


Challenges for environmental cleaning in pediatric healthcare

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Objectives

- To understand how pediatric and neonatal patients impact environmental cleaning practices and how to identify factors when choosing routine surface disinfectants;
- To identify different environmental contamination sources for pediatric and neonatal patients;
- To identify considerations when choosing novel disinfectant technologies

Role of environment in HAIs


- **Fighting AMR in the Healthcare Environment: Microbiome-Based Sanitation Approaches and Monitoring Tools**, D'Acciotti M, Soffritti I, Mazzacane S, Caselli E, *International journal of molecular sciences*, Mar 27;20(7), 2019.
- **The role of environmental contamination in the transmission of nosocomial pathogens and healthcare-associated infections**, Suleyman G, Alangaden G, Bardossy AC, *Current infectious disease reports*, 27;20(6), 2018.
- **Environmental contamination and hospital-acquired infection: factors that are easily overlooked**, Beggs C, Knibbs LD, Johnson GR, Morawska L, *Indoor air*, Oct;25(5):462-74, 2015.
- **The role of the surface environment in healthcare-associated infections**, Weber D, Anderson D, Rutala VJ, *Current Opinion in Infectious Diseases*, 26(4):338-344, 2013.
- **The role played by contaminated surfaces in the transmission of nosocomial pathogens**, Otter JA, Yezli S, French GL, *Infection control and hospital epidemiology*, Jul;32(7):687-99, 2011.
- **And more.....**




Routes of Contamination

Aspergillus, Bacillus cereus


RSV, Influenza






Aspergillus, Bacillus cereus

Legionella, Pseudomonas








MDR, *Clostridium difficile*

How are neonatal/pediatric patients different ?

- Immature immune systems
- “Reservoir” for communicable illnesses
- Developmental behaviors

How do they contaminate their environment ?

Persistence in the environment

Table 1
Persistence of clinically relevant bacteria on dry inanimate surfaces.

Type of bacterium	Duration of persistence (range)	Reference(s)
<i>Acetobacter</i> spp.	2 days to 2 months	[18, 25, 28, 29, 87, 88]
<i>Bordetella pertussis</i>	2 – 5 days	[89, 90]
<i>Campylobacter jejuni</i>	up to 6 days	[91]
<i>Clostridium difficile</i> (spores)	5 months	[92–94]
<i>Chlamydia pneumoniae</i> , <i>C. trachomatis</i>	< 30 hours	[54, 95]
<i>Chlamydia psittaci</i>	15 days	[96]
<i>Corynebacterium diphtheriae</i>	7 days – 6 months	[96, 96]
<i>Corynebacterium jeikeium</i>	1–8 days	[21]
<i>Escherichia coli</i>	1.5 hours – 16 months	[12, 16, 17, 22, 28, 52, 90, 97–99]
<i>Enterococcus</i> spp. including VRE and VSE	5 days – 4 months	[9, 26, 28, 100, 101]
<i>Haemophilus influenzae</i>	12 days	[90]
<i>Helicobacter pylori</i>	< 90 minutes	[23]
<i>Klebsiella</i> spp.	2 hours to > 30 months	[12, 16, 28, 52, 90]
<i>Listeria</i> spp.	1 day – months	[15, 90, 102]
<i>Mycobacterium bovis</i>	> 2 months	[13, 90]
<i>Mycobacterium tuberculosis</i>	1 day – 4 months	[30, 90]
<i>Neisseria gonorrhoeae</i>	1 – 3 days	[24, 27, 90]

Kramer et al. BMC Infectious diseases, 2006

Disinfectant history

- Girolamo Fracastoro(1478-1553):
 - Contact alone
 - Fomites (a word he first used)
 - At a distance (through the air)
- Antony Van Leeuwenhoek (1622-1723)
 - First human to see microorganisms
 - Effect of pepper on the "little animals"



Disinfectant

- A substance, or mixture of substances, capable of **destroying or irreversibly inactivating pathogenic (disease-causing) and potentially pathogenic (opportunistic) microorganisms, but not necessarily bacterial spores**, present on environmental surfaces and inanimate objects due to the antimicrobial action of the active ingredient(s).

