
Sources of Infection in Long-Term Care Facility - Environmental Issues

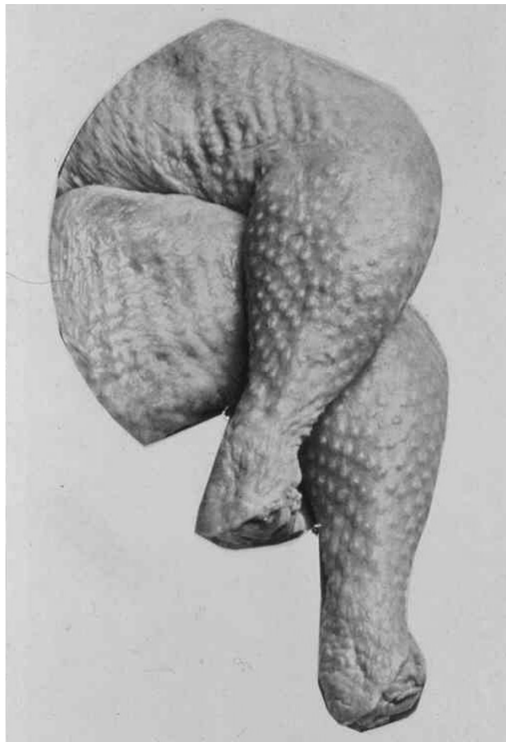
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Environmental Issues

- Environmental Sampling
- Hand Hygiene
- Surface Disinfection
- Medical Waste
- Linen
- Plant Engineering
- Nutrition and Food Services
- Disinfection and Sterilization



Nutrition and Food Services

- Why? Job of providing food for residents that is wholesome, appetizing, economical and safe to eat.
- What? General principles of protection, equipment, storage, preparation, service.
- How? Rounding

Factors that Contributed to 725 Reported Foodborne Disease Outbreaks, 1961-72

Factor	Frequency % (No)
Inadequate refrigeration	336 (46)
Preparing food far in advance of planned service	156 (22)
Infected persons practicing poor personal hygiene	151 (21)
Inadequate cooking or heat processing	140 (19)
Holding food in warming devices at bacteria-incubating temperatures	114 (16)
Contaminated raw ingredient in uncooked food	84 (12)

Factors that Contributed to 725 Reported Foodborne Disease Outbreaks, 1961-72 (cont)

Factor	Frequency % (No)
Inadequate reheating	66 (9)
Cross-contamination	58 (8)
Inadequate cleaning of equipment	57 (7)
Obtaining foods from unsafe sources	44 (6)
Using leftovers	23 (3)
Storing acid foods in toxic containers	19 (3)
Intentional additives	17 (2)
Incidental additives	8 (1)

Bryan, FL J. Environ Health 38:74, 1975.

Institutional Foodservice – NURSING HOMES: Percent of Observations Found Out of Compliance for Each RISK FACTOR

Foodborne Illness Risk Factor	Total Observations	Observations out of compliance	% observations out of compliance
Improper Holding/Time & Temperature	483	141	29.2%
Contaminated Equipment/Protection from Contamination	459	77	16.8%
Poor Personal Hygiene	455	73	16.0%
Other/Chemical	96	12	12.5%
Inadequate Cooking	166	16	9.6%
Food From Unsafe Sources	192	4	2.1%

FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurants and Retail Food Facility Types (2009) p.54.

Institutional Foodservice – HOSPITALS: Percent of Observations Found Out of Compliance for Each RISK FACTOR

Foodborne Illness Risk Factor	Total Observations	Observations out of compliance	% observations out of compliance
Improper Holding/Time & Temperature	483	175	36.2%
Contaminated Equipment/Protection from Contamination	443	78	17.6%
Poor Personal Hygiene	77	73	17.1%
Other/Chemical	14	96	14.6%
Inadequate Cooking	193	9	4.7%
Food From Unsafe Sources	222	5	2.3%

FDA Report on the Occurrence of Foodborne Illness Risk Factors in Selected Institutional Foodservice, Restaurants and Retail Food Facility Types (2009) p.42.

Nutrition and Food Services Staff

- Exclude employees with communicable diseases (skin, respiratory, gastrointestinal) from contact with food products or utensils in accordance with the occupational health policy
- Routine culturing of food service personnel for enteric pathogens has not been shown to be cost-effective

Nutrition and Food Services Staff

- Wash hands after: using toilet, handling raw food, contact with unclean equipment and work surfaces, soiled clothing; wash rags and touching the mouth, nose, ears, eyes and hair.

