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Topics included: Air Quality, Pesticides, Natural Disasters, BPA, Mold, Lead, Mercury
Disinfectant and Disinfection By-product Exposure in Early Care and Education

Stephanie Holm, MD MPH
• Mark Miller, MD MPH
• Timur Durrani, MD MPH
• Victoria Leonard, RN PhD
• Sam Goldman, MD MPH

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Learning Objectives

• Describe why disinfectant use in early care and education settings is of concern
• Describe known toxicities of the major disinfectant classes
• Describe the EPA Safer Choice Program and the Green Cleaning, Sanitizing and Disinfecting Toolkit
Why do we care about disinfectant toxicity in early care and education?
Scope Of The Problem

- 6 million US children <5 in center based childcare
- Children do not respect personal boundaries
- Frequent hand-oral behaviors
- Many caregivers are women of child bearing age
Disinfectant Use Is Mandated at the State Level

- Most state guidelines require either bleach or an EPA-registered hospital-grade disinfectant
- The goal is prevention of early childhood diseases
- Particular surfaces (e.g. changing tables) must be disinfected after each use
- Ventilation standards are not specific, using terms like “adequate ventilation”
Specific Toxics Found

- Detectable airborne chloroform in all 14 child care facilities tested in DC*
- 40 centers in California studied:**
  - Formaldehyde above chronic exposure thresholds in >85%
  - Many with chloroform levels above safe harbor guidelines

*Quiros-Alcala et al. 2015, **Bradman 2012
Disinfectant Efficacy
Lack Of Guidance Regarding Organisms to Target

- **Potential Bacteria:**
  - Bordetella pertussis
  - Campylobacter jejuni
  - E. coli
  - Salmonella
  - Shigella
  - MRSA

- **Potential Parasites:**
  - Entamoeba histolytica
  - Giardia

- **Potential Viruses:**
  - Coxsackie
  - HIV
  - Hepatitis A
  - Hepatitis B
  - Hepatitis C
  - Influenza
  - Norovirus
  - RSV
  - Rhinovirus
  - Rotavirus
EPA Classified: Hospital-Grade Disinfectants

- Classified as pesticides under the category of antimicrobials
- Hospital-grade: specific product has efficacy proven against Staphylococcus aureus and Pseudomonas aeruginosa
- Pesticide Product Labeling Sheets are publically available
- No information on inactive ingredients
- Few comparison studies
- EPA does not certify devices
Pesticide Product and Label System

The Pesticide Product and Label System (PPLS) provides a collection of pesticide product labels (Adobe PDF format) that have been accepted by EPA under Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). New labels were added to PPLS on July 24, 2017.

EPA Registration, Distributor Product, or Special Local Need Number:

The EPA Registration Number (EPA Reg. No.) appears on all registered pesticides sold in the United States. It is usually found on the back panel of the label along with the detailed instructions for use. Enter the company number (the first set of digits before the dash) to see all products marketed by that company or the entire number (including the dash) to view the label for a particular product. To search by Special Local Need Number, please enter two-letter state abbreviations with or without 6 digit number (i.e. OH123456).

Product or Alternative Brand Name:

Enter the name of the product. As you type, options will be presented to you. Keep in mind that product names may vary, so if you don’t find the product you are looking for, try the EPA Registration Number Search above.

Company Name:

Enter the name of the company. Some companies may have several divisions that manufacture and market pesticide products. You may need to try different names to find the label for the product you are looking for.
## Aggregate Data from Product Labeling Sheets

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<th>Bleach</th>
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<th>Glucic Acid</th>
<th>Ethanol</th>
<th>Hydrochloric Acid</th>
<th>Hypochlorous Acid</th>
<th>Peroxides</th>
<th>Peroxide/PAE mixture</th>
<th>Lactic Acid</th>
<th>Other</th>
<th>Phenols</th>
<th>Quats</th>
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Summary of The Aggregated Data

- Likely no disinfectant that will cover all necessary organisms.
- “Hospital-Grade” is not a good indicator of efficacy against relevant organisms in these settings.
- Most common classes are bleach, quaternary ammonium compounds, peroxides.
- All three of these cover most of our suggested organisms relatively well.
Differences between cleaning, sanitizing and disinfecting may not be well understood.

- Cleaning
- Sanitizing
- Disinfecting

Visible soiling requires use of a cleaning step prior to disinfection.

