New Trends in Environmental Hygiene: Decontaminating Soft Surfaces
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Presentation Outline

1. HAI Impacts & Causes
2. Fomite Contamination & Transmission
3. Mitigation Strategies
4. Evaluation of a Soft Surface Sanitizer
5. Wrap-up / Questions
Part 1: HAI Impacts & Causes
Part 1: HAI Impacts & Causes

Healthcare-Associate Infection (HAI) Statistics

HAI Instances: 1,737,125
- 33,269 newborns in high-risk nurseries
- 19,059 newborns in well-baby nurseries
- 417,946 adults and children in ICUs
- 1,266,851 adults and children outside of ICUs

HAI Deaths: 98,987
- 35,967 pneumonia
- 30,665 bloodstream infections
- 13,088 urinary tract infections
- 8,205 surgical site infections
- 11,062 infections of other sites

Klevens, RM et al. 2007.
Part 1: HAI Impacts & Causes

Cost of Infections

- US annual direct hospital HAIs cost >$45B
- Typical 420 bed hospital (with 5% HAI rate) is estimated to pay an additional $36M/year for HAI treatment

<table>
<thead>
<tr>
<th></th>
<th>Average Length of Stay</th>
<th>% In-hospital Mortality</th>
<th>Average Charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without HAIs</td>
<td>5.2</td>
<td>1.5%</td>
<td>$9,377</td>
</tr>
<tr>
<td>With HAIs</td>
<td>24.4</td>
<td>9.0%</td>
<td>$52,096</td>
</tr>
</tbody>
</table>

AHRQ, 2010

- HAI patient stay, on average, **5 times longer** than those without
- HAI patients **600% more likely** to die in the hospital than those without
Part 1: HAI Impacts & Causes

Antimicrobial Resistant, HAI-Causing Pathogens

- **S. aureus**
- **E. coli**
- **CoNS**
- **Klebsiella**
- **P. aeruginosa**
- **E. faecalis**
- **C. albicans**
- **Enterobacter spp.**
- **Enterococcus spp.**
- **E. faecium**
- **Other Candida/NOS**
- **O. other**
- **Acinetobacter baumannii**
- **Serratia spp.**
- **Proteus spp.**

NHSN update: Sievert et al., 2013
Part 1: HAI Impacts & Causes

Additional Environmental Pathogens of Concern

- *C. difficile*
- *Legionella pneumophila*
- *Aspergillus* sp.
- CRE
- Norovirus
- Influenza
- Rotavirus
- SARS
Part 1: HAI Impacts & Causes

Infectious Disease and Healthcare Workers

- Healthcare workers have frequent contact with high-risk populations

- >20% of people worldwide who acquired severe acute respiratory syndrome (SARS) by 2003 were healthcare workers¹

- Cross sectional study: 50 hospitals surveyed reported a hospitalization rate ~3 times greater than the general population²

¹Tai, 2006
²Pryluka et al. 2012
Part 1: HAI Impacts & Causes

MRSA Colonization

- *S. aureus* carriage has been known to be one of the most strongly associated risk factors for subsequent infection
- Presence of MRSA nasal colonization can provide an indication of higher risk for subsequent infection

<table>
<thead>
<tr>
<th>Prevalence for Nasal Carriage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Population:</strong></td>
</tr>
<tr>
<td>0.8%- &lt;2%</td>
</tr>
<tr>
<td><strong>First Responders:</strong></td>
</tr>
<tr>
<td>EMS personnel(^1): 4.6%</td>
</tr>
<tr>
<td>Firefighters(^2): 22.5%</td>
</tr>
<tr>
<td><strong>Healthcare Workers:</strong></td>
</tr>
<tr>
<td>Hospital: 4.6%</td>
</tr>
<tr>
<td>Non-hospital: 3.4%</td>
</tr>
</tbody>
</table>


Sources:
1. Stevenson *et al.*, 2010
2. Roberts *et al.*, 2011

Source: Albrich & Harabarth, 2008
Part 2: Fomite Contamination & Transmission
Part 2: Fomite Contamination & Transmission

What is a Fomite?

An inanimate porous (soft) or non-porous (hard) surface.

Examples:
- Counter tops
- Medical equipment
- Bed rails
- IV poles
- Privacy curtains
- Upholstered furniture
During illness, microbes are shed in large numbers in body secretions including blood, feces, urine, saliva, and nasal fluid.