Nutrition and Food Services



Nutrition and Food Services

- Amount of hand contact
- Cleanliness of equipment
- Length of time foods are held at bacteria-incubating temperatures (<45°F or >140°F)

Nutrition and Food Services

No Hand Contact



Nutrition and Food Services

No Hand Contact, Serving Utensils



Nutrition and Food Services

Food Preparation



Nutrition and Food Services

Cooked Foods Reach Appropriate Temperature (145-165°F)



Nutrition and Food Services

Cooked Foods Reach Appropriate Temperatures (145-165°F)

Cook all food to these minimum internal temperatures as measured with a food thermometer before removing food from the heat source. For reasons of personal preference, consumers may choose to cook food to higher temperatures.

Product	Minimum Internal Temperature & Rest Time
Beef, Pork, Veal & Lamb Steaks, chops, roasts	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Ground meats	160 °F (71.1 °C)
Ham , fresh or smoked (uncooked)	145 °F (62.8 °C) and allow to rest for at least 3 minutes
Fully Cooked Ham (to reheat)	Reheat cooked hams packaged in USDA-inspected plants to 140 °F (60 °C) and all others to 165 °F (73.9 °C).

Product	Minimum Internal Temperature
All Poultry (breasts, whole bird, legs, thighs, wings, ground poultry, giblets, and stuffing)	165 °F (73.9 °C)
Eggs	160 °F (71.1 °C)
Fish & Shellfish	145 °F (62.8 °C)
Leftovers	165 °F (73.9 °C)
Casseroles	165 °F (73.9 °C)

Nutrition and Food Services

Food Preparation



Nutrition and Food Services

Cleanliness of Cutting Boards



Nutrition and Food Services

Food Storage (First in, First Out)





Nutrition and Food Services

- Fruits, vegetables
 - Dairy products
 - Meat, poultry
- } 33°F – 45°F

CMS guidance: Cold - 41°F and below

Nutrition and Food Services

Monitoring Temperatures



Nutrition and Food Services

Monitoring Temperatures



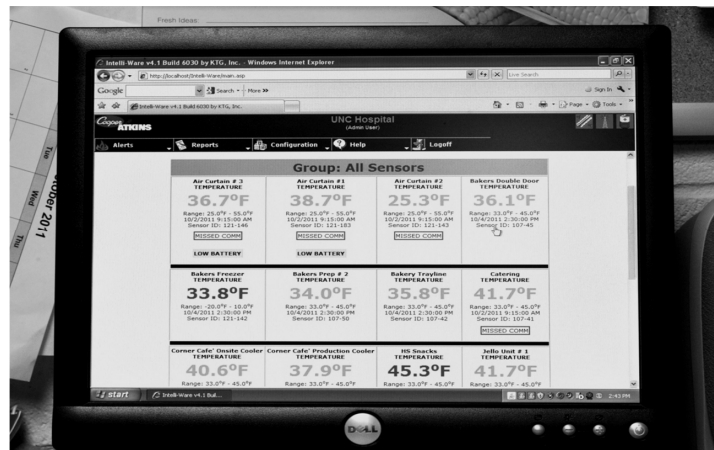
Nutrition and Food Services

Monitoring Temperatures



Nutrition and Food Services

Monitoring Temperatures Electronically



Nutrition and Food Services

- Steam Tables
 - Maintain hot foods at 140°F or above.
 - Should not be used to warm foods.
- Cold Tables
 - Maintain cold foods at 45°F or lower.
 - Should not be used to refrigerate foods.

CMS guidance: Hot – 135 °F and above, Cold - 41°F and below

Nutrition and Food Services



Nutrition and Food Services

Steam Tables at 140°F



Nutrition and Food Services

Automatic Washer-140°F wash for 20s, 180°F rinse for 10s



Nutrition and Food Services

Pot Cleanup (manual temp 110-120°F; sanitized for 30s 170°F or 50ppm Cl at 75°F)





Environmental Issues

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- Surface Disinfection
- Medical Waste
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- Plant Engineering
- Nutrition and Food Services
- Disinfection and Sterilization

Disinfection and Sterilization

WA Rutala, DJ Weber, and HICPAC, www.cdc.gov

EH Spaulding believed that how an object will be disinfected depended on the object's intended use.

