

Cleaning and Disinfection in the Time of SARS-CoV-2

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August 6, 2020

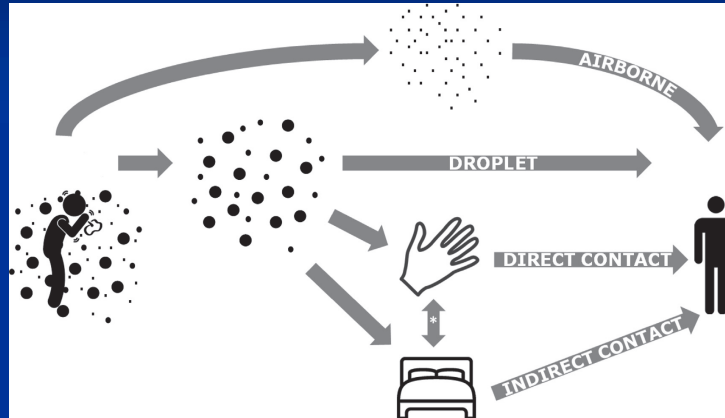
Objectives

- To review evidence that contaminated surfaces and fomites may contribute to transmission of respiratory viruses in healthcare settings
- To discuss commonsense measures to reduce risk for transmission in community settings
- To be aware of practical approaches for decontamination of respiratory viruses on hard and soft surfaces

2

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Possible role of surface contamination in transmission of SARS and MERS coronaviruses and influenza in healthcare settings



Otter JA. Transmission of SARS and MERS coronaviruses and influenza in healthcare: the possible role of dry surface contamination. J Hosp Infect 2016;92:235-50; Boone SA, Gerba CP. Significance of fomites in the spread of respiratory and enteric viral disease. Appl Environ Microbiol 2007;73:1687-96..

3

Cleaning and disinfection in response to COVID-19

- UV-C for buses and subway cars
- Electrostatic sprayers for first responder vehicles and airplanes
- “Deep cleaning” of subway systems and schools
- Spraying outdoor areas with disinfectant



4

Exaggerated risk of transmission of COVID-19 by fomites

Emanuel Goldman
Lancet Infect Dis 2020; July 3, 2020

Hygiene Theater Is a Huge Waste of Time

People are power scrubbing their way to a false sense of security.
July 27, 2020

Derek Thompson

Staff writer at *The Atlantic*

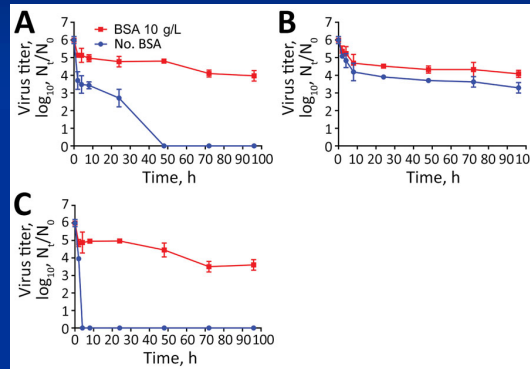
All those studies that made COVID-19 seem likely to live for days on metal and paper bags were based on unrealistically strong concentrations of the virus. ...“as many as 100 people would need to sneeze on the same area of a table to mimic some of their experimental conditions.” The studies “stacked the deck to get a result that bears no resemblance to the real world,” Goldman said. **5**

Viral load in respiratory secretions

- SARS-CoV-2 in respiratory samples by PCR¹⁻²
 - Median 6 log₁₀ copies/mL
 - 15% of samples >8 log₁₀ copies/mL
- RSV and influenza by PCR³
 - ~6-8 log₁₀ copies/mL
- Culture for virus in nasal secretions⁴⁻⁵
 - RSV - ~3 log₁₀ PFU/mL
 - Rhinovirus ~1-4 log₁₀ PFU/mL

1. Kleiboeker S. J Clin Virol 2020;129:104439; 2. Pan Y. Lancet Infect Dis 2020;20:411-12; 3. Hijano DR PLoS One 2019;14:e0220908; 4. Walsh EE. J Infect Dis 2013;207:1424-32; 5. Gwaltney JM, Hendley JO. Am J Epidemiol 1978;107:357-61. **6**

Prolonged infectivity of SARS-CoV-2 on fomites



A. Glass; B. Polystyrene plastic; C. Aluminum

Pastorino B. Emerg Infect Dis September 2020.

7

Survival of SARS-CoV-1 on surfaces, by inoculum size

Inoculum TCID ₅₀ /mL	Paper	Disposable gown	Cotton gown
10 ⁶	24 h	2 days	24 h
10 ⁵	3 h	24 h	1 h
10 ⁴	<5 min	1 h	5 min

Lai MY, et al. Clin Infect Dis 2005;41:e67-e71.