Fomites become contaminated with microbes

- Direct contact with body secretions or fluids
- Contact with aerosolized microbes
- Contact with soiled hands
  - Talking
  - Coughing
  - Sneezing
  - Vomiting

Part 2: Fomite Contamination & Transmission

Hospital Environment Contamination Widely Researched

✓ Boyce JM. Environmental contamination makes an important contribution to hospital infection. J Hosp Infect. 2007; 65(52):50-54.
Pathogens can persist on fomites from hours to months, depending on numbers deposited, type of organism and environmental conditions.

**Gram-positive bacteria**
- *Staphylococcus aureus*: Survived 7 days-7 months\(^1\)
- MRSA: Survived 20 days on cotton, 40 days on polyester\(^2\)
- VRE: Survived for more than 80 days on both cotton and polyester\(^2\)

**Viruses**
- SARS virus: survives up to 96 hours on fomites\(^3\)
- Norovirus surrogate (feline calicivirus): survives 21-28 days on fomites\(^4\)
- Influenza A and B: survives 12 hours on cloth, tissues, paper\(^5\)

**Fungi** *Candida, Aspergillus, Mucor, and Fusarium*
- Survival ranged from 1 day to often weeks on common fabrics

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1. Kramer et al., 2006
2. Neely et al., 2001
3. Duan et al., 2003
4. Doultree, 1999
5. Baker et al., 2001
An age of increasing treatment resistance warrants appropriate environmental controls and effective contact control protocols.
## Part 2: Fomite Contamination & Transmission

### 2012 Hand Hygiene Compliance Rates by Unit/Floor

<table>
<thead>
<tr>
<th>Floor (Units):</th>
<th>Weekdays % Compliant (n)</th>
<th>Weeknights % Compliant (n)</th>
<th>Weekends % Compliant (n)</th>
<th>Weekdays* (IP Data) % Compliant (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1 (ED unit)</td>
<td>10% (n= 30)</td>
<td>8% (n=37)</td>
<td>8% (n=13)</td>
<td>35% (n=20)</td>
</tr>
<tr>
<td>D2 (Adult units: ICU &amp; Med Surgery)</td>
<td>45% (n=33)</td>
<td>50% (n=30)</td>
<td>51% (n=47)</td>
<td>59% (n=36)</td>
</tr>
<tr>
<td>D3 (Adult units: ICU &amp; Med Surgery)</td>
<td>38% (n=42)</td>
<td>38% (n=48)</td>
<td>14% (n=21)</td>
<td>53% (n=32)</td>
</tr>
<tr>
<td>D4 (NICU)</td>
<td>77% (n=13)</td>
<td>67% (n=9)</td>
<td>100% (n=5)</td>
<td>100% (n=7)</td>
</tr>
<tr>
<td>D5 (Peds Unit)</td>
<td>57% (n=14)</td>
<td>57% (n=21)</td>
<td>61% (n=33)</td>
<td>42% (n=24)</td>
</tr>
<tr>
<td>D6 (PICU &amp; Peds Unit)</td>
<td>73% (n=22)</td>
<td>68% (n=27)</td>
<td>62% (n=34)</td>
<td>42% (n=38)</td>
</tr>
</tbody>
</table>

* (IP Data) from Infection Prevention team audits; highlighted values denote the most extreme low and high hand hygiene compliance rates observed by the researcher.

Anna Burns, MEZCOPH Internship Report, 2012
Part 2: Fomite Contamination & Transmission

Fomite Contamination and Healthcare Workers

- 65% of nurses assisting MRSA patients contaminated their nursing uniforms or gowns with MRSA.
- 42% of personnel with no direct patient contact contaminated their gloves from surfaces.
- Patient clothing and bedding can release hazards into the air during handling.
- Pathogens will survive long enough to be transmitted between soft surfaces and patients or to healthcare worker’s environment.
Part 2: Fomite Contamination & Transmission

**Essential Principles**

- **Patient screening is not enough**
  - Patient-to-patient transmission positively correlated with environmental contamination
  - 20-40% of nosocomial infections occur via hands of HCP

- **Handwashing alone is not enough**
  - Compliance routinely 40-50%
  - Must be supplemented with environmental controls

- **Must have a comprehensive infection control plan**

- **The environment is a major route of transmission**
  - Hard surfaces: targeted but many sites missed
  - Water: aerosols, sink drains
  - Air: poor understanding of airborne transmission
  - Soft surfaces: largely overlooked source
Part 2: Fomite Contamination & Transmission