CRITICAL - objects which enter normally sterile tissue or the vascular system or through which blood flows should be **sterile**.

SEMICRITICAL - objects that touch mucous membranes or skin that is not intact require a disinfection process (**high-level disinfection [HLD]**) that kills all microorganisms but high numbers of bacterial spores.

NONCRITICAL - objects that touch only intact skin require **low-level disinfection** (or non-germicidal detergent).

Critical Medical/Surgical Devices

Rutala et al. ICHE 2014;35:883; Rutala et al. ICHE 2014;35:1068; Rutala et al. AJIC 2016;44:e47

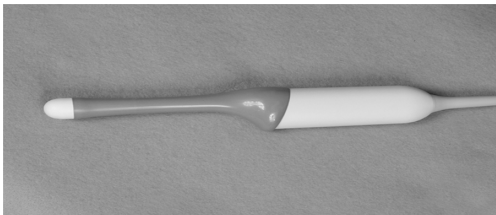


- **Critical**

- Transmission: direct contact
- Control measure: sterilization
- Surgical instruments
 - Enormous margin of safety, rare outbreaks
 - ~85% of surgical instruments <100 microbes
 - Washer/disinfector removes or inactivates 10-100 million
 - Sterilization kills 1 trillion spores

Semicritical Medical Devices

Rutala et al. AJIC 2016;44:e47



- **Semicritical**

- Transmission: direct contact
- Control measure: high-level disinfection
- Endoscopes top ECRI list of 10 technology hazards, >100 outbreaks (GI, bronchoscopes)
 - 0 margin of safety
 - Microbial load, 10^7 - 10^{10}
 - Complexity
 - Biofilm
- Other semicritical devices, rare outbreaks
 - ENT scopes, endocavitary probes (prostate, vaginal, TEE), laryngoscopes, cystoscopes
 - Reduced microbial load, less complex

High-Level Disinfection of “Semicritical Objects”

Exposure Time \geq 8m-45m (US), 20°C

Germicide	Concentration
Glutaraldehyde	\geq 2.0%
Ortho-phthalaldehyde	0.55%
Hydrogen peroxide*	7.5%
Hydrogen peroxide and peracetic acid*	1.0%/0.08%
Hydrogen peroxide and peracetic acid*	7.5%/0.23%
Hypochlorite (free chlorine)*	650-675 ppm
Accelerated hydrogen peroxide	2.0%
Glut and isopropanol	3.4%/26%
Glut and phenol/phenate**	1.21%/1.93%

*May cause cosmetic and functional damage; **efficacy not verified

Noncritical Medical Devices

Rutala et al. AJIC 2016;44:e1; Rutala, Weber. Env Issues NI, Farber 1987



- Noncritical medical devices
- Transmission: secondary transmission by contaminating hands/gloves via contact with the environment and transfer to patient
- Control measures: hand hygiene and low-level disinfection
- Noncritical devices (stethoscopes, blood pressure cuffs, wound vacuum), rare outbreaks

LOW-LEVEL DISINFECTION FOR NONCRITICAL EQUIPMENT AND SURFACES

Exposure time \geq 1 min	
Germicide	Use Concentration
Ethyl or isopropyl alcohol	70-90%
Chlorine	100ppm (1:500 dilution)
Phenolic	UD
Iodophor	UD
Quaternary ammonium (QUAT)	UD
QUAT with alcohol	RTU
Improved hydrogen peroxide (HP)	0.5%, 1.4%
Chlorine, PA with HP, 4% HP (<i>C. difficile</i>)	UD