8

Hand-to-hand transmission of rhinovirus colds

- Rhinovirus present in 65% of donor hand rinses and 46% of recipient hand rinses
- Virus on donors' hands was transferred 71% of recipients' fingers during hand contact
- 11 of 15 hand contact exposures resulted in infection in the recipient
- Conclusion: hand contact/self-inoculation is a very effective way to transmit rhinovirus

Gwaltney JM. Ann Intern Med 1978;88:463-7.

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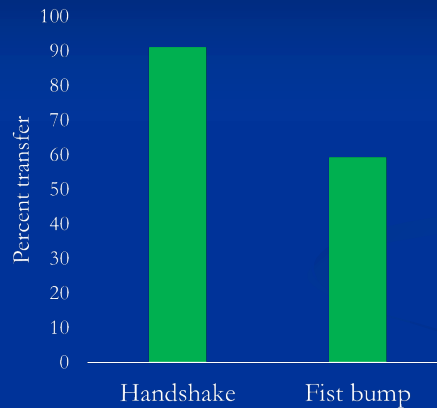
“Let’s not shake hands in this special time”

Xi Jinping



10

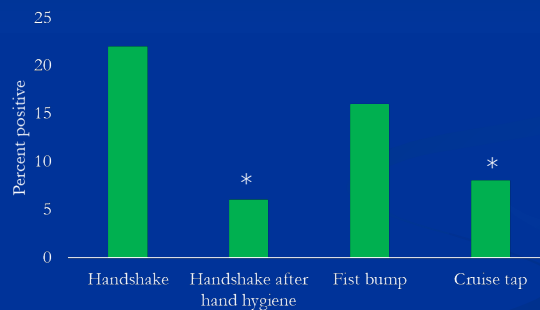
Transfer of bacteriophage MS2 by handshake versus fist bump



Jones L. Transfer of bacteriophage MS2 by handshake versus fist bump. Am J Infect Control 2020;48:727-729; Pinto-Herrera NC. Transfer of MRSA by fist bump versus handshake. Infect Control Hosp Epidemiol 2020;41:962-964.

11

Transfer of MRSA by handshake versus fist bump



Pinto-Herrera NC. Transfer of MRSA by fist bump versus handshake. Infect Control Hosp Epidemiol 2020;41:962-964.

12

Transmission of experimental rhinovirus infection by contaminated surfaces

- Donors with colds wipe their nose and then held a coffee cup or rubbed a plastic tile
- Recipients handled the coffee cups or touched the tiles and then touched their eyes and nose
- 50% of those touching the coffee cups and 56% touching the tiles became infected
- Disinfecting the tiles reduced the risk for infection

Gwaltney JM, Hendley JO. Am J Epidemiol 1982;116:828-33.

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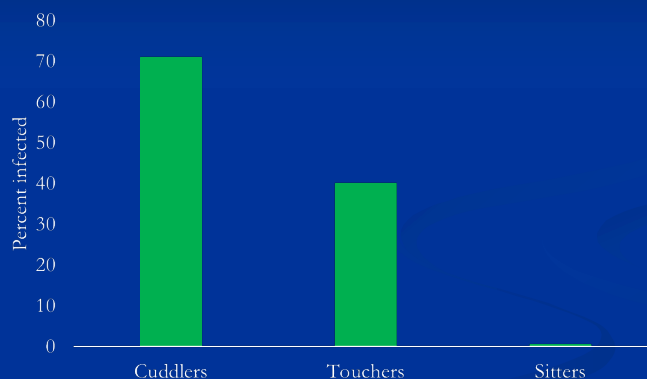
Modes of transmission of RSV

- “Cuddlers” – caring for infected infant for 2-4 hours with direct contact while wearing gowns but no mask or gloves
- “Touchers” – touch contaminated surfaces with infant out of the room and rubbed nose or eyes
- “Sitters” – sat more than 6 feet from an infected infant with no contact with surfaces

Hall CB. J Pediatr 1981;99:100-103

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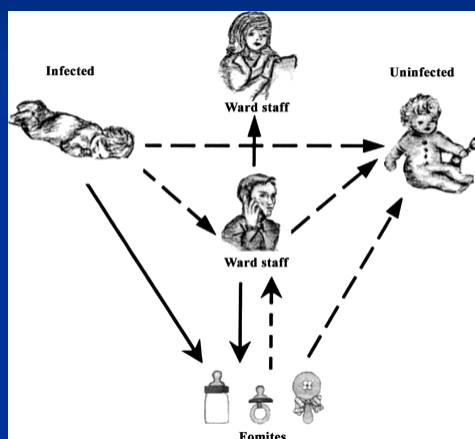
Modes of transmission of RSV



Hall CB. J Pediatr 1981;99:100-103

15

Modes of nosocomial transmission of RSV



Hall CB. J Pediatr 1981;99:100-103; Hall CB. Clin Infect Dis 2000;31:590-6.

16

Frequency of transfer of MRSA from skin of patients by gloved hands versus fomites



Alhmidi H. Manuscript in revision.

17

MRSA colonies transferred by gloved hands and stethoscope diaphragm

Glove prints



Stethoscope print



Alhmidi H. Manuscript in revision.