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Part 2: Fomite Contamination & Transmission

Soft Surfaces

- **Problem**
  - Soft surfaces have been implicated in the spread of HAIs
  - Contribute to spread via direct contact, aerosol transmission, cross-contamination potentials
  - Epidemiological evidence for soft surfaces/textiles link to infectious outbreaks
  - Soft surface control frequently overlooked in cleaning, sanitizing, disinfection protocols

- **Healthcare environment continuum**

- **Patient protection**
- **Worker safety**
- **Fomite contamination role**
  - Activity/behavior patterns
  - High risk/high touch surfaces
  - Cross-contamination potentials
  - Emerging concerns
Part 2: Fomite Contamination & Transmission

What are Soft Surfaces?

- Linens, bedding, mattresses
- Workers/visitors/patient clothing
- Laundry (facility/household)
- Privacy curtains, drapes
- Upholstery
  - In-room couches
  - Desk, bedside chairs
  - Waiting, reception areas
- Cushions, throw pillows
- Mouse pads
- Lanyards
- Carpet, rugs

May be cotton, canvas, denim, linen, polyester, blended fabrics.
### Part 2: Fomite Contamination & Transmission

#### Studies – Privacy Curtains

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 22/28 (78%) curtains culture positive for <em>S. aureus</em></td>
<td>Palmer, 1999</td>
</tr>
<tr>
<td>• Genetic source tracking bed linen isolates to curtains</td>
<td>Das et al., 2002</td>
</tr>
<tr>
<td>• PFGE matched patient isolates to bed linens &amp; fomites</td>
<td></td>
</tr>
<tr>
<td>• 31/200 (16%) curtains in shared rooms positive for MRSA</td>
<td>Klakus et al., 2007</td>
</tr>
<tr>
<td>• Culture survey: 21/50 (42%) VRE, (11/50) 22% MRSA, (2/50) 4% <em>C. diff</em></td>
<td>Trillis et al., 2008</td>
</tr>
<tr>
<td>• Hand imprint cultures indicated frequent spread</td>
<td></td>
</tr>
<tr>
<td>• 12/13 (92%) contaminated w/in 1 wk; MRSA, VRE</td>
<td>Ohl et al., 2012</td>
</tr>
<tr>
<td>• 41/43 (95%) contaminated at least once during 3 wk study;</td>
<td></td>
</tr>
<tr>
<td>• Evidence of frequent recontamination</td>
<td></td>
</tr>
<tr>
<td>• Antibacterial vs plain curtains, contaminated within 14 vs 2 days</td>
<td>Schweizer et al., 2012</td>
</tr>
<tr>
<td>• Within 4 weeks 27/30 contaminated</td>
<td></td>
</tr>
</tbody>
</table>
Part 2: Fomite Contamination & Transmission

Privacy Curtains Rarely Cleaned

- Protocols for cleaning and changing
- DeAngelis et al., 2013: “Are we doing enough?”
  - WV, PA, OH, KT, VA, MD policies
    - 55% written policy on cleaning curtains
    - 53% written policy on change frequency
    - 37% clean only when visibly soiled
      - 13% every month
      - 13% every 3 months
      - 13% once per year
      - 39% other
    - 86% felt that improvements could be made
## Part 2: Fomite Contamination & Transmission

### Studies – Mattresses & Bedding

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>• “Heavy” Staph contamination and airborne infection via blankets</td>
<td>Colbeck, circa 1950</td>
</tr>
<tr>
<td>• Cross contamination via mattresses</td>
<td></td>
</tr>
<tr>
<td>• Mattress disinfection reduced rates of boils/infections.</td>
<td></td>
</tr>
<tr>
<td>• Over half of isolation room beds and mattresses (132/252) tested positive for MRSA</td>
<td>Sexton et al., 2006</td>
</tr>
<tr>
<td>• <em>Bacillus, Pseudomonas, Burkholderia</em>, MRSA pathogens isolated from air during linen changes</td>
<td>Creamer &amp; Humphreys, 2008</td>
</tr>
</tbody>
</table>
## Part 2: Fomite Contamination & Transmission