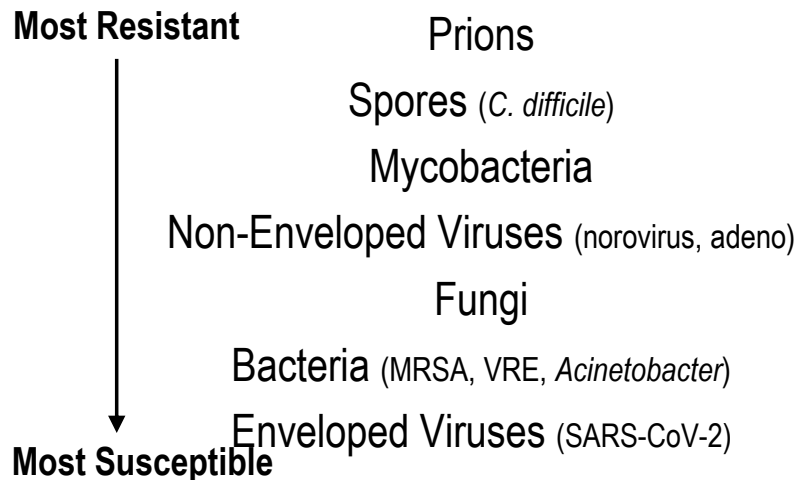
UD=Manufacturer's recommended use dilution; others in development/testing-electrolyzed water; polymeric guanidine; cold-air atmospheric pressure plasma (Boyce Antimicrob Res IC 2016. 5:10)

COVID:19: Overview of Contamination of the Healthcare Environment and Effective Surface Disinfection Technologies

The healthcare environment can be contaminated with SARS-CoV-2 and serve as a fomite, leading to possible transmission to personnel and patients

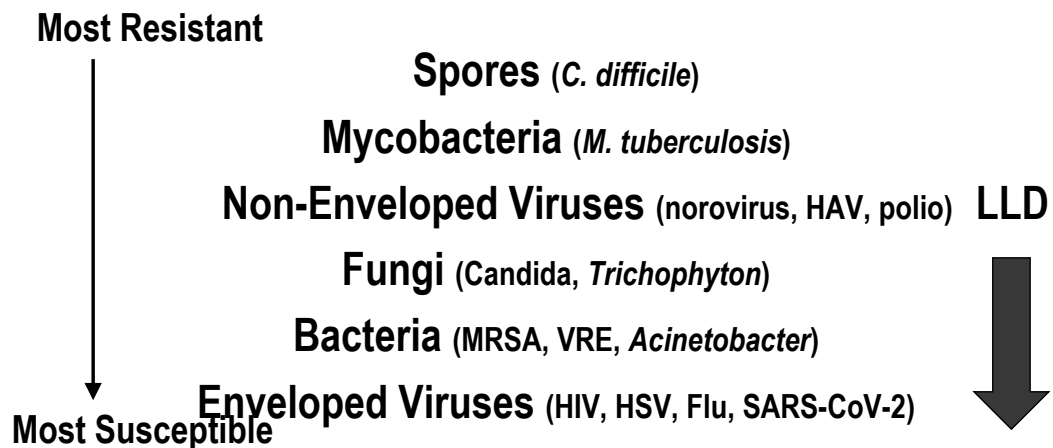
Role of environment in SARS-CoV-2 transmission and environmental disinfection

Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

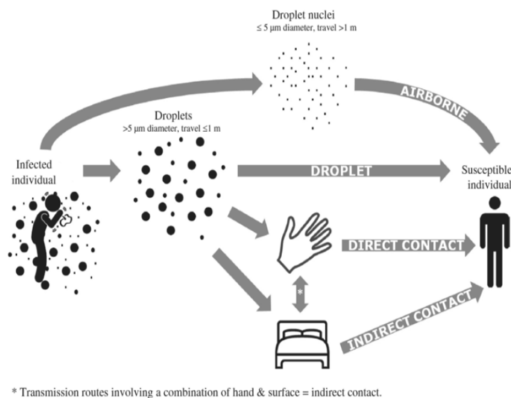


Microbiological Disinfectant Hierarchy

Rutala WA, Weber DJ, HICPAC. www.cdc.gov



Transmission of SARS-CoV-2



- Droplet (< 6 feet)
- Direct-person-to-person via respiratory droplets
- Indirect (via the contaminated environment); not main route
- Asymptomatic (infection transmission demonstrated)
- Pre-symptomatic-highly likely

Role of Healthcare Surface Environment in SARS-CoV-2 Transmission

Kanamori, Weber, Rutala, Clin Infect Dis, In press

- Centers for Disease Control & Prevention says the virus spreads from person to person mainly through respiratory droplets from coughing, sneezing or talking in close proximity to each other, but the CDC has also said it may be possible for a person to get COVID-19 by touching a surface or object that has the virus on it and then touching their own mouth, nose or possibly their eyes. CDC clarified while it is still possible that a person can catch it from touching a contaminated surface, it's "not thought to be the main way the virus spreads."