18

WHO guidance on cleaning and disinfection in the context of COVID-19

- Clean and disinfect
- Chlorine-based disinfectants (≥ 1000 ppm)
- Spraying and fogging not recommended
- Spraying individuals with disinfectants not recommended under any circumstances
- Inpatient rooms – disinfect at least twice daily
- Non-healthcare settings – high-touch surfaces in gyms, restaurants, schools, home, etc

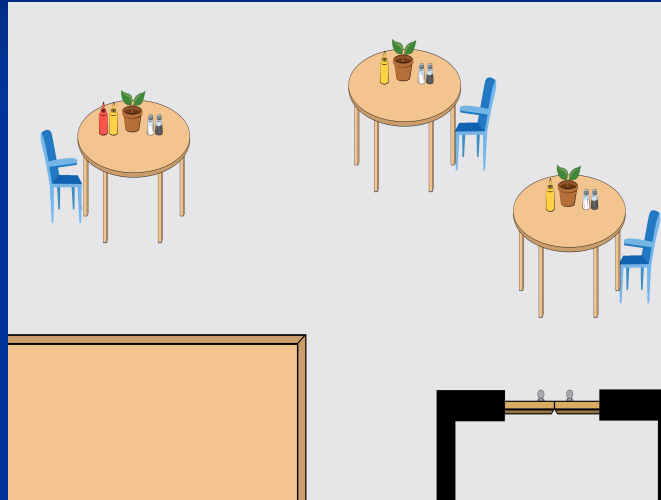
WHO. Cleaning and disinfection of environmental surfaces in the context of COVID-19. Interim guidance May 15 2020.

19

Opportunities to reduce risk for transmission in community settings

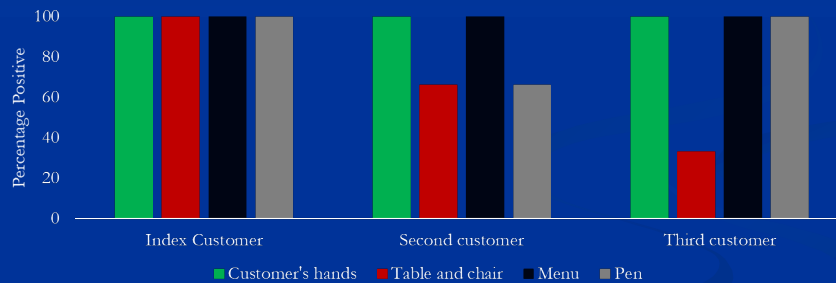
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Simulated restaurant with contaminated index customer



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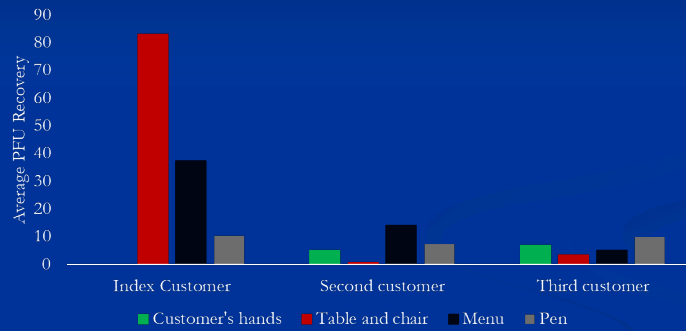
Simulated restaurant with contaminated index customer



Alhmidi H. Manuscript in preparation.

22

Simulated restaurant viral plaque-forming units (PFU) recovered

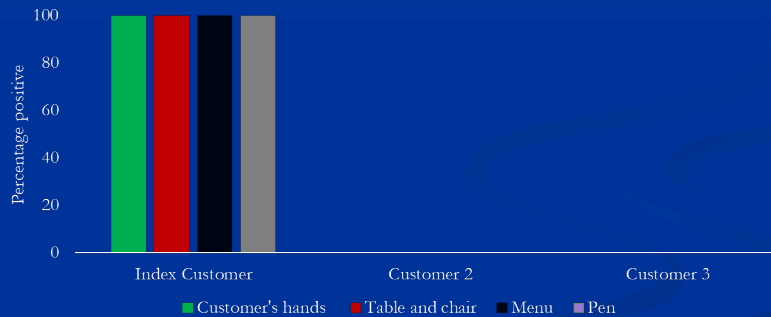


Inoculum: 10⁴ PFU applied to hands of index customer

Alhmidi H. Manuscript in preparation.

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Intervention: disposable menus and decontamination of shared pens

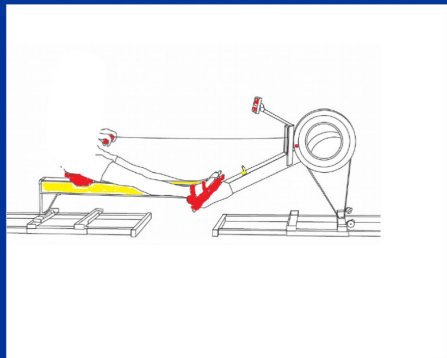


Alhmidi H. Manuscript in preparation.

