COVID-19: Practical lessons learnt in virus control

Prof. John Holah, Principal Corporate Scientist, Kersia

IAFP München 4-6 May, 2022

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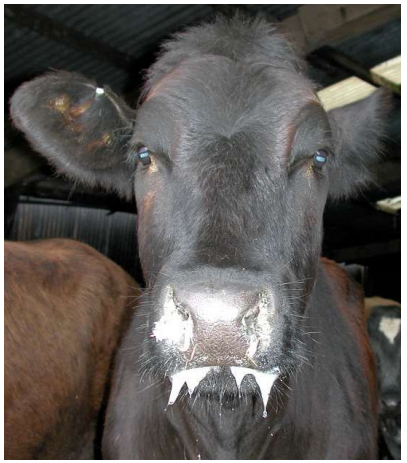
Prior to COVID-19

- Hepatitis A – poor handwashing of infected food handlers
- Hepatitis E – undercooked pork or shellfish
- Norovirus – poor handwashing of infected food handlers
- Norovirus – winter vomiting sickness – factory spill kit
- No routine cleaning and disinfection to control viruses (dairy phage - starter cultures)



Post Covid-19

- Maintaining food production is critical. COVID-19 is here to stay
- Routine cleaning and disinfection has to control person/food and person/person risk
  - on surfaces that the person(s) has/have touched
  - on surfaces on which droplets/aerosols may have settled
- Following a COVID-19 case, the food processing and/or ancillary area (e.g. office, canteen) or environment will be contaminated with SARS-CoV-2

- Is the food product a risk?
- Is the packaging a risk?
- How long could these droplets/aerosols and surface attached coronavirus particles survive?
- How long will COVID-19 be with us?

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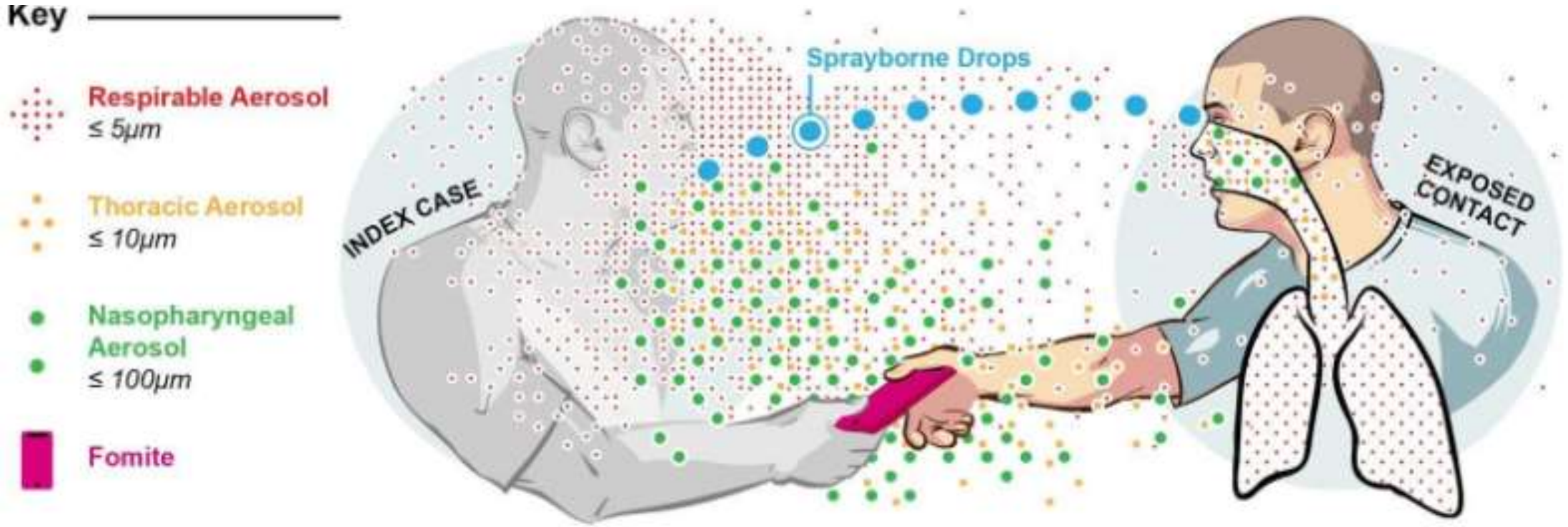

FAQs on Protecting Yourself from COVID-19 Aerosol Transmission

Shortcut to this page: https://tinyurl.com/FAQ-aerosols
Version: 1.86, 25-Nov-2020

Particle size (µm)	0.5	1	3	10	100
Time to settle 1.5m	41h	12h	1.5h	8.2min	5.8sec

- Number of droplets generated
- <5µm aerosols >5µm droplets
- 40,000 droplets from a sneeze[1], 3000 from a cough (same as talking for 5 min)[2]
- Average velocity of droplets = 11m/s[3]

Settlement times in still air[4]

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Coronavirus disease (COVID-19): Food safety for consumers

14 August 2020 | Q&A

Can I get COVID-19 from food?

There is currently no evidence that people can catch COVID-19 from food or food packaging. COVID-19 is a respiratory illness and the transmission route is through person-to-person contact and through direct contact with respiratory droplets generated when an infected person coughs or sneezes.