Role of Healthcare Surface Environment in SARS-CoV-2 Transmission

Kanamori, Weber, Rutala, Clin Infect Dis, In press

- Evidence suggests:
 - The healthcare environment contaminated with SARS-CoV-2 may play a role in transmission of SARS-CoV-2
 - Medical devices commonly used in daily practice also can be contaminated
 - Environmental surfaces in rooms occupied by patients with SARS-CoV-2 RNA and shared patient care items should be regularly (e.g., daily) and rigorously cleaned/disinfected by well-trained healthcare providers using appropriate disinfectant with an emerging viral pathogen claim.

Role of Healthcare Surface Environment in SARS-CoV-2 Transmission

Kanamori, Weber, Rutala, Clin Infect Dis, In press

SARS-CoV-2 RNA				
Bed Rail	Sink	BP monitor	Infusion pump	Keyboard
Bedside table	Floor	ECG monitor	Fluid stand	Phone
Chair	Toilet seat	Oxygen regulator	Hand sanitizer	Computer mouse
Doorknob	Toilet bowl	Oxygen mask	Trash can	Door
Light switches	Stethoscope	CT scanner	Self-service printer	Glass window
Call button	Pulse oximetry	Ventilator	Desktop	PPE storage area
Centrifuge	Biosafety cabinet	Infant bed	Air outlet	Ambu bag
TV remote	Bed sheet	Urinary catheters	TV	Beepers

Role of Healthcare Surface Environment in SARS-CoV-2 Transmission

Kanamori, Weber, Rutala, Clin Infect Dis, In press

- CDC recommends that an EPA-registered disinfectant on the EPA's List N that has qualified under the emerging pathogen program for use against SARS-CoV-2 be chosen for the COVID-19 patient care.
- List N has >450 entries and 32 different active ingredients

List N Tool: COVID-19 Disinfectants

<https://cfpub.epa.gov/giwiz/disinfectants/index.cfm>

The screenshot shows the EPA List N Tool: COVID-19 Disinfectants web application. The header includes the EPA logo and the text "United States Environmental Protection Agency". Below the header, the title "List N Tool: COVID-19 Disinfectants" is displayed, along with a "Feedback" button. The main content area features a search interface with a sidebar on the left containing filters: "EPA Registration Number", "Active Ingredient", "Use Site", "Contact Time", "Browse All", and "Keyword Search". The "EPA Registration Number" filter is active, showing a text input field with the placeholder "Enter only the first two parts of the registration number (ex. 12)". To the right of the input field is a "Show results" button and a "Clear results" button. Below the search interface, there is a paragraph of text explaining the tool's purpose: "Search EPA's list of products for use against SARS-CoV-2, the virus that causes COVID-19, by selecting one or more of the corresponding criteria above. All products on this list meet EPA's criteria for use against SARS-CoV-2, the virus that causes COVID-19. These products are for use on surfaces, NOT humans. At any point, click the 'Show Results' button to view your customized list of results. Select as many, or as few, criteria as you would like. Click the 'Clear Results' button to remove all previous selections and start over. Click 'Browse All' to display all products."

List N Tool: COVID-19 Disinfectants

32 Active Ingredients

- Ethyl alcohol
- Hydrogen peroxide
- Hypochlorous acid
- Isopropyl alcohol
- Peracetic acid
- Phenolic
- Quaternary ammonium

Inactivation of Coronavirus

Kampf G J Hosp Infect 2020

Table II. Inactivation of coronaviruses by different types of biocidal agents in suspension tests.

