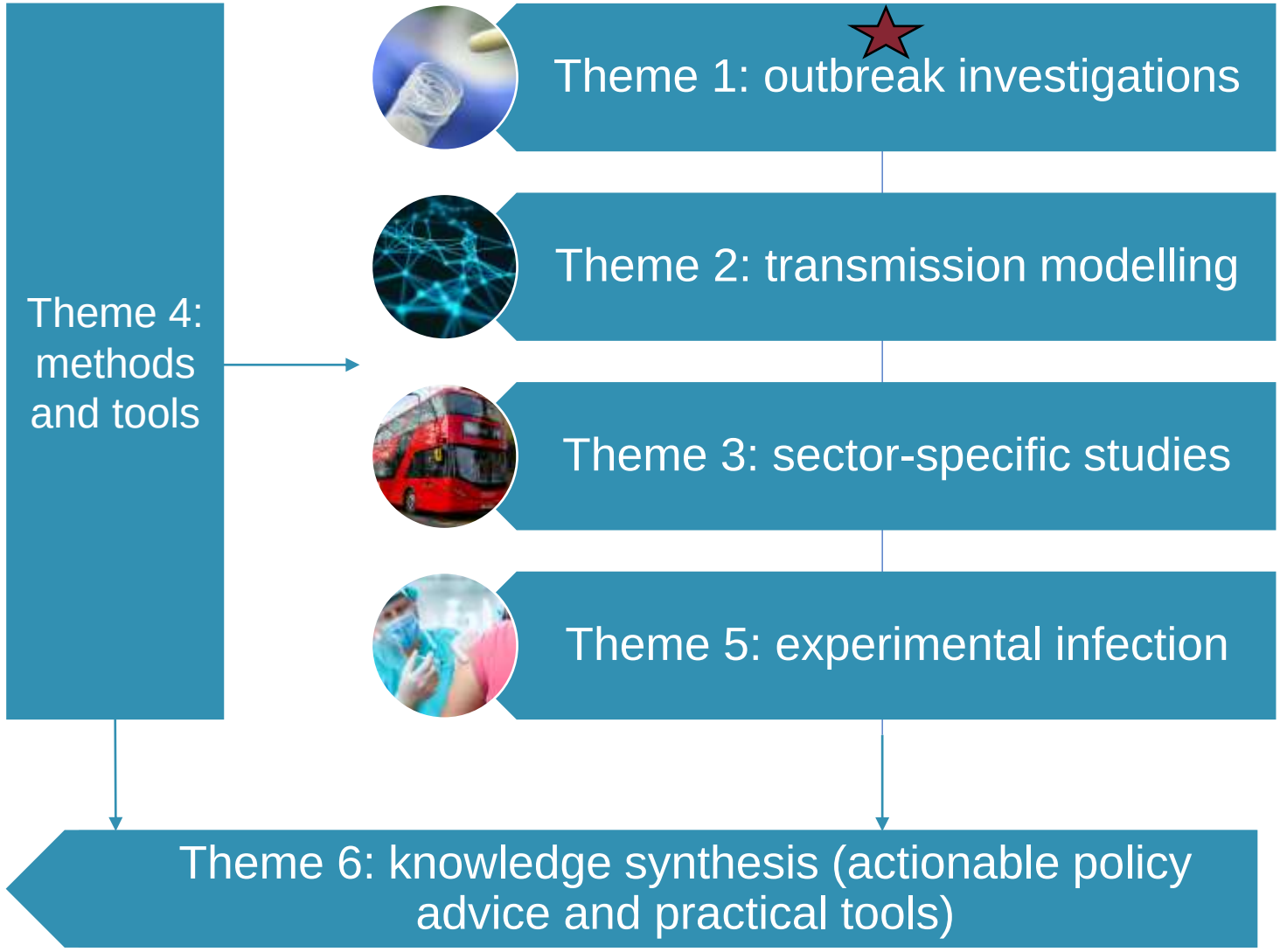
Partners and funders

- Part of COVID-19 National Core Studies programme coordinated by GO-Science
- Funded by HM Treasury until January 2023
- Led by HSE Chief Scientific Adviser Prof Andrew Curran
- Approx. 120 researchers from 21 academic and government institutions across the UK