Live coronavirus found on frozen food packaging in China

Authorities say there have been no cases of transmission to consumers and the risk of it happening is low

Coronavirus - latest updates

See all our coronavirus coverage

People walk next to frozen food on shelves in a store that focuses on imported goods, in Beijing, China. Photograph: Roman Pilipey/EPA

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

efsa European Food Safety Authority

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9 March 2020

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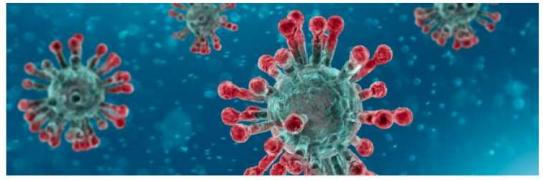
Coronavirus: no evidence that food is a source or transmission route



EFSA is closely monitoring the situation regarding the outbreak of coronavirus disease (COVID-19) that is affecting a large number of countries across the globe. There is currently no evidence that food is a likely source or route of transmission of the virus.

Coronavirus Disease 2019 (COVID-19)

Very low risk of getting COVID-19 from food and packaging or treated drinking water

- The risk of getting COVID-19 from food you cook yourself or from handling and consuming food from restaurants and takeout or drive-thru meals is thought to be very low. Currently, there is no evidence that food is associated with spreading the virus that causes COVID-19.
- The risk of infection by the virus from food products, food packaging, or bags is thought to be very low. Currently, no cases of COVID-19 have been identified where infection was thought to have occurred by touching food, food packaging, or shopping bags.
- Although some people who work in food production and processing facilities have gotten COVID-19, there is no evidence of the virus spreading to consumers through the food or packaging that workers in these facilities may have handled.

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Strain	Conditions	Result
SARS-CoV-2[5]	60%RH, 21°C on stainless steel (indoors) 70%RH, 25°C (summer) 66%RH, 13°C (spring/fall)	Half-life = 7.75 h – remains viable for 1-4 days Half-life = 3.41 h – remains viable for 1-3 days Half-life = 23.46 h – remains viable for >7 days
SARS-CoV-2[6]	Darkness, room temp	Half-life =1.1-1.2hr - (95%ci 0.64-2.64h)
SARS-CoV-2[7]	Human skin	Survival for 9.04 hours

Surface survival [8]

Temperature (°C)	Time (h) to achieve a 1 log reduction	Time (h) to achieve 4 log reduction
4	163	653 (27 days)
10	148	593
20	82.5	330
30	27	108
40	5.25	21

RH	20°C	6°C
%	Half-life h	Half-life h
30	26.8	34.5
50	67.5	102.5
80	3.3	86.0

- Presence or infective?
- Survival decreased with time and temperature and increases with soiling
- Fallow may not work – must disinfect

Airborne survival [9]

(HCoV 299E)

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Speculation

microbial biotechnology

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Clinical evidence that the pandemic from 1889 to 1891 commonly called the Russian flu might have been an earlier coronavirus pandemic

Harald Brüssow ✉, Lutz Brüssow,

First published: 13 July 2021 | https://doi.org/10.1111/1751-7915.13889 | Citations: 1

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Summary

Contemporary medical reports from Britain and Germany on patients suffering from a pandemic infection between 1889 and 1891, which was historically referred to as the Russian flu, share a number of characteristics with COVID-19. Most notable are aspects of multisystem affections comprising respiratory, gastrointestinal and neurological symptoms including loss of taste and smell perception; a protracted recovery resembling long covid and pathology observations of thrombosis in multiple organs, inflammation and rheumatic affections. As in COVID-19 and unlike in influenza, mortality was seen in elderly subjects while children were only weakly affected. Contemporary reports noted trans-species infection between pet animals or horses and humans, which would concur with a cross-infection by a broad host range bovine coronavirus dated by molecular clock arguments to an about 1890 cross-species infection event.

European Commission

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Q&A: Why history suggests Covid-19 is here to stay

27 January 2021

by *Anthony King*

Republish

In the late 19th century a flu-like illness that caused loss of taste and smell likely came from the 'common cold' coronavirus in circulation today, according to Prof. Marc Van Ranst, an expert on coronaviruses. Image credit - Rob Stevens/KU Leuven

A mysterious flu-like illness that caused loss of taste and smell in the late 19th century was probably caused by a coronavirus that still causes the 'common cold' in people today, according to Professor Marc Van Ranst at KU Leuven in Belgium, an expert on coronaviruses.

He says that the foothold of the SARS-CoV-2 virus in the human population today means it is likely to follow a similar pattern and become a continuously circulating, or 'endemic' virus, joining four other human coronaviruses that infect people with common cold symptoms.

Could you tell us about your work showing that a coronavirus called OC43 may have caused the 'Russian flu' pandemic of the 1890s, which spread from St Petersburg across Europe to the US?

COVID-19 enhanced hygiene measures

1. Social distancing, provision of screens between employees
2. Additional ventilation of the workplace if possible
3. The increased undertaking of hand washing and the use of hand hygiene products (including a potential increase in hand hygiene monitoring),
4. Additional disinfection of environmental human touch points (e.g. door handles, switches, stop/start buttons, HMI screens, hand rails, keyboards, hand soap and towel dispensers)
5. Additional disinfection of environmental surfaces in which SARS-CoV-2 could accumulate via droplets expressed through the mouth and nose (e.g. floors in heavy trafficked areas - footwear).