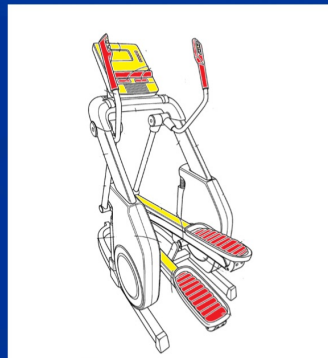
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High-touch surfaces at the gym

Rower

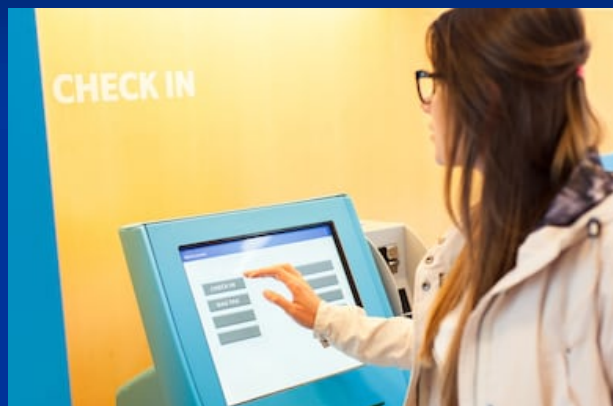


Elliptical



25

Touchscreens

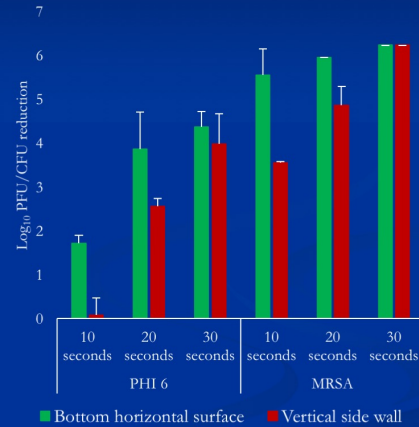


Alhmidi H. Evaluation of an automated UV-C light disinfection device and patient hand hygiene for reduction of pathogen transfer from interactive touchscreen computer kiosks. *Am J Infect Control* 2018;46:464-467.

26

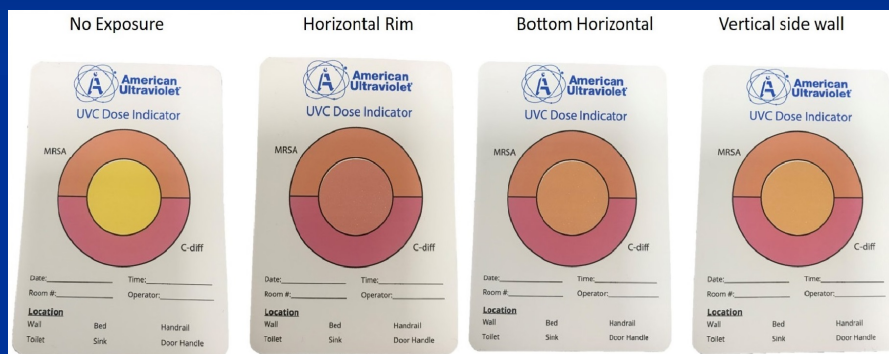
UV-C light for decontamination of airport security bins

- Respiratory viruses frequently recovered from airport, particularly security bins ¹
- Ideal for UV – hard smooth surfaces, frequently contacted, limited potential for alternative cleaning



1. Ikonen N. Deposition of respiratory virus pathogens on frequently touched surfaces at airports. BMC ID 2018;18:437; 2. Memish ZA. Environmental sampling for respiratory pathogens in Jeddah airport during the 2013 Hajj season. AJIC 2014;42:1266-9; 3. Cadnum JL. Evaluation of UV-C Light for Rapid Decontamination of Airport Security Bins. Pathog Immun. 2020;5(1):133-142.

Colorimetric indicators demonstrating UV-C delivery to sites on security bin



Cadnum JL. Evaluation of UV-C Light for Rapid Decontamination of Airport Security Bins. Pathog Immun 2020;5(1):133-142.