★ COVID-OUT: Understanding transmission and risk factors through investigation of outbreaks in a range of occupational settings



COVID-OUT

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Step 1: Identify workplace outbreaks
- UKHSA HPZone
- HSE databases (e.g. Riddor)

Step 2: Recruit site to COVID-OUT study

Step 3: Site visit
- Environmental surface sampling
- Ventilation assessment
- Assess COVID-prevention measures

Step 4: Worker recruitment
- Worker questionnaire
- Personal swabs (qPCR) – 3 samples over 5 weeks
- Personal bloods (serology) – 2 draws over 5 weeks

Data generation

- Workplace environmental analysis
- Ventilation assessment
- Worker questionnaires (epi data)
- Analysis of control measures
- qPCR analysis of surface samples ★
- Viral isolation at CL3
- NGS analysis
- qPCR analysis of worker swabs
- Serology

Sample analysis

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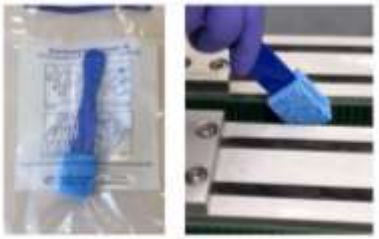

Sample collection

Nucleic acid extraction

Analysis

UKHSA led sampling

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Aug 20 – Dec 21

8 workplaces

- 4 x food (F)
- 3 x core infrastructure (CI)
- 1 x distribution (D)

47/195 confirmed positive (24.1%)

Mainly high-touch point sites

5 sites with 20%+ samples positive

Site (Month)	Samples collected	Positive (%)	Suspect (%)	Negative (%)
Site A (F) Aug 2020	16	0 (0.0%)	1 (6.25%)	15 (93.75%)
Site B (F) Nov 2020	16	8 (50.0%)	1 (6.25%)	7 (43.75%)
Site C (F) Nov 2020	24	11 (45.8%)	3 (12.5%)	10 (41.7%)
Site D (D) Feb 2021	31	7 (22.6%)	4 (12.9%)	20 (64.5%)
Site E (CI) Mar 2021	32	13 (40.6%)	2 (6.3%)	17 (53.1%)
Site F (F) Apr 2021	35	7 (20.0%)	5 (14.3%)	23 (65.7%)
Site G (CI) May 2021	21	0 (0.0%)	2 (9.5%)	19 (90.5%)
Site H (CI) Dec 2021	20	1 (5.0%)	2 (10.0%)	17 (85.0%)
Total	**195**	**47 (24.1%)**	**20 (10.3%)**	**128 (65.6%)**

What does ‘positive’ mean?

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Does Ct value = transmission risk?

There is a correlation, but it is not absolute

Rule of thumb 

Reasoning? Ct >32 rarely generates WGS

Ct >30 rarely results in isolation

Ct value	Level of contamination
<25.0	Very high
25.0-27.9	High
28.0-31.9	Moderate
32.0-34.9	Low
>35.0	Very low
Not detected (ND)	None

UKHSA led sampling

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Aug 20 – Dec 21

8 workplaces

- 4 x food (F)
- 3 x core infrastructure (CI)
- 1 x distribution (D)

Only 14/195 samples (7.2%) with potentially significant levels of RNA

2/195 samples (1.0%) with potentially significant levels of RNA (both above Ct 31.0 though)

Site (Month)	Samples collected	Ct >35.0 (includes –ve)	Ct 32.0-34.9	Ct <31.9
Site A (F) Aug 2020	16	16 (100.0%)	0 (0.0%)	0 (0.0%)
Site B (F) Nov 2020	16	15 (93.8%)	1 (6.3%)	0 (0.0%)
Site C (F) Nov 2020	24	16 (66.7%)	6 (25.0%)	2 (8.3%)
Site D (D) Feb 2021	31	28 (90.3%)	3 (9.7%)	0 (0.0%)
Site E (CI) Mar 2021	32	28 (87.5%)	4 (12.5%)	0 (0.0%)
Site F (F) Apr 2021	35	35 (100.0%)	0 (0.0%)	0 (0.0%)
Site G (CI) May 2021	21	21 (100.0%)	0 (0.0%)	0 (0.0%)
Site H (CI) Dec 2021	20	20 (100.0%)	0 (0.0%)	0 (0.0%)
Total	**195**	**179 (91.8%)**	**14 (7.2%)**	**2 (1.0%)**