- Dwell Time
- No products certified for porous surfaces (untreated wood, fabric).
Toxicities of Particular Classes of Disinfectant
**Bleach (Sodium hypochlorite)**

- Most common disinfectant used
- Mechanism thought to be by protein aggregation
- Dwell time usually 5-10 min
- Large acute exposures clearly cause respiratory effects
- Chronic low level bleach exposure associated with asthma in animal studies and custodial workers*
- Designated asthmagen
- Unintentional bleach poisonings have occurred in child care settings**

*Kim et al 2014,  Mirabelli et al 2007; **Goldberg 2014
Quaternary Ammonium Compounds (QACs)

- Cationic detergents
- Disinfect via multiple routes:
  - disruption of cellular membranes
  - possible intracellular effects
- Usual dwell times: 4-10 minutes
- Ammonia released during cleaning
- Known asthmagens, higher odds ratio after exposure than bleach
- Evidence of mutagenicity and possible reproductive toxicity in animal studies*
- Chloramine gas released if mixed with bleach, see https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3793292.pdf

*Ferk et al 2007, Hrubec et al 2017
Peroxides

- Oxidizing agent, more oxidizing than bleach
- Does not get inactivated by organic material like bleach does
- Dwell times range 1-10 min
- No known association with asthma
- Ingestion of concentrated (3%) hydrogen peroxide solutions usually causes only mild GI upset,* but can cause corrosive injuries at higher concentrations

*Quiros-Alcala et al. 2015, **Bradman 2012
Those who do cleaning work have highest rates of work related asthma*

Increased risk of asthma in anyone whose job involves cleaning product exposure, especially those preparing disinfectants**

People who clean their own homes have higher rates of lower respiratory symptoms if they use bleach or multiple kinds of sprays***

Data are limited

Kids in homes cleaned with bleach NOT more likely to have asthma*
  • Studies did not adjust for whether child was present during cleaning

Children whose homes have higher VOCs are more likely to have asthma**

Increased risk of subclinical airways inflammation with increased cleaning spray use in the home***

Policy Implications
Need For Relevant Guidelines

- What organisms are we trying to protect children from in early care and education environments?
- Does this require hospital grade disinfectants, or disinfectants at all?
- If so, which are most efficacious? Which are least harmful?
Suggested Process for Expert Guideline Development

1. Review the literature for what organisms are relevant for routine disinfecting of surfaces in early child care (as well as for cleaning and sanitizing).

2. Review the literature for organisms that warrant additional consideration during outbreaks.
Suggested Process for Expert Guideline Development

Are there other techniques to decrease presence of these organisms while decreasing exposure to disinfectants?

1. Review literature on cloth type, use of disposable barriers, precleaning with soap and disinfection devices (such as steam cleaners)
2. Review literature on ventilation
Suggested Process for Expert Guideline Development

**What types of surface require disinfection?**

- **Non-porous**
  - Use existing EPA PPLS data to review efficacy of products against selected organisms

- **Porous**
  - Data not collected by EPA because surface disinfection not usually felt to be successful. Either discourage use of porous surfaces or new techniques will be needed.

- **Non-porous with biofilm**
  - Data not collected by EPA, will need to review scientific literature
Suggested Process for Expert Guideline Development

1. A database should exist with all ingredients of the disinfectant products (active and inactive) so that all components' safety can be reviewed.

2. In the absence of a comprehensive database the EPA safer choices list provides a list of safer active ingredients as well as products which have been reviewed by the EPA as safer.

Of the products found to be efficacious against the relevant organisms on these surfaces, what are their toxicities for children and workers?
Produce a set of expert guidelines which contains a list of possible products from which Early Child Care Centers can choose to use for disinfection that maximize efficacy while minimizing harm, with recommendations for:

- Techniques to safely minimize disinfectant use
- Routine disinfection of surfaces that are porous, nonporous and nonporous with biofilms
- Disinfection of the same surfaces during outbreaks of Early Child Care relevant diseases
Advocating Safer Products
## EPA’s Safer Choice Program-Antimicrobial Pilot Project

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<th>Active Ingredients</th>
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<tr>
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<td>Sodium Bisulfate</td>
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</table>
Green Cleaning, Sanitizing, and Disinfecting: A Curriculum for Early Care and Education
Green Cleaning Toolkit

- Available at: https://www.epa.gov/sites/production/files/documents/ece_curriculumfinal.pdf
- Aimed at Early Care and Education Providers
- Introduces many of the concepts covered here to a lay audience, including:
  - Differences between cleaning, sanitizing, disinfecting
  - Choosing safer products
Green Cleaning Toolkit

- Includes
  - A 64 page *Green Cleaning, Sanitizing, and Disinfecting for Early Care and Education* curriculum booklet.
  - 3 Posters
  - 9 stand alone fact sheets for ECE providers
  - 2 fact sheets for families
  - A Wallet Card.
  - A checklist to help you develop and maintain a Green Cleaning, Sanitizing and Disinfecting Program.
Green Cleaning Toolkit

Hard copies of the Toolkit are available through our non-profit partner, Informed Green Solutions:

http://www.informedgreensolutions.org/?q=publications/green-cleaning-toolkit
Clearer guidelines needed.

Of the commonly available disinfectants on the market, both bleach and QACs are known asthmagens.

QACs also have potential for reproductive and mutagenic harm.

Peroxide based products seem to be the safest at this time.

Use the antimicrobial pesticide pilot project for guidance.

Use the green cleaning toolkit.
References

References


EPA US. 2016. FOIA Request Results. C. Furlowed.


Furlow C. Re: FOIA request EPA-HQ-2016-010386.


References

References

References

- Scotland HP. 2015. Infection Prevention and Control in Childcare Settings. 1–44.
References

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www.pehsu.net/nationalclassroom.html