Practical approaches for decontamination of respiratory viruses on hard and soft surfaces

29

Disinfectants and UV-C light versus coronaviruses

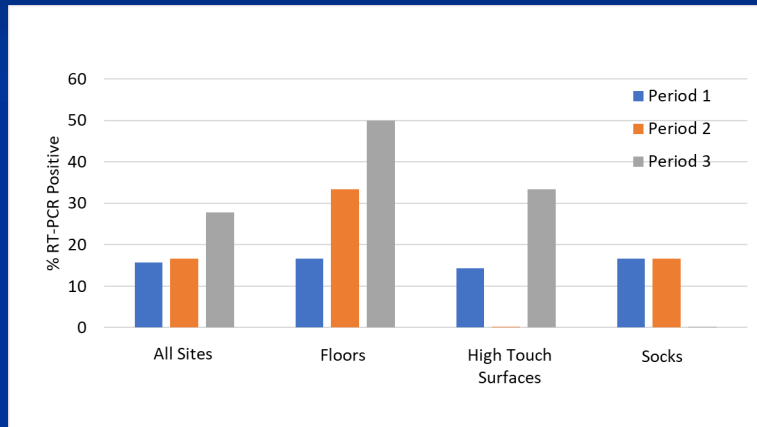
- A wide range of disinfectants are active against coronaviruses
- UV-C light rapidly inactivates SARS-CoV-2
- Simulated sunlight rapidly inactivates SARS-CoV-2

Dev Kumar G. Biocides and Novel Antimicrobial Agents for the Mitigation of Coronaviruses. Front Microbiol 2020;11:1351; Bianco A. UVC irradiation is highly effective in inactivating and inhibiting SARS CoV2 replication. medRxiv preprint doi: <https://doi.org/10.1101/2020.06.05.20123463>; Ratnesar-Shumate. Simulated Sunlight Rapidly Inactivates SARS-CoV-2 on Surfaces. J Infect Dis 2020;222:214-222.

30

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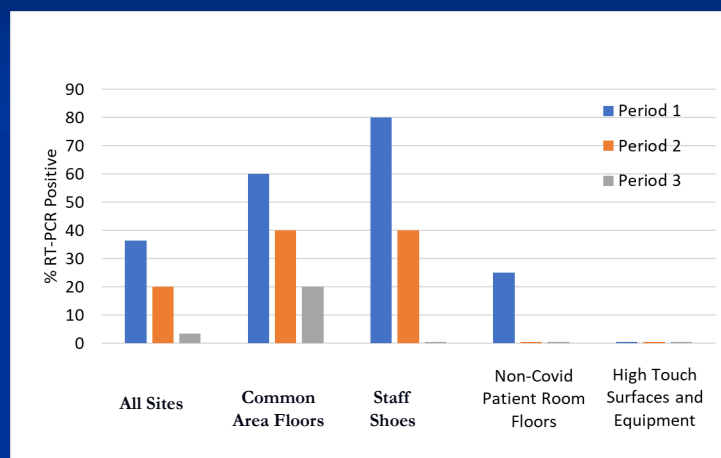
SARS-CoV-2 RNA in COVID-19 rooms



Redmond SN. Infect Control Hosp Epidemiol in press.

31

**SARS-CoV-2 RNA on COVID-19 wards
outside of COVID-19 rooms**



Redmond SN. Infect Control Hosp Epidemiol in press.

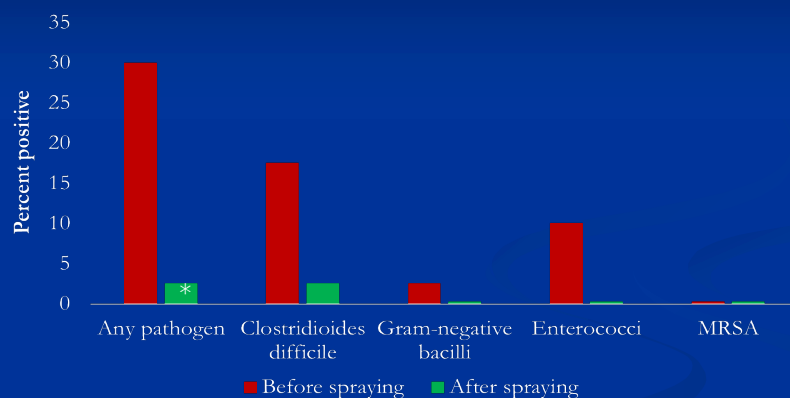
32

Electrostatic sprayer



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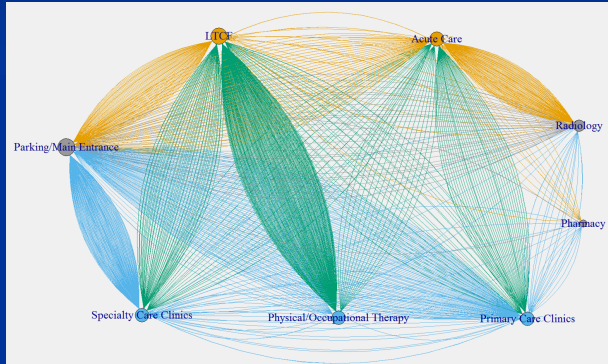
Contamination before versus after application of disinfectant using an electrostatic sprayer



Cadnum JL. Evaluation of an electrostatic spray disinfectant technology for rapid decontamination of portable equipment and large open areas in the era of SARS-CoV-2. Am J Infect Control 2020;48:951-954.