COVID-OUT sampling

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Mar 21 – Feb 22

13 workplaces (11 sampled)

- 4 x manufacturing (M)
- 3 x food (F)
- 2 x office (O)
- 1 x distribution (D)
- 1 x core infrastructure (CI)

61/758 confirmed positive (8.0%)

Mainly high-touch point sites

2 sites with 20%+ samples positive

Site (Month)	Samples collected	Positive (%)	Suspect (%)	Negative (%)
001 (M) (March 2021)	36	14 (38.9%)	3 (8.3%)	19 (52.8%)
002 (M) (March 2021)	66	8 (12.1%)	11 (16.7%)	47 (71.2%)
003 (D) (May 2021)	76	25 (32.9%)	14 (18.4%)	37 (48.7%)
004 (O) (May 2021)	69	2 (2.9%)	7 (10.1%)	60 (87.0%)
005 (F) (June 2021)	60	1 (1.7%)	6 (10.0%)	53 (88.3%)
006 (NA)	NA	NA	NA	NA
007 (CI) (July 2021)	90	0 (0.0%)	0 (0.0%)	90 (100.0%)
008 (O) (September 2021)	60	10 (16.7%)	1 (1.7%)	49 (81.7%)
008 2nd visit (O) (September 2021)	42	1 (2.4%)	1 (2.4%)	40 (95.2%)
009 (M) (October 2021)	70	0 (0.0%)	1 (1.4%)	69 (98.6%)
010 (M) (November 2021)	55	0 (0.0%)	0 (0.0%)	55 (100.0%)
011 (NA)	NA	NA	NA	NA
012 (F) (January 2022)	65	0 (0.0%)	0 (0.0%)	65 (100.0%)
013 (F) (February 2022)	69	0 (0.0%)	0 (0.0%)	69 (100.0%)
Total	**758**	**61 (8.0%)**	**44 (5.8%)**	**653 (86.2%)**

COVID-OUT sampling

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Mar 21 – Feb 22

13 workplaces (11 sampled)

- 4 x manufacturing (M)
- 3 x food (F)
- 2 x office (O)
- 1 x distribution (D)
- 1 x core infrastructure (CI)

Only 15/758 samples (2.0%) with potentially significant levels of RNA

None with significant levels of RNA

Site (Month)	Samples collected	Ct >35.0 (includes –ve)	Ct 32.0-34.9	Ct <31.9
001 (M) (March 2021)	36	34 (94.4%)	2 (5.6%)	0 (0.0%)
002 (M) (March 2021)	66	66 (100.0%)	0 (0.0%)	0 (0.0%)
003 (D) (May 2021)	76	69 (90.8%)	7 (9.2%)	0 (0.0%)
004 (O) (May 2021)	69	69 (100.0%)	0 (0.0%)	0 (0.0%)
005 (F) (June 2021)	60	59 (98.3%)	1 (1.7%)	0 (0.0%)
006 (NA)	NA	NA	NA	NA
007 (CI) (July 2021)	90	90 (100.0%)	0 (0.0%)	0 (0.0%)
008 (O) (September 2021)	60	55 (91.7%)	5 (8.3%)	0 (0.0%)
008 2nd visit (O) (September 2021)	42	42 (100.0%)	0 (0.0%)	0 (0.0%)
009 (M) (October 2021)	70	70 (100.0%)	0 (0.0%)	0 (0.0%)
010 (M) (November 2021)	55	55 (100.0%)	0 (0.0%)	0 (0.0%)
011 (NA)	NA	NA	NA	NA
012 (F) (January 2022)	65	65 (100.0%)	0 (0.0%)	0 (0.0%)
013 (F) (February 2022)	69	69 (100.0%)	0 (0.0%)	0 (0.0%)
Total	**758**	**743 (98.0%)**	**15 (2.0%)**	**0 (0.0%)**