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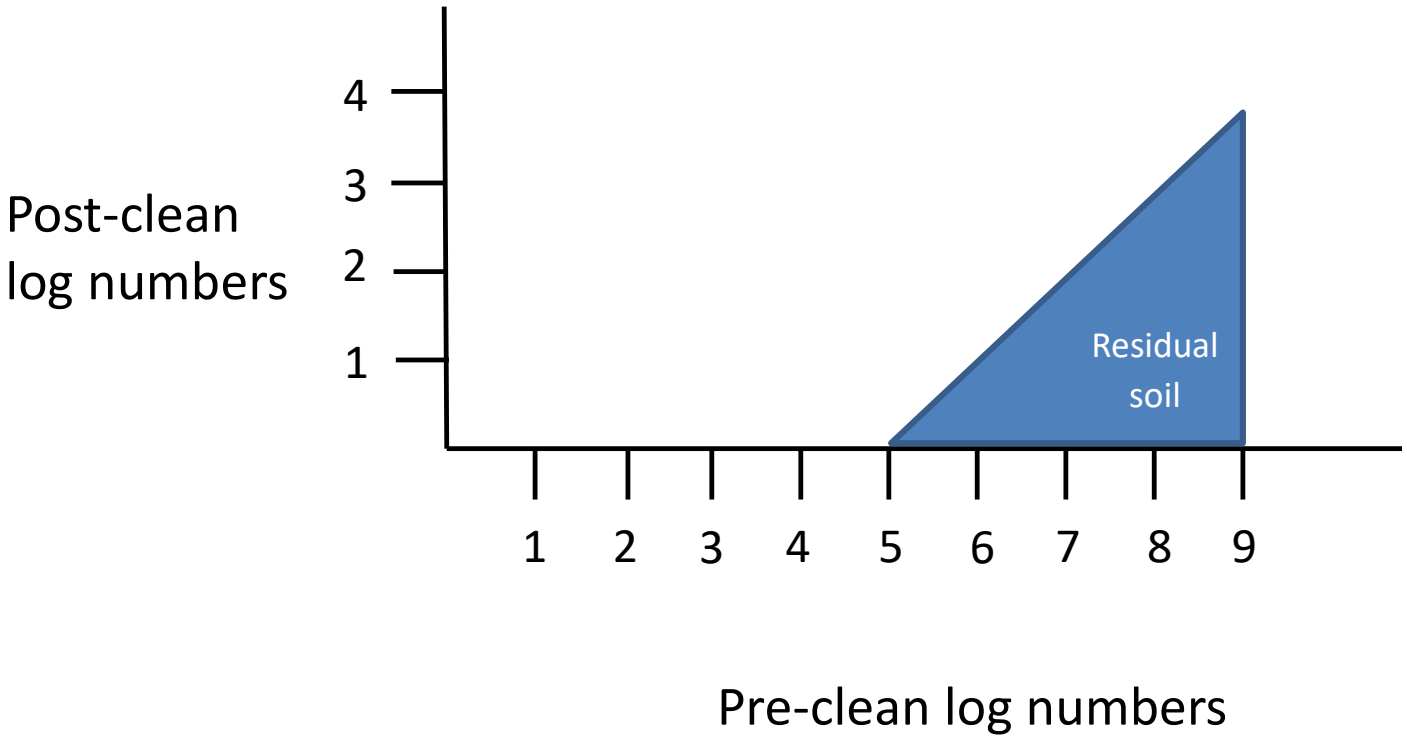
2-stage cleaning and disinfection for bacterial control

Detergent

3 log reduction

Physical removal, cell damage

Disinfectant
2 log reduction
Cell damage, removal



Detergent antiviral properties?

- "Washing your hands with soap and water dissolves the virus" (WHO, 2020)
- Independent testing at Perfectus Biomed Group (Daresbury, Cheshire, UK)
- Six detergents were chosen to reflect the type of detergents commonly used in the food processing and food service industries
- Detergents were tested against HCoV-299E using the method of the European virucidal disinfectant test EN 14476, under dirty conditions, according to their recommended concentrations and contact times.
- Cell line, Tissue Culture Infectious Dose 50 assay ($TCID_{50}$)

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Detergent effects

Product	Generic description	Contact time (min)	Conc. (%)	pH	Log reduction	Percentage reduction
Caustak 25	Caustic detergent (CIP, soak or boil-out)	20	5	13.50	1.83	98.53
			1	13.06	1.5	96.84
Chlorsan	Chlorinated caustic detergent (CIP, automated tray washing, soak or boil-out)	20	5	13.31	2.33	99.54
			0.25	12.27	1.67	97.85
Holsolve	Low alkalinity detergent (foam applications, manual cleaning)	20	5	12.12	3.00	99.90
			0.5	11.00	0.83	85.32
Initial	pH neutral surfactant-based detergent (manual cleaning)	5	2	7.96	3.67	99.98
			1	7.79	2.83	99.85
M1	Surfactant-based detergent (manual cleaning)	5	5	8.82	3.25	99.94
			1	8.60	2.64	99.77
Holphos	Phosphoric acid based detergent (CIP, automated tray washing, soak or boil-out)	20	5	1.72	2.67	99.78
			1	2.01	2.17	99.32

All tests undertaken against EN 14476 under dirty conditions against HCoV-299E

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Disinfectant developments

Prions

↓

Coccidia (e.g.Cryptosporidia)

↓

Spores

↓

Mycobacteria

↓

Cysts (Giardia)

↓

Small non-enveloped viruses (e.g. Norovirus)

↓

Gram –ve bacteria

↓

Fungi

↓

Large non-enveloped viruses (e.g. Adenovirus)

↓

Gram +ve bacteria

↓

Enveloped viruses

→ WHO
1000ppm chlorine
>60% alcohol

→ Early scientific literature [11]