### Studies – Upholstered Furniture

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Seeded pathogenic fungi survived 5-30 days (longest on synthetic fibers)</td>
<td>Neely &amp; Orloff, 2001</td>
</tr>
<tr>
<td>• 14/14 &amp; 13/14 sites positive after 24h, VRE and <em>P. aeruginosa</em> seed</td>
<td>Lankford et al., 2006</td>
</tr>
<tr>
<td>• Post-cleaning 7 and 5 sites remained positive</td>
<td></td>
</tr>
<tr>
<td>• VRE on 3/10 background chair samples</td>
<td>Noskin, 2000</td>
</tr>
<tr>
<td>• Seeded VRE spread to all surfaces in 72 h</td>
<td></td>
</tr>
<tr>
<td>• 2-4 log disinfectant efficacy (10 min) against norovirus surrogates</td>
<td>Malik 2006</td>
</tr>
</tbody>
</table>
### Part 2: Fomite Contamination & Transmission

#### Studies – Apparel

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Prospective cohort of MDRPs</td>
<td>Morgan et al., 2012</td>
</tr>
<tr>
<td>• 120/585 (20.5%) patient interactions resulted in contaminated gloves/gowns.</td>
<td></td>
</tr>
<tr>
<td>• Significant association between contaminated hands and white coats</td>
<td>Munoz-Price et al., 2012</td>
</tr>
<tr>
<td>• Collection of 238 uniform samples from 135 personnel (nurses, physicians)</td>
<td>Wiener-Well et al., 2011</td>
</tr>
<tr>
<td>• 143/238 (60%) colonized with potential pathogens &amp; DROs</td>
<td></td>
</tr>
<tr>
<td>• Uniform contamination over time</td>
<td>Burden et al., 2011</td>
</tr>
<tr>
<td>• Time 0 to 3 h= 50% contamination levels of 8 h wear; 8 h= same as infrequently laundered coats</td>
<td></td>
</tr>
<tr>
<td>• Nurses’ uniforms- <em>S. aureus, C. diff, VRE</em> detected pre and post duty</td>
<td>Perry et al., 2001</td>
</tr>
<tr>
<td>• Antimicrobial scrubs reduced MRSA burden 4-7 logs- but not VRE</td>
<td>Bearman et al., 2012</td>
</tr>
</tbody>
</table>

*Other studies on ties, sleeves, hospital gowns*
Part 2: Fomite Contamination & Transmission

Laundering Efficacy

• CDC guidelines for soft surfaces focuses on laundering
  – Many items cannot be routinely laundered
  – Recontamination occurs within 2 days\(^1\)
  – Soil visibility poor indicator of pathogen contamination
• 93% (28/30) of cleaning towels positive for culturable microbes post laundering\(^1\)
  – Following both in-house and contracted services
• Varying laundering practices with scrubs\(^3\)
  – 93% (28/30) & 12% (5/41) of home-laundered positive for pathogenic fungi & bacteria, respectively
  – 10% (2/21) hospital-laundered positive for pathogenic fungi

\(^{1}\text{Schweizer et al., 2012} \quad ^{2}\text{Sifuentes et al., 2013} \quad ^{3}\text{Nordstrom et al., 2012} \)
Part 2: Fomite Contamination & Transmission

Cross-Contamination Potentials

• Pathogens will survive long enough to be transmitted between soft surfaces and patients or to healthcare worker’s environment.
• Many surfaces are commonly touched but infrequently cleaned/changed
• Transfer to hands or other surfaces frequently occurs
• Such transfer is also possible when soft surfaces, such as fabrics or plastics, are involved.\(^1\)
• VRE easily transferred to upholstery cushions and from the fabric cushions to people.\(^2\)
• Laundering has significant limitations
• Less awareness for handwashing when touching surfaces vs. patients?

\(^1\)Scott & Bloomfield, 1990
\(^2\)Noskin et al., 2000
Part 2: Fomite Contamination & Transmission

Epidemiological Evidence of Transmission

- An outbreak of severe nausea and diarrhea in hospital *carpet* installers (2 cases) linked to SRSV in carpet (Cheesbrough et al., 1997)

- Hospital-acquired fungemia in neonates (8 cases) associated with intravascular *pressure-monitoring devices* (Solomon et al., 1986)

- *Pseudomonas aeruginosa* infection outbreak (48 cases; 3 deaths) connected to use of flexible *bronchoscopes* (Srinivasan et al., 2003)

- Three separate studies link recurrent patient acquisition of *Acinetobacter baumannii*, *P. aeruginosa*, and MRSA to widespread environmental contamination. (reviewed by Neely, 2013)

- Multiple-antibiotic-resistant *Acinetobacter baumanii* outbreak (13 cases) implicates *dry fabrics* such as *curtains*, as an important transmission reservoir (Das et al., 2002)
  - “Typing by pulsed field gel electrophoresis demonstrated that the patients’ isolates and those from the environment were indistinguishable.”