Biocidal agent	Concentration	Virus	Strain / isolate	Exposure time	Reduction of viral infectivity (log ₁₀)	Reference
Ethanol	95%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.5	[29]
	85%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.5	[29]
	80%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.3	[29]
	80%	MERS-CoV	Strain EMC	30 s	> 4.0	[14]
	78%	SARS-CoV	Isolate FFM-1	30 s	≥ 5.0	[28]
	70%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.9	[30]
	70%	CCV	Strain I-71	10 min	> 3.3	[30]
2-Propanol	100%	SARS-CoV	Isolate FFM-1	30 s	≥ 3.3	[28]
	75%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.0	[14]
	75%	MERS-CoV	Strain EMC	30 s	≥ 4.0	[14]
	70%	SARS-CoV	Isolate FFM-1	30 s	≥ 3.3	[28]
	50%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.7	[30]
	50%	CCV	Strain I-71	10 min	> 3.7	[30]
	50%	SARS-CoV	Isolate FFM-1	30 s	≥ 4.3	[29]
2-Propanol and 1-propanol	45% and 30%	SARS-CoV	Isolate FFM-1	30 s	≥ 2.8	[28]
Benzalkonium chloride	0.2%	HCoV	ATCC VR-759 (strain OC43)	10 min	0.0	[31]
	0.05%	MHV	Strains MHV-2 and MHV-N	10 min	> 3.7	[30]
	0.05%	CCV	Strain I-71	10 min	> 3.7	[30]
	0.00175%	CCV	Strain S378	3 d	3.0	[32]
Didecylmethyl ammonium chloride	0.0025%	CCV	Strain S378	3 d	> 4.0	[32]
Chlorhexidine digluconate	0.02%	MHV	Strains MHV-2 and MHV-N	10 min	0.7 – 0.8	[30]
	0.02%	CCV	Strain I-71	10 min	0.3	[30]
	0.21%	MHV	Strain MHV-1	30 s	≥ 4.0	[33]
Sodium hypochlorite	0.01%	MHV	Strains MHV-2 and MHV-N	10 min	2.3 – 2.8	[30]
	0.01%	CCV	Strain I-71	10 min	1.1	[30]
	0.001%	MHV	Strains MHV-2 and MHV-N	10 min	0.3 – 0.6	[30]
	0.001%	CCV	Strain I-71	10 min	0.9	[30]
Hydrogen peroxide	0.5%	HCoV	Strain 229E	1 min	> 4.0	[34]
Formaldehyde	1%	SARS-CoV	Isolate FFM-1	2 min	> 3.0	[28]

Inactivation of Coronavirus

Kampf G J Hosp Infect 2020

	0.7%	SARS-CoV	Isolate FFM-1	2 min	> 3.0	[28]
	0.7%	MHV		10 min	> 3.5	[30]
	0.7%	CCV	Strain I-71	10 min	> 3.7	[30]
	0.009%	CCV		24 h	> 4.0	[35]
Glutardialdehyde	2.5%	SARS-CoV	Hanoi strain	5 min	> 4.0	[36]
	0.5%	SARS-CoV	Isolate FFM-1	2 min	> 4.0	[28]
Povidone iodine	7.5%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	4.6	[37]
	4%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	5.0	[37]
	1%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	1%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	4.3	[37]
	0.47%	SARS-CoV	Hanoi strain	1 min	3.8	[36]
	0.25%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	0.23%	SARS-CoV	Hanoi strain	1 min	> 4.0	[36]
	0.23%	SARS-CoV	Isolate FFM-1	15 s	≥ 4.4	[38]
	0.23%	MERS-CoV	Isolate HCoV-EMC/2012	15 s	≥ 4.4	[38]

SARS = Severe Acute Respiratory Syndrome; MERS = Middle East Respiratory Syndrome; MHV = mouse hepatitis virus; CCV = canine coronavirus; HCoV = human coronavirus.

Recommendations for Cleaning and Disinfecting of Noncritical Surfaces and Medical Devices in COVID-19 Patient Care

Kanamori, Weber, Rutala, Clin Infect Dis, In press

- Standardize cleaning/disinfection of environmental surfaces and medical devices in rooms occupied by COVID-19 patients.
- Follow CDC recommendation for letting room remain empty (or wearing PPE required for COVID-19 patient care) after discharge for the specified time period.
- Provide education and training for cleaning/disinfecting staff on proper donning and doffing of PPE as recommended by CDC.

Table B.1. Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *

Air changes/hour (ACH) and time required for airborne-contaminant removal by efficiency *

ACH § ¶	Time (mins.) required for removal 99% efficiency	Time (mins.) required for removal 99.9% efficiency
2	138	207
4	69	104
6 ⁺	46	69
8	35	52
10 ⁺	28	41
12 ⁺	23	35
15 ⁺	18	28
20	14	21
50	6	8

Health Care Providers (HCP) Fighting COVID-19

HCP, including EVS, worked heroically to fight transmission-Lompoc Valley



Environmental Issues

- Environmental Sampling
- Hand Hygiene
- Surface Disinfection
- Medical Waste
- Linen
- Plant Engineering
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THANK YOU!