Sodium hypochlorite
QACs
Ethanol
Hydrogen peroxide

→ EN 14476

Virucidal =
Adenovirus, Murine Norovirus and Poliovirus

Limited spectrum =
Adenovirus, Murine Norovirus

Enveloped =
Vaccinia

McDonnell and Russell (1999)[10]

Mutations are unlikely to have any effect on disinfectant reistance[11]

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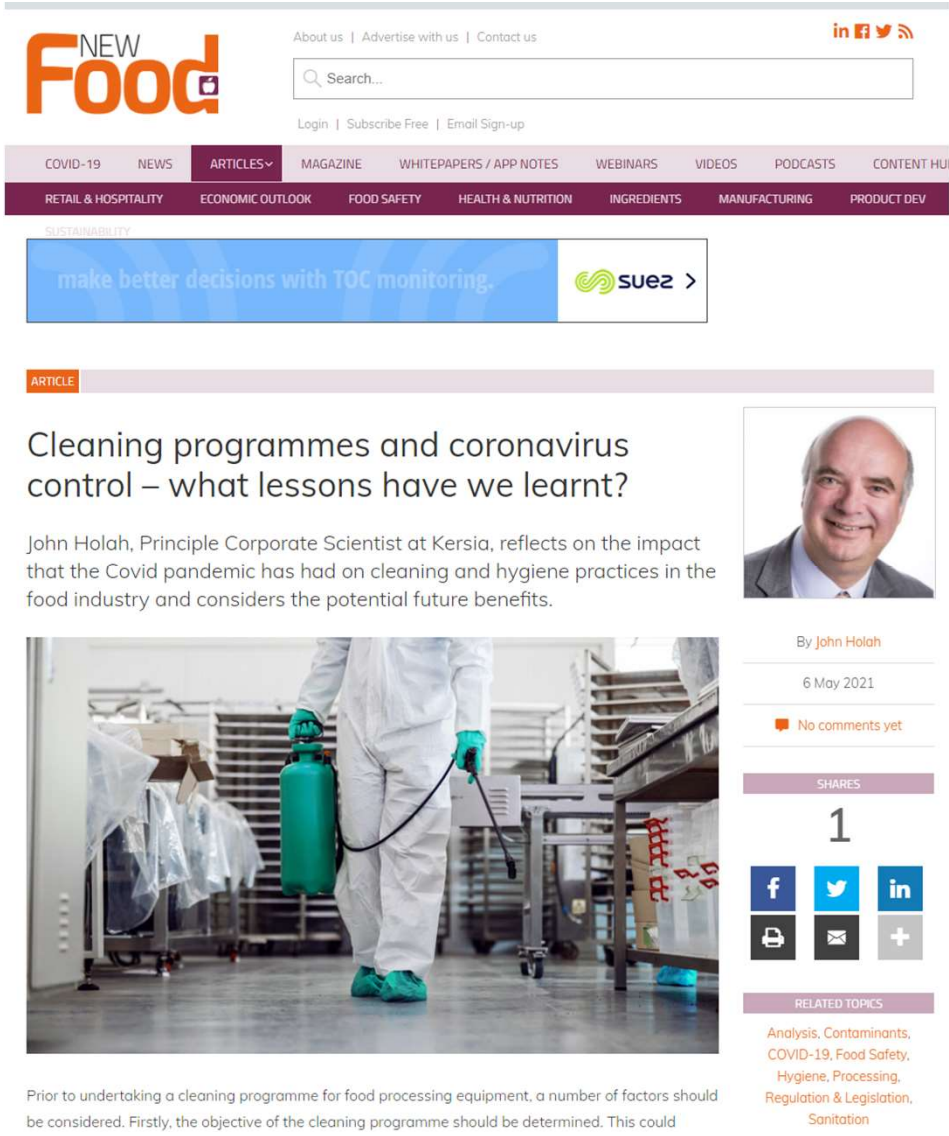
Implications: routine cleaning and disinfection

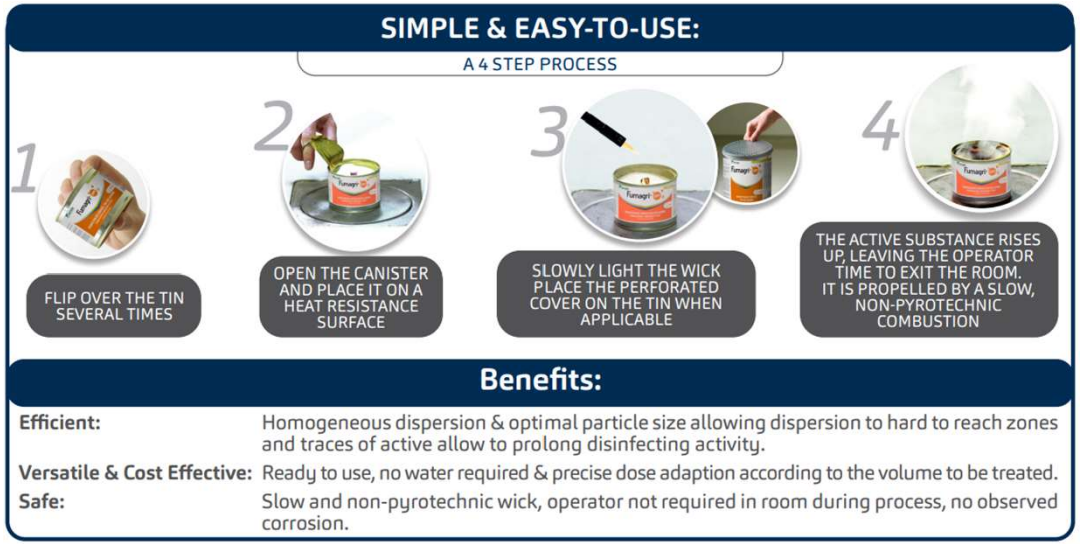
- Cannot make antiviral claims for detergents
  - No idea about soiling loads – 'disinfection' requires surface cleanliness
  - 4 log reduction required
- Concept that both the cleaning and disinfection stage are important is appropriate for coronavirus
- Routine end-of-production cleaning and disinfection will be effective for food surface coronavirus control
- Add additional disinfection of fomites (hand contact) and settlement points (floors) – 'COVID-19 CIC'