- **Laundry** as possible OB source: *Streptococcus, babies vests; Bacillus, MRSA, P. aeruginosa, VRE linens; Trichophyton, contaminated socks* (reviewed by Fijan & Turk, 2012)

- **Mattresses** implicated in burn unit (*Pseudomonas* spp., 66 cases; *Acinetobacter*, 63 cases); post-natal ward (MRSA, 110 cases) (reviewed by Creamer & Humphreys, 2008)

- Persistent *Acinetobacter* isolations traced to feather *pillows* (Weernink et al., 1995)
Part 2: Fomite Contamination & Transmission

Fomite Transmission – The Bottom Line

• Patients occupying rooms previously occupied by VRE, MRSA, *C. diff*, or *Acinetobacter* patients have an average 73% risk increase of acquiring the same pathogen.
• 40% of near patient surfaces inadequately cleaned
Part 2: Fomite Contamination & Transmission

ICU Surface Touch Frequency

Huslage et al., 2010
Part 2: Fomite Contamination & Transmission

Non-ICU Surface Touch Frequency

Huslage et al., 2010

*No correlation between touch frequency and microbial contamination; (Huslage et al., 2012 unpublished)
Viruses that only infect *E. coli* 700609

Bacteriophage ΦX174, MS2 and similar bacteriophages have been used as a human virus surrogate in studies to examine the spread and inactivation of pathogens:
- norovirus
- poliovirus
- influenza
- rhinovirus

Used in hospitals, daycare centers, and nursing homes*

*SOURCES: Gerhardt et al., 2012; Rheinbaben, Shunemann, Grob, & Wolff, 2000; Thompson & Yates, 1999; Shin & Sobsey, 2003; Sharp, 2001; Emmoth et al., 2012*
Part 2: Fomite Contamination & Transmission

Case Study – Office Wellness

Percentage of MS-2 and P-22 contaminated hands and fomites at T=4 hrs and T=7 hrs
Part 2: Fomite Contamination & Transmission

Cross-Contaminated First Responder Items

<table>
<thead>
<tr>
<th>Phase of study</th>
<th>Percent of surfaces contaminated</th>
</tr>
</thead>
<tbody>
<tr>
<td>No decontamination</td>
<td>56% (27/48)</td>
</tr>
<tr>
<td>Current practices</td>
<td>54% (26/48)</td>
</tr>
<tr>
<td>H2O2 Intervention</td>
<td>40% (19/48)</td>
</tr>
</tbody>
</table>
Reduced Intervention Efficacy

• Cross contamination between medical equipment and communal areas not recognized
  – (Reynolds & Sexton, 2010) detected MRSA in communal areas and office surfaces (11/160; 7%)
  – Most contaminated site- break room couches (4/20; 20%)
  – MRSA spread from first responders’ office surfaces and equipment to admin personnel
  – Tracer studies prove broader environmental spread

• Numerous surfaces not recognized/targeted for disinfecting (soft surfaces, equipment cases, personal items)
Part 3:
Mitigation Strategies
Part 3: Mitigation Strategies

Infection Prevention

• Building infection control is a multi-layered issue

• The three E’s of Infection Prevention:

1. **Education**
   Identify vulnerable environments; effective mitigation strategies; need for behavior modification, signage, training, communication, etc.