Health Canada, 2018

Hospital grade disinfectant

- What is a hospital-grade disinfectant ?
- Safety of hospital-grade disinfectants



Holms S., American Journal of Infection Control, 2019

Factors related to products Pros and Cons

Hospital Disinfectants for Disinfection of Environmental Surfaces

Hospital disinfectants commonly used in all health care settings include:^{92,153-155}

- Alcohol (ethyl or isopropyl)
- Improved hydrogen peroxide
- Iodophors
- Phenolics
- Quaternary ammonium compounds
- Sodium hypochlorite (bleach)

PIDAC, Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Health Care Settings, 2018


Figure 1.
Classes of Microorganism Ranked in Descending Order from Least to Most Susceptible to Chemical Disinfectants

Least susceptible	BACTERIA WITH SPORES <i>(Bacillus subtilis, Clostridium tetani, C. difficile, C. botulinum)</i>	Chemical Sterilant
	PROTOZOA WITH CYSTS <i>(Giardia lamblia, Cryptosporidium parvum)</i>	High Level Disinfectant
	NON-ENVELOPED VIRUSES <i>(Coxsackievirus, poliovirus, rhinovirus, rotavirus, Norwalk virus, hepatitis A virus)</i>	Intermediate Level Disinfectant
	MYCOBACTERIA <i>(Mycobacterium tuberculosis, M. avium-intracellulare, M. chelonae)</i>	
	FUNGI <i>(Candida species, Cryptococcus species, Aspergillus species, Dermatophytes)</i>	
	VEGETATIVE BACTERIA <i>(Staphylococcus aureus, Salmonella typhi, Pseudomonas aeruginosa, coliforms)</i>	Low Level Disinfectant
Most susceptible	ENVELOPED VIRUSES <i>(Herpes simplex, varicella zoster virus, cytomegalovirus, Epstein-Barr virus, measles virus, mumps virus, rubella virus, influenza virus, respiratory syncytial virus, hepatitis B and C viruses, hantaviruses, and human immunodeficiency virus)</i>	

Health Canada, 1998.

Challenges in pediatric settings

- Humanization of care
 - One room / One patient / One family
 - The child is not the only "patient"



Challenges in pediatric settings

- Family members
 - Siblings
- Visitors



Playroom / Waiting room



Toys


- Cleaning and disinfection :
 - Who ?
 - When ?
 - Frequency ?




BYOT ?

PIDAC, Best Practices for Environmental Cleaning for Prevention and Control of Infections in All Health Care Settings, 2018

Technologies



Doctors Medical Center
Check it out! Doctors Medical Center has made another addition to our pediatric surgical program! Last year, we introduced our little black Mercedes. Now we have a pink Volkswagen Beetle! These sweet cars take our smallest patients to the operating room. The goal is to reduce anxiety and stress, and make the experience less scary for everyone involved. Doesn't that have appeal? [Click!](#)
The new pink car was generously donated by one of our employees and her family. [Volkswagen | Mercedes-Benz](#)





What else makes them different?

- Specific equipment and sizing



Equipment

- Electric breastpumps
- Ventilators
- Cleaning and disinfection:
 - Who ?
 - When ?
 - Frequency ?

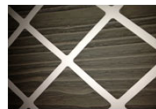


Pediatric rehabilitation and long-term care

- Home environments
- School attendance
- Wheelchairs
- Specialized room therapy



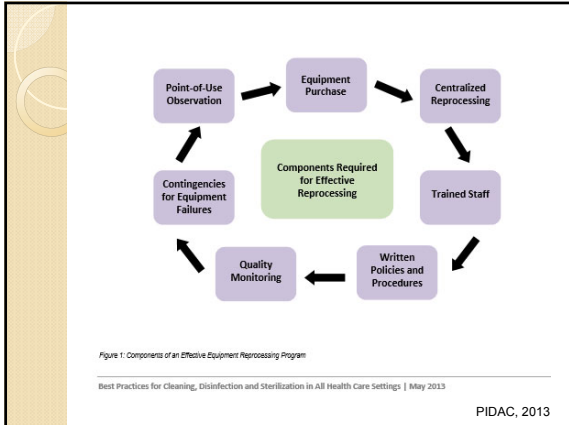
Contamination of Supplies/Linen




Animals

- Assistive dogs
 - for kids with autism
- Zootherapy





Key messages



- The environment can be responsible for an important proportion of HAIs;
- Neonates and pediatrics are not « little adults », their needs are different ;
- Improved cleaning and disinfection of room surfaces decreases the risk of HAIs.