Workplace outbreak overview 1

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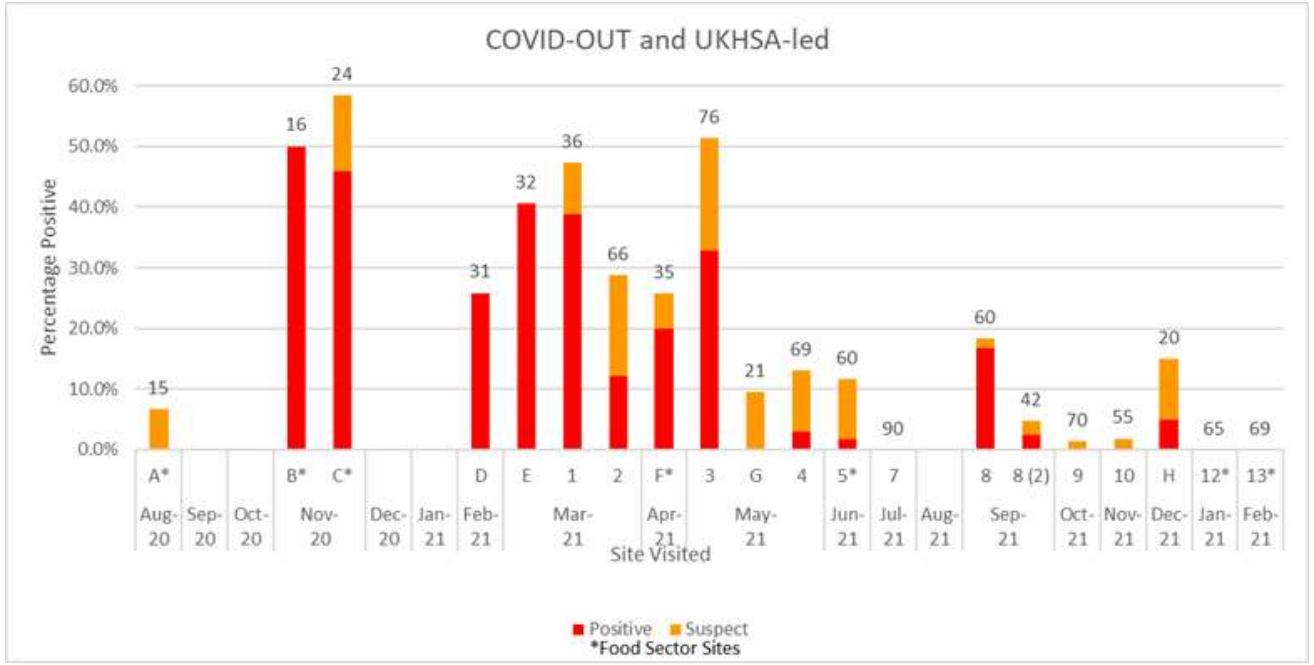