2. **Engineering**
   Passive control benefit; infection control engineered into building design, equipment, procedures, policies

3. **Enforcement**
   Monitoring, incentives, remedial action
Part 3: Mitigation Strategies

General Recommendations

• **Improve** hand hygiene compliance
• **Identify/isolate** patients rapidly
• **Reduce** pathogen shedding: daily chlorhexidine bathing
• **Clean/disinfect** the environment effectively
• **Train/behavior modification**
Replace this…

…with this!
Part 3: Mitigation Strategies

Education – Identified Barriers

- **Products vs. Procedures**
  - Inconsistent disinfection practices and products used
    - Use EPA-registered hospital approved disinfectants
    - Observe contact times (most 30 sec - 5 min)
    - Perform hand hygiene after contact with surfaces
    - Train/retrain personnel processes needed
  - Decontamination observed only when surfaces were visibly soiled with bodily fluids
    - Establish frequency protocols (daily, 3x weekly, etc.)
    - Allow adequate time for comprehensive cleaning
  - Contact times not achieved
    - 70% (56/80) <1 min recommended time

- **Product approved use**
  - Compatibility with surface/manufacturers warranty

- **Frequent cross-contamination means all surfaces should be targeted**
Part 3: Mitigation Strategies

Risk Reduction – Personal Hygiene

• Disinfect personal workplace items
  • Couches, remote controls, office supplies, door knobs…
  • Cell phones, bags…

• List of products that are EPA certified for MRSA/VRE: http://www.epa.gov/oppad001/list_h_mrsa_vre.pdf

• Good hygiene is important
  – Includes personal and communal
  – Hand washing reduces germs on hands by 99-99.9%
  – 30-60 seconds of washing
Part 3: Mitigation Strategies

Risk Reduction – Data Collection

- Better education
- Data collection
  - Process recording
  - Measured effects
  - Cost/benefit
- Utilize a soft surface treatment checklist
Part 3: Mitigation Strategies

Education – Invisible Invaders

• Visual inspection not reliable
  – Must have routine protocols in place
  – Develop a maintenance plan for specific tasks
    • Assign responsibility for all equipment
    • Include non-patient areas/contact items
  – Soft surface monitoring
    • May not be amenable to dyes
    • Require viable test agents
    • No clear definition of “clean”
Part 3: Mitigation Strategies

Engineering – Hospital Design

• **Antimicrobial Surfaces**
  – Metals: Copper, Silver
    • Naturally antimicrobial
    • Prevent colonization
    • Reduce pathogen survival
    • Cu
      – 97% reduction in surface pathogens
      – 40% reduction in HAI risk
      – 99.9% reduction in 2 hours
    – Passive control between routine cleaning/sanitizing
      • Supplemental- not a substitute
      • Reduces contamination but does not necessarily prevent cross-contamination

• **No touch (automated) disinfecting systems**
  – Hydrogen peroxide, UV
  – Reduced “operator error”
  – Need thorough evaluation
  – Numerous studies showing frequency reduction/ reduced C. *difficile* infections
  – Need broader efficacy testing; risk/cost benefit analysis
Part 3: Mitigation Strategies

Engineering – Antimicrobial Textiles

- “Bare below the elbows” British National Health Service rule
- Bacterial contamination occurs within hours of wearing clean scrubs
  - Bacterial adherence increases with polyester fiber content
  - Re-utilized gowns vs disposable for HCW
- Transfer from cloth to fingers
  - Increases with moisture content
  - Increases with friction
  - Increases with polyester content
- Antimicrobial textiles
  - Ex: Silver particles woven into fabric
    - 99.6% to 99.999% reduction in 24 hours, depending on bacterial species
  - ? Dose, durability, functionality, release rates
  - ? Sensitization, normal flora effects, absorption toxicity
  - ? Resistance, risk-benefit evaluation
Part 3: Mitigation Strategies

Enforcement – Increasing Compliance

- <50% of hospital rooms are adequately cleaned/disinfected using chemical germicides
  - Education, check lists, efficacy measurement (tracer dyes) improve cleaning
- New tools in tracking behaviors and compliance
Part 4: Case Study
Evaluation of a Soft Surface Sanitizer in Healthcare Environments
Part 4: Evaluation of a Soft Surface Sanitizer

Case Study Background

- Healthcare environments
  - Previously, surface sanitization focused on non-porous surfaces

- Soft surfaces more difficult to sanitize
  - Not evenly adsorbed
  - Contact time difficult to achieve
  - Often times results in discoloration

- Objective: Determine the efficacy of a soft surface sanitizer in the healthcare environment
Part 4: Evaluation of a Soft Surface Sanitizer

Case Study Methodology

- Three healthcare facilities
  - Intermediate/long term care facility
  - Occupational doctor’s office
  - Local health center
- Visited twice
  - Minimum of a week between visits
- Sample sites
  - Waiting room chairs
  - Patient room chairs
  - Privacy curtains
- Sampled before and after application of sanitizer
### Part 4: Evaluation of a Soft Surface Sanitizer