https://www.newfoodmagazine.com/article/146870/cleaning-programmes-and-coronavirus-control-what-lessons-have-we-learnt/
https://www.holchem.co.uk/media-centre/cleaning-programmes-and-coronavirus-control-lessons-learnt-john-holah-principle-corporate-scient/

Airborne disinfection options

- Fogging
- Ultrad
- Ozone/UV/H_2O_2/ClO_2



Fogging effectiveness – DEFRA LINK - Campden BRI 1998

25µm - too big

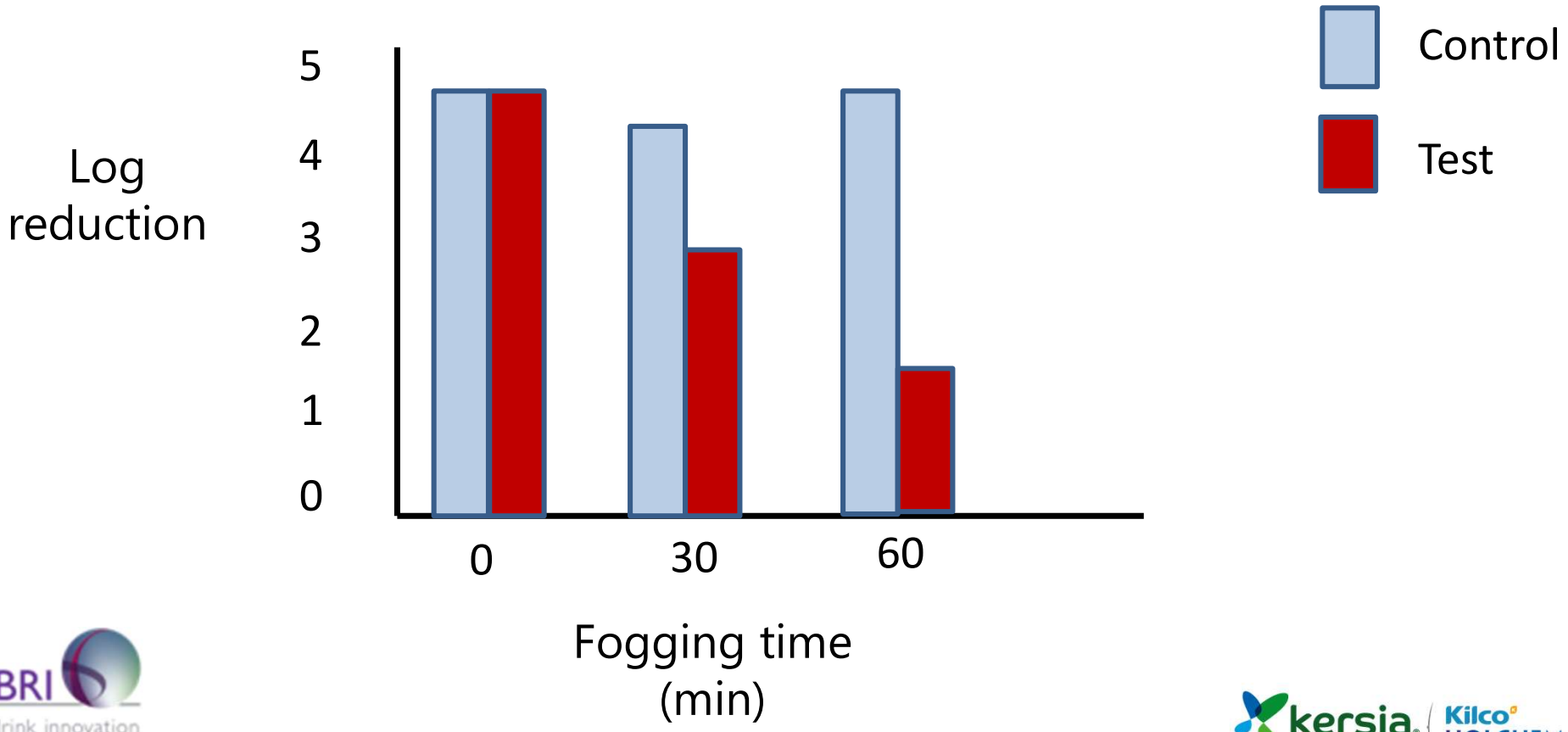
15µm - just right

100% humidity

2.5µm - too small

Burfoot et.al. (1999) Fogging for the disinfection of food processing factories and equipment. Trends in food Science and Technology 10:205-210