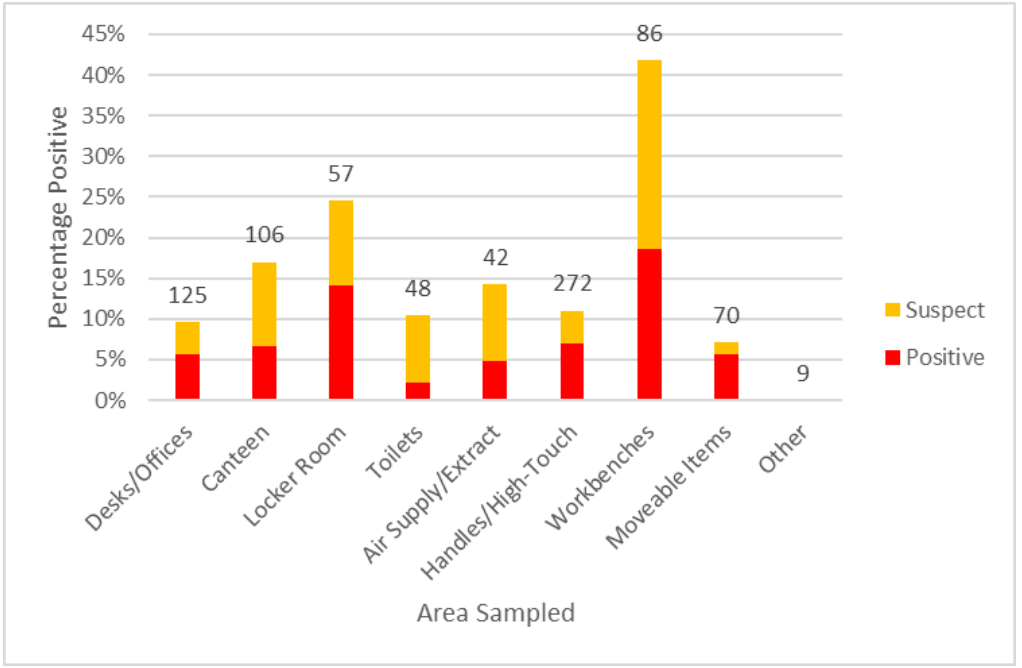

Workplace outbreak overview 2

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UKHSA-led sampling found **24.1%** of samples positive for SARS-CoV-2 RNA

COVID-OUT sampling found **8.0%** of samples positive for SARS-CoV-2 RNA

UKHSA-led sampling found **7.2%** of samples with potentially significant contamination and **1.0%** of samples indicating significant contamination

COVID-OUT sampling found **2.0%** of samples with potentially significant contamination

Difference can be explained by many factors including time from notification to sampling and vaccination status during pandemic

Lowest Ct found to date from any workplace sampling is Ct 31.07 (food sector site)

11 positives sent for whole genome sequencing – none returned more than 50% sequence

Workplace outbreak overview 3

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Site-specific data

- Surface sampling can identify weaknesses in cleaning regime
- Surface sampling can identify increased risk areas
- Data generated has led to sites updating procedures
- No samples identified to date inferring infectious virus present at the time of sampling

Wider-trends

- Apparent decrease is positivity since summer 2021
- Numerous explanations for this including ↑ vaccination rates
- Need to analyse personal worker samples + epi data before drawing conclusions
- Potential for location-specific risks to be overlooked

Legacy activities

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Optimisation of sampling methods

- Validation of commercial swabs/sponges
- Housekeeping genes
- Control samples

Optimisation of molecular methods

- Viability qPCR (platinum chloride / RNase A)
- Respiratory virus multiplex

Optimisation of virology methods

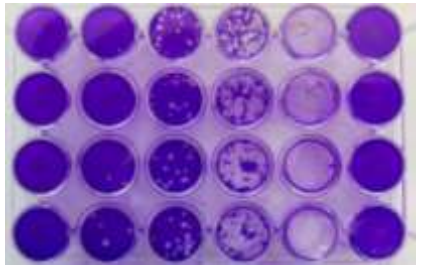
- Analysis of recovery rates
- Isolation optimisation for environmental samples

Transition to other respiratory viruses

- Influenza
- Seasonal coronaviruses
- EV-D68

Establish flexible response team

- Imported high consequence pathogens
- Norovirus




Flu outbreak shuts hospital ward

A ward at the Conquest Hospital is currently closed due to an outbreak of influenza.

Enterovirus D68: What is the mystery respiratory virus making US children sick?

Final Thoughts

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Food Sector has experienced impactful outbreaks

Many sectors similarly affected

Positive samples typically in non-production (low care) areas

Elevated hygiene controls reduce contamination – only 1 positive sample in ‘high care’ areas

A site is not a single entity – it is a collection of different areas

Risk assessments and control measures need to reflect differences between areas

Likely that impact of COVID linked to staff interaction and infection control measures

Difficult to balance productivity with optimal working environment

Big question: What COVID-control measures should be kept?

Control measures also effective against other pathogens

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UKHSA FWE laboratories

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Thank you

Rob Johnston
Food, Water and Environmental Scientist

Barry Atkinson
Senior Virologist

sites.manchester.ac.uk/covid19-national-project

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Post-Pandemic recommendations

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Not all COVID-control measures should be removed

- Many control measures effective against numerous pathogens
- Many control measures are cost-effective
- All sites should review the potential effectiveness going forwards
- Good hand hygiene and proportionate physical distancing should be promoted
- Location specific risk assessments can be extremely beneficial