#### Case Study Results

<table>
<thead>
<tr>
<th>Site (n)</th>
<th>Percent HPC (n)</th>
<th>Percent HPC Reduction</th>
<th>Percent \textit{Staphylococcus sp.} (n)</th>
<th>Percent MRSA (n)</th>
<th>Percent \textit{S. pyrogenes} (n)</th>
<th>Percent \textit{E. coli} (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting Room Chair (30)</td>
<td>100 (30)</td>
<td>98.5</td>
<td>13 (4)</td>
<td>3 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Patient Chair (28)</td>
<td>100 (28)</td>
<td>97.7</td>
<td>7 (2)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Curtain (14)</td>
<td>100 (14)</td>
<td>95.0</td>
<td>7 (1)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

#### Soft Surface HPC Contamination

![Bar graph showing bacterial concentration before and after treatment.]

- **Before**:
  - Waiting Room Chair (30): 938 cfu/sq in
  - Patient Chair (28): 448 cfu/sq in
  - Privacy Curtain (14): 255 cfu/sq in

- **After**:
  - Waiting Room Chair (30): 14 cfu/sq in
  - Patient Chair (28): 10 cfu/sq in
  - Privacy Curtain (14): 13 cfu/sq in

- **>95% reduction of HPC bacteria**
Important to completely cover the target area

- EPA registered products for 99.9% reduction of bacteria on soft surfaces in 30 seconds
- Apply spray using a smooth, sweeping motion to mist consistently across fabric until wet
- Routine application lowers bacterial load present
- Daily application to prevent regrowth
- Cost effective solutions to laundering or dry cleaning soft surfaces

Reduced exposure will reduce risk!
Part 4: Evaluation of a Soft Surface Sanitizer

**Continuing Soft Surface Study**

- Tracer study aimed at identifying:
  - Pathogen transmission patterns
  - Frequency needs
  - “Spot” cleaning assessment
  - Common areas vs patient room levels
  - Household transmission potentials

- Targeting chronic and acute care facilities
Part 5: Wrap-Up
### Part 5: Wrap-Up

**Future Research Needs**

<table>
<thead>
<tr>
<th>Increase exposure awareness</th>
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<tbody>
<tr>
<td>• Transmission among patients/workers</td>
</tr>
<tr>
<td>• Transmission outside workplace</td>
</tr>
<tr>
<td>• External contributors- visitors, fomites</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Evaluate best vs. effective practice</th>
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<tbody>
<tr>
<td>• Visibly soiled vs. routine protocols</td>
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<tr>
<td>• Disinfectant preparation/shelf life</td>
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<td>• Contact times/ efficacy</td>
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<tr>
<th>Determine cost-benefit</th>
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<tbody>
<tr>
<td>• Cost savings associated with preventing HAIs</td>
</tr>
<tr>
<td>• ROI of soft surface sanitizing</td>
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<tr>
<th>Identify effective mitigation strategies</th>
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<tbody>
<tr>
<td>• Quantify contamination cycles</td>
</tr>
<tr>
<td>• Determine pathogen survival times on soft surfaces</td>
</tr>
<tr>
<td>• Frequency/timing appropriate/effective</td>
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<tr>
<td>• Commonly touched items targeted- transfer efficiency, risk assessment</td>
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<tr>
<td>• Multiple transmission routes targeted</td>
</tr>
<tr>
<td>- Hands- workers, patients, visitors</td>
</tr>
<tr>
<td>- Hard surfaces</td>
</tr>
<tr>
<td>- Soft surfaces</td>
</tr>
<tr>
<td>- Electronics- screens, keyboards</td>
</tr>
<tr>
<td>- Air- centralized vs localized</td>
</tr>
<tr>
<td>- Water</td>
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</tbody>
</table>
Part 5: Wrap-Up

Summary

- HAIs are widespread and extremely costly
- Healthcare workers are at higher risk of HAIs than the average population
- Infection-causing pathogens can live on fomites in the healthcare environment for extended periods of time, posing a risk to patients, staff and visitors
- Like hard surfaces, soft surfaces can also play a role in infection transmission
- Education, engineering and enforcement are critical to stopping the spread of pathogens in the healthcare environment
- Products EPA-registered for soft surfaces can help reduce the risk of infection via soft surfaces between launderings (or when laundering is not possible).
Thank you!
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