Airborne reduction of *S. aureus* with time



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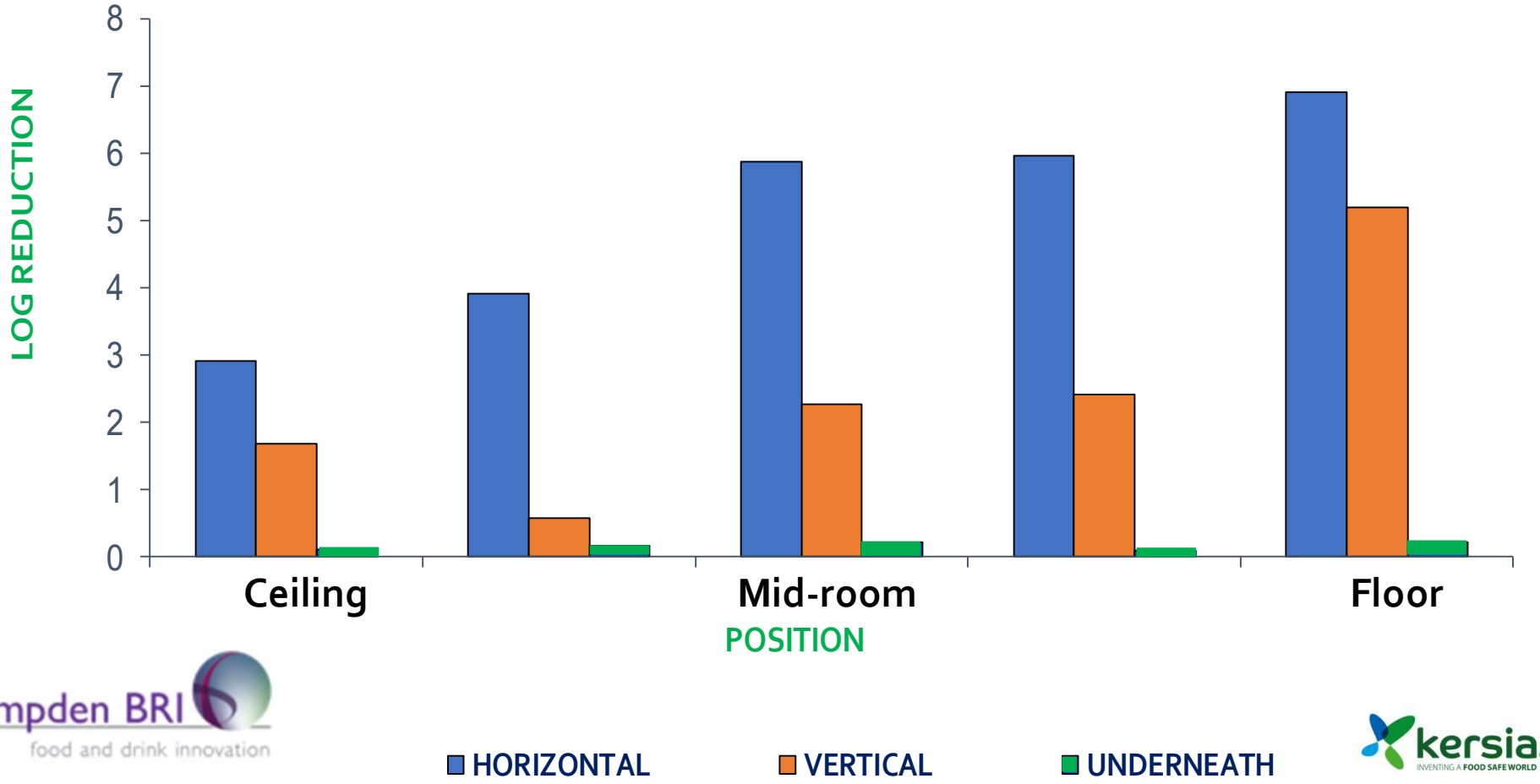
Comparative reductions at different coupon orientations with *S. aureus*



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Viral decontamination

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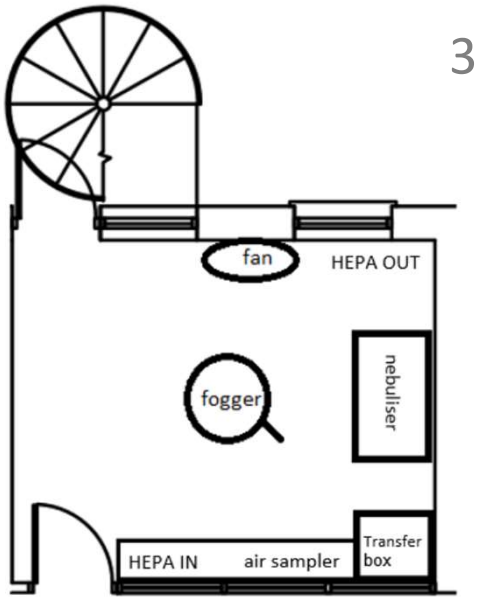
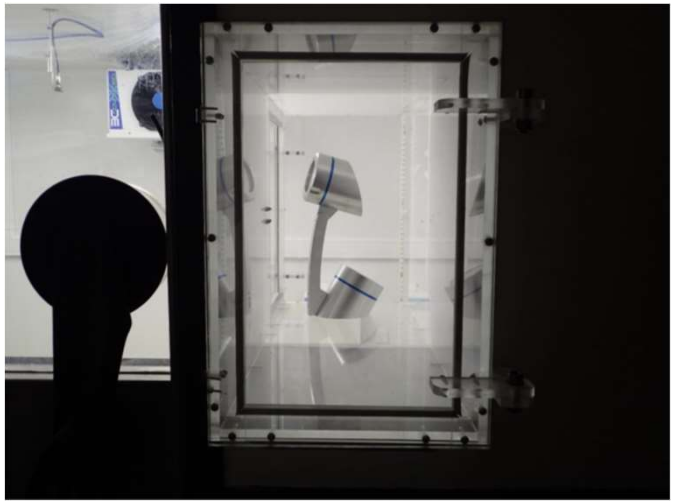