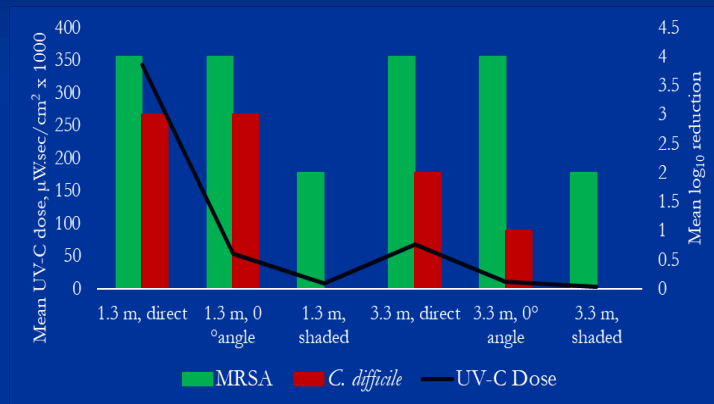
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Spores on wheels: Movement of wheelchairs within a hospital and LTCF



Jenson AL. Am J Infect Control 2018 Nov 21. pii: S0196-6553(18)30984-2. **35**

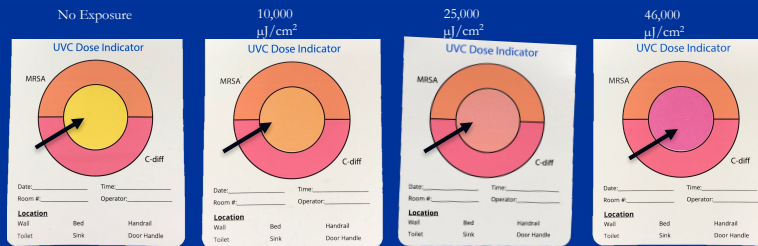
UV-C doses and log reductions with 5-minute exposure



Boyce JM, Donskey CJ. Understanding ultraviolet light surface decontamination in hospital rooms: A primer. ICHE 2019.

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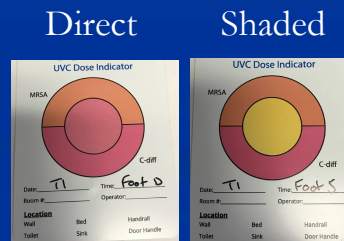
Colorimetric indicators



Cadnum JL. ID Week 2019. Manuscript in progress.

37

Direct versus shaded foot of bed



38

Decontamination of N95 respirators

- Contingency capacity strategies
 - Extended use
 - Reuse without decontamination (eg, issue 5 respirators and rotate them each day)
- Crisis capacity strategy
 - Decontamination and reuse
 - Most promising methods per CDC: UV, vaporous hydrogen peroxide, and moist heat

Van Doremalen N, et al. NEJM 2020 DOI: 10.1056/NEJMc2004973

39

Problem with current approaches to reuse and decontamination

- High level disinfection (6 log reduction in spores; 3 log reduction in viruses) required for FDA emergency use authorization approval
- Technologies that meet FDA criteria require long treatment cycles and transfer to a central in-house or off-site processing area
- Multiple reuses with once daily or less frequent decontamination