Objectives revisited


- To identify different environmental contamination sources for pediatric and neonatal patients;
- To understand how pediatric and neonatal patients impact environmental cleaning practices and how to identify factors when choosing routine surface disinfectants;
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New and Evolving Products


- Antimicrobial surfaces
- No-Touch disinfection systems
 - UV
 - Hydrogen peroxide
 - Other




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Antimicrobial Surfaces


- Replacing or treating materials/surfaces traditionally used in the health care setting (e.g., plastic, stainless steel) with materials with antimicrobial properties
- Limited evidence, with the exception of copper, of persistent reduction of microbial contamination in clinical settings
- No evidence of reduction of HAIs




Healthier Children. A Better World.™ Photo credit: Copper Development Association 

Ultraviolet Light (UV)


- At certain wavelengths, can kill microorganisms by destroying bonds in genetic materials
 - Bacteria and viruses > bacterial spores
- No residue
- Equipment and furniture must be moved into line of vision for disinfection to occur



Healthier Children. A Better World.™ Photo credit: Microchemlab.com 

Hydrogen Peroxide

- Effective against a wide range of microorganisms, including bacteria, viruses and spores, particularly those of *C. difficile*
- Environmentally safe residues
- No need to move furniture and equipment away from the walls *BUT* sealing of air ducts from the room and gaps under doors is required prior to decontamination procedure




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Situation Faced

Q. Is there something else we could be doing to enhance our environmental cleaning/disinfection practices, recognizing that we'll still need to manually clean?


- Consultation with Procurement re: Request for Proposal (RFP) considerations
- Stakeholders:
 - Environmental Services
 - Microbiology
 - Occupational Health and Safety
 - Biohazard specialist
 - IPAC
- Tasks:
 - "Literature reviews"
 - Technology/products
 - Efficacy




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Product Assessment Tool*

- Six categories of assessment:
 - General usage
 - Germicidal efficacy
 - Safety
 - Environmental impact
 - Operational cost considerations
 - Customer service




*We based ours on the "Surface Disinfectant Product Assessment Tool" from  Professional and Technical Services

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General Usage


- Ease of use?
- Time required per cycle?
- Does the product require alterations to the room environment e.g. HVAC, moving furniture?



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Germicidal Efficacy


- Product efficacy claims and references



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Safety


- Is the product irritating to eyes or skin?
- Does the product require PPE to be worn by the users?



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Environmental Impact


- Is the product biodegradable?
- Is the product compatible with healthcare device materials?
- Is there any residual residue after use?



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Operational Costs


- Are there additional operating costs outside of the product itself?
- Are there special storage or transportation considerations?
- Will implementation improve staff productivity or reduce operational costs elsewhere?



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Customer Service

- What type of training does the supplier provide?
 - Initial + ongoing
- What type of additional educational material is provided?
- What type of technical support is provided?



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Scoring Process


Score	Totals
Total # YES	
Total # NO	
% YES	

Overall Impression:


1 2 3 4 5

Product does NOT meet needs Product SOMEWWHAT meets needs Neutral Product MOSTLY meets needs Product MEETS needs


Comments: _____

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OK, so now you've chosen a product...will it work for you?




- Product Trial
 - Location chosen based on area with high impact but challenging to operationalize
 - Assumption was that if we could make it work there, we could use it anywhere in the facility
 - Another consideration - staff in the area were very engaged!

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Trial Evaluation – Lessons Learned

- If you're looking to save on labour costs for room cleaning, you won't!
 - Rooms require set-up after they've been manually cleaned, regardless of the option you choose
- Not a time saver!
 - In high turnover areas and seasons, there may be resistance to using this technology
- Prepare patients and families in the area beforehand
 - "Dear Parent" letter


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Trial Evaluation – Lessons Learned

- Training...and not just housekeeping staff
 - Facility operators
 - Clinicians
 - Unit clerks
 - Facility Administrators – "...at worst, this will be cost neutral (hopefully)... e.g. potentially saving \$\$ with downstream costs such as not having to discard as many med/surg supplies on discharge

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Trial Evaluation – Lessons Learned

- Patient risk assessment for spread outside trial area – everyone wants it but not enough to go around so how to prioritize usage?
 - High risk patient areas
 - High risk events e.g. outbreaks
 - Equipment/devices that are difficult to manually clean – routine use?


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The complex block contains contact information and logos. At the top left, there is a vertical gold bar with a circular pattern. Below it, the text 'Contact Information:' is followed by two email addresses: nadia.desmarais.hsj@ssss.gouv.qc.ca and laurie.streitenberger@sickkids.ca. At the bottom left is the logo for CHU Sainte-Justine, and at the bottom right is the logo for SickKids.