30m^3 test chamber

Collison nebuliser
1.6 bar, 0.3mL/min

Satellite-fogjet-trolley

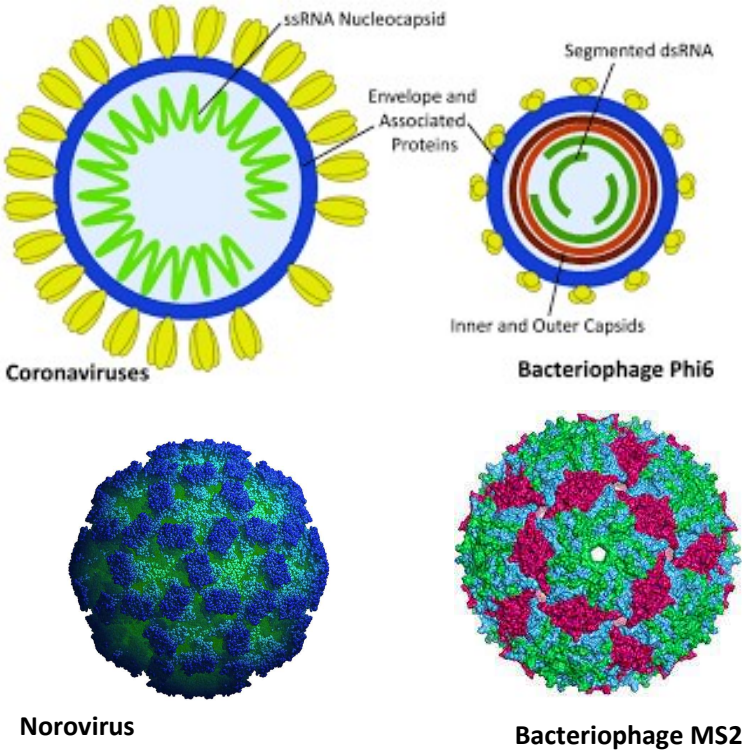


Merck
MAS-100
air sampler

Triplicate tests

Experimental design

- 10 min aerosolisation
- Phi6 *Pseudomonas syringae* phage – an enveloped RNA virus and a surrogate for coronavirus and influenza
- MS2 *Escherichia coli* phage – a non-enveloped RNA virus and a surrogate for norovirus
- 1 jet of a Satellite-fogjet-trolley, 30 min fog, 60 min settlement
- Active (Triamine) at 3%
- Sopura Sopuroxoid 3.2 (PAA) at 1.53%



Bacteriophage plaque assay

Time (Control)	Phi 6 (Log pfu/m^3)	MS2 (Log pfu/m^3)
0	5.8	5.6
12	5.7	5.3
24	5.5	5.3
36	5.4	5.3
48	5.8	5.6
60	5.3	4.7
72	5.4	5.7
84	4.6	5.2
96	4.6	5.1
108	4.6	5.3

Fogging has physical, chemical and biological factors involved in reducing viral infectivity

Disinfectant	Virus	Log reduction vs baseline	Log reduction vs 96 min control
Active	Phi 6	>5	>3.35
	MS2	>0.8	>0.3
Sopuroxoid	Phi 6	>5	>3.8
	MS2	>4.3	>2.8

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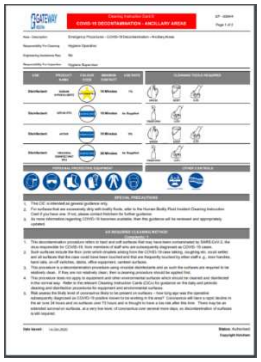
Implications: decontamination