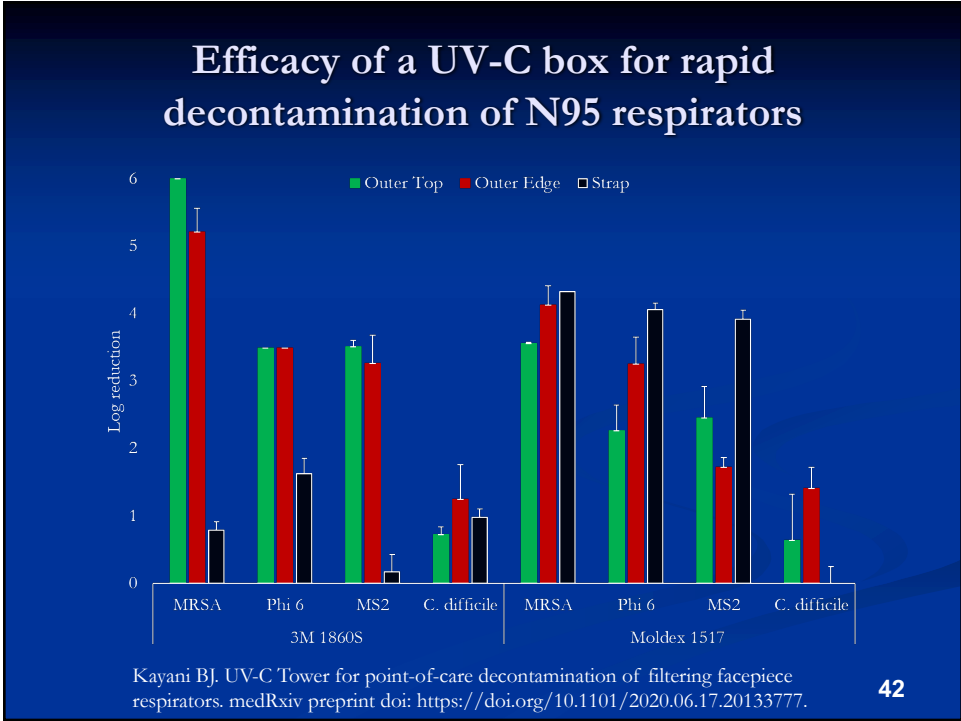
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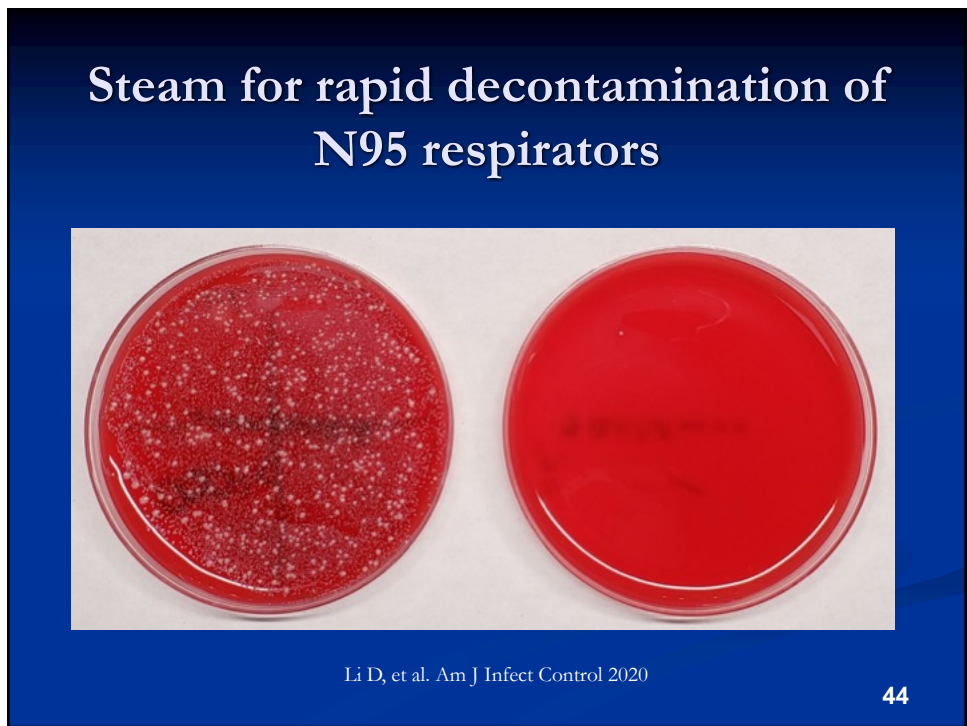
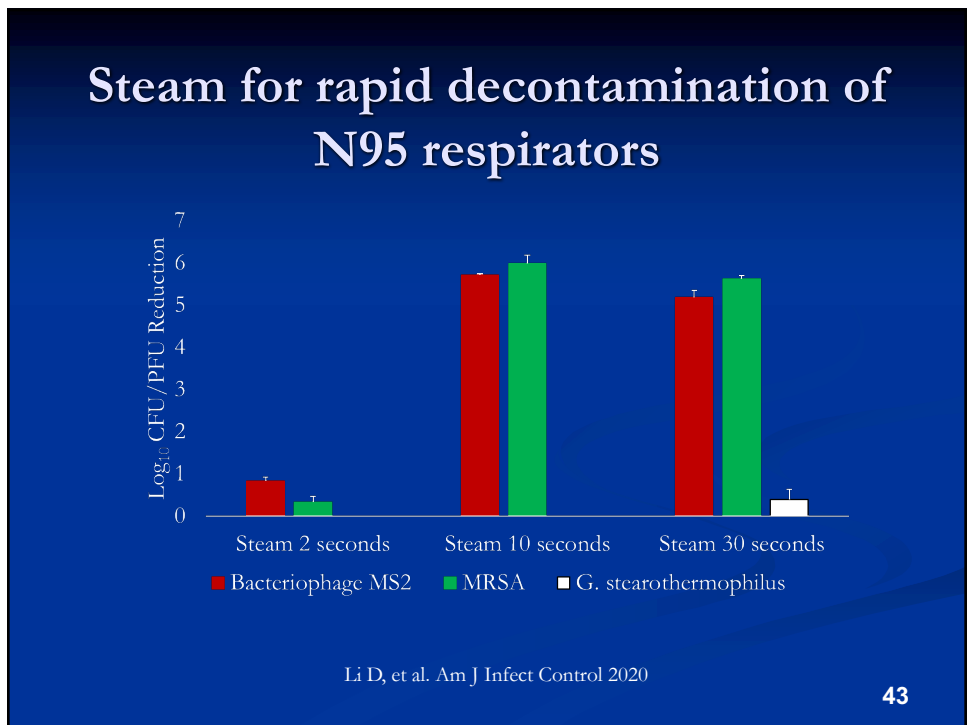
N95 respirator decontamination

3M 1860S

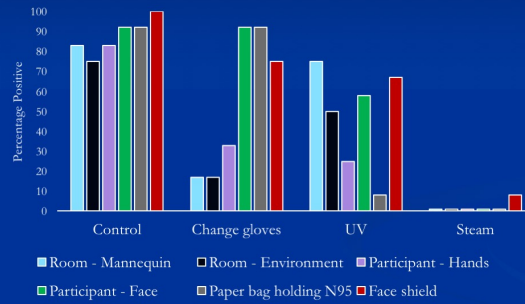
Outer Top
Outer Edge
Strap
Inner Surface

41





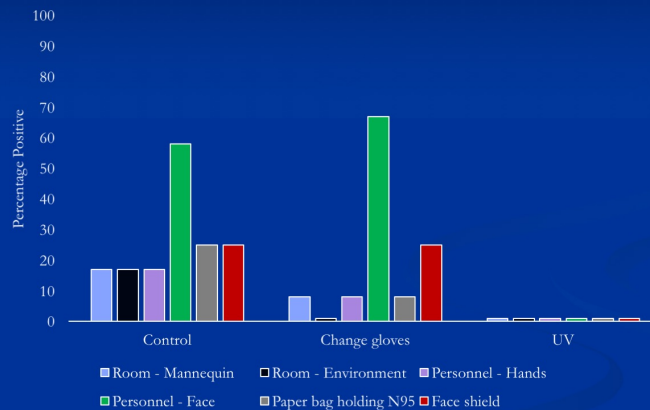
Evaluation of interventions to reduce contamination during re-use of respirators



Li DF. A simulation study to evaluate interventions to reduce contamination during reuse of N95 respirators Manuscript submitted.

45

Evaluation of interventions to reduce contamination during re-use of respirators

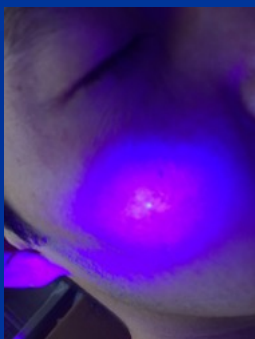


Li DF. A simulation study to evaluate interventions to reduce contamination during reuse of N95 respirators Manuscript submitted.

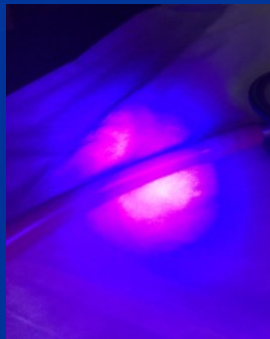
46

Fluorescent lotion contamination

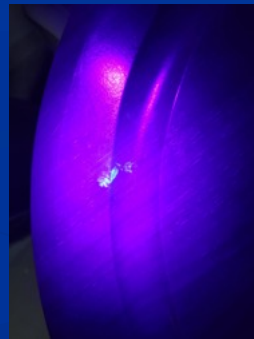
Face



Face shield



Bedside table



47

Summary

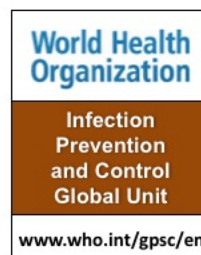
- The importance of surfaces and fomites in transmission of respiratory viruses is uncertain
- Commonsense measures may reduce risk for transmission in community settings
- Many disinfectants and UV-C light are effective against SARS-CoV-2

48

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www.webbertraining.com/schedulep1.php	
August 13, 2020	AHEAD - A CONSOLIDATED FRAMEWORK FOR BEHAVIOURAL INFECTIOUS RISKS IN ACUTE CARE - PART 2 Speaker: Prof. Hugo Sax and Dr. Lauren Clack , University of Zurich Hospitals, Switzerland
August 18, 2020	<i>(FREE Teleclass)</i> POLIO ERADICATION IN INDIA AND TAKEAWAYS FOR OTHERS Speaker: Dr. Ranga Reddy , Infection Control Academy of India
August 26, 2020	<i>(FREE Teleclass)</i> HOSPITAL LAUNDRY AND C. DIFFICILE SPORE INACTIVATION Speaker: Kevin P. McLaren , American Reuseable Textile Association
September 10, 2020	LOOK AT WHAT THE CAT SCRATCHED IN - PET ASSOCIATED ZOOSES, WHAT'S NEW AND RELEVANT FOR INFECTION PREVENTION AND CONTROL Speaker: Prof. Jason Stull , Prof. Jason Stull, University of Prince Edward Island, and Ohio State University
September 17, 2020	REPROCESSING OF CRITICAL FOOT CARE DEVICES Speaker: Clare Barry , Infection Control Consultant, Canada, and Merlee Steele-Rodway , Canadian Association of Medical Device Reprocessing
September 24, 2020	WATERBORNE PATHOGENS: WHY IS THEIR PROFILE CHANGING? Speaker: Prof. Syed A Sattar , Centre for Research on Environmental Microbiology, Canada

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