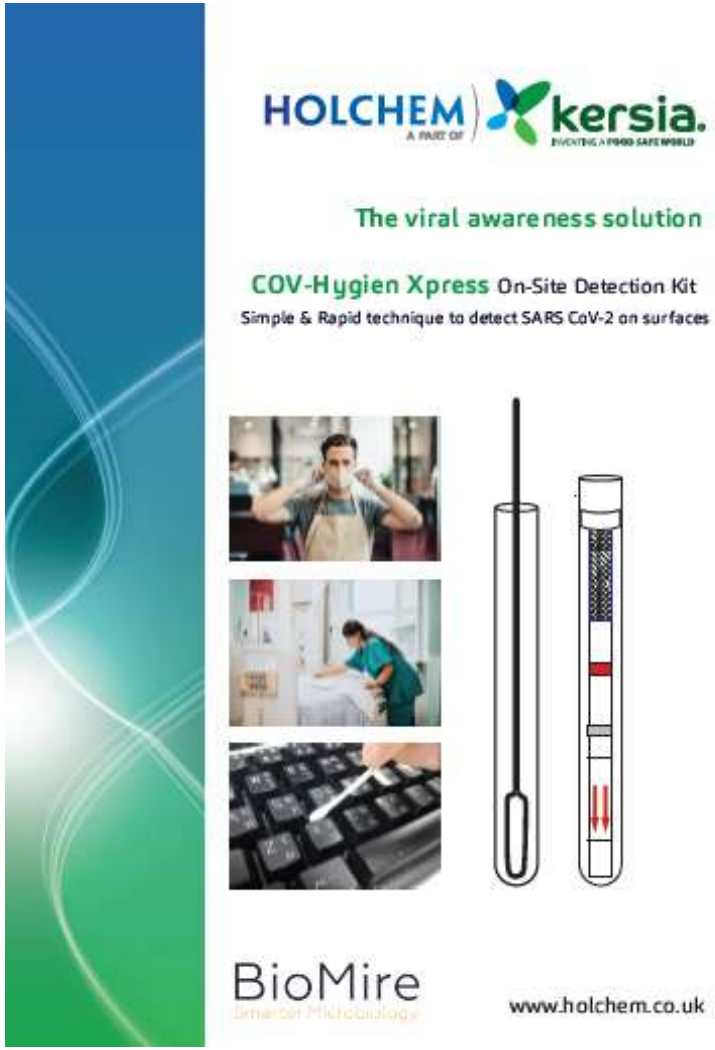
- Cleaners - separate bubble?
- Consider COVID-19 personal protective equipment (PPE)? Risk assessment – number of COVID-19 cases and likely aerosol produced.
- Know/suspected SARS-CoV-2 sources are decontaminated first (re listeria model).
  - Floors (and other low level surfaces close to walkways)
  - Hand contact points,
  - Other collector points – floor cleaning equipment, vehicle wheels, air vents/fans
- EOP clean and generic COVID-19 Kersia CIC for production areas and ancillary areas
- Additional food processing surfaces afterwards following specific CICs (overheads)?
- Fogg
- EOP clean before you start production (as you would after any fallow period)

https://www.holchem.co.uk/media-centre/cleaning-and-disinfection-for-routine-hygiene-and-covid-control/

Cleaning verification

- Detection of SARS-CoV-2 is possible on surfaces using swabbing with analysis by antibodies or qRT-PCR.
- 116 factories, 22,643 samples, 1.23% positive (PCR)[12]

	Antigen based	RTqPCR based
Speed	Approximately 15 min (monitoring)	24-48hours? (verification only)
Cost	Relatively cheap ($25)	Expensive
Sensitivity	5000 virus particles	A few strands of RNA
Outcome	A risk reduction tool	Definitive result



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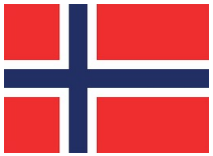
Decline of food poisoning worldwide




Disease	Number of confirmed human cases	
	2019	2020
Campylobacteriosis	220,682	120,946
Salmonellosis	87,923	52,702
STEC infections	7,775	4,446
Yersiniosis	6,961	5,668
Listeriosis	2,621	1,876







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Causal effects?

- Peoples' behaviour may have changed via a focus on hand hygiene
- Peoples' eating habits may have changed so that they were more likely to eat perceived safer foods and consume food cooked in the home
- Consumers purchased more pre-packed foods during the pandemic, potentially because they were safer as they would be touched less, and were more likely to check 'use by' dates
- Social interaction was much reduced, in the home and in the workplace
- People who had mild illness from food poisoning were not reporting it as they may have thought public health authorities were overstretched and/or they may not have been able to access a health practitioner
- Fewer tests undertaken by government laboratories
- People were not eating out as food service establishments Note: - food service has traditionally been perceived as a higher risk for food poisoning than eating at home

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Additional evidence

- But if the food industry has been instrumental in making safer food (and is the major social interaction for its workers), extended use of hand hygiene products and the extended disinfection of environmental surfaces during production **is the new norm**
- Evidenced by
  - Reduced product general microbial indicator counts (TVC or Enterobacteriaceae)
  - Reduced environment general microbial indicator counts (TVC or Enterobacteriaceae)
  - Reduced product pathogen detections (particularly environmental and skin pathogens such as Listeria, *B. cereus*, *Staph aureus* etc.)
  - Reduced environmental pathogen detections (particularly environmental pathogens such as Listeria)
  - Improvement in product quality or shelf-life
  - Reduced customer complaints
  - Reduced staff absenteeism

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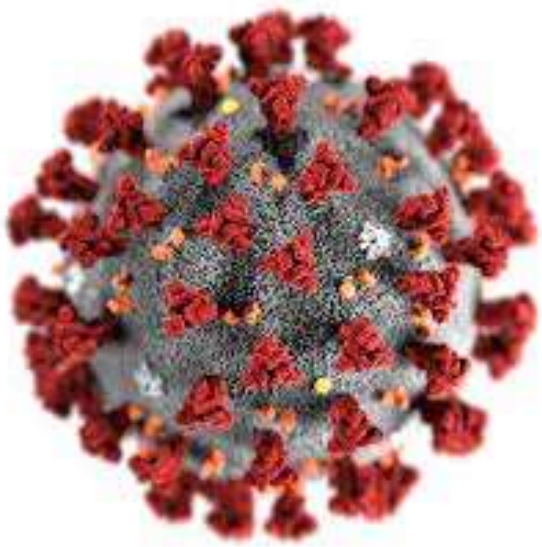
Conclusions

Kersia/Holchem has helped facilitate innovations in viral:

- Detergent effects
- Disinfection claims
- Routine CICs
- Additional disinfection of fomites – COVID CIC
- Fogging effects
- Decontamination CICs
- Rapid verification tools



We must maintain our higher hygiene standards re food safety until evidence suggests otherwise

Are we better prepared for the next pandemic ?

Any questions : john.holah@kersia-group.com

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