USE OF GERMICIDES IN HOME AND HEALTHCARE SETTINGS: IS THERE A RELATIONSHIP BETWEEN GERMICIDE USE AND ANTIMICROBIAL RESISTANCE

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Disclosures: Consultant to Germitec, PDI, Merck, Pfizer
Thanks to Dr. William Rutala for slides
USES OF GERMICIDES:
OVERWHELMING EVIDENCE OF EFFICACY

- Water purification (chlorine compounds)
- Sterilization of critical medical equipment
- High-level disinfection of semicritical medical equipment
- Hand hygiene
- Skin antisepsis
BACKGROUND
Antibiotic use and overuse is the main driving force of antibiotic resistance.

Does the use of disinfectants/antiseptics result in antiseptic and/or disinfectant resistance?

Do antibiotic resistant bacteria exhibit altered susceptibility to disinfectants/antiseptics?

Do disinfectants/antiseptics precipitate antibiotic resistance?
CLASSIFICATION OF GERMICIDES

- **Antisepsis** (antiseptics = germicides used on skin or mucous membranes)
  - Hand hygiene
  - Skin antisepsis (e.g., surgical site preparation, IV site)
  - Patient treatment (bathing) to reduce HAIs in ICU
  - Surgical scrub of HCP

- **Disinfection and Sterilization (Spaulding)** (disinfectants = germicides used on equipment or inanimate environment)
  - Critical items (sterile tissue): Sterilants
  - Semi-critical items (mucous membranes): High-level disinfectants
  - Non-critical items (intact skin): Low-level disinfectants
ANTISEPTIC AGENTS

- Alcohols
  - Usual use concentrations: 70-90%

- Chlorhexidine gluconate
  - Usual use concentrations: Oral rinse, 0.12% (1,200 mg/L), 2% (20,000 mg/L), 4% (40,000 mg/L)

- Iodine and iodophors

- Parachlorometaxylenol (PSMX)

- Hexachlorophene

- Benzalkonium chloride

- Triclosan
CHEMICAL STERILANTS & HIGH-LEVEL DISINFECTANTS

- Peracetic acid plus hydrogen peroxide
- Glutaraldehyde
- Hydrogen peroxide
- Ortho-phthalaldehyde
- Peracetic acid
- Improved hydrogen peroxide
DISINFECTANTS: LOW-LEVEL

- Quaternary ammonium compounds
- Hypochlorites
- Phenolics
- Alcohol: Ethyl or isopropyl (70-90%)
- Improved hydrogen peroxide
- Hydrogen peroxide plus peracetic acid
CHARACTERIZING “RESISTANCE”

- Assessment
  - Phenotypic: Growth patterns when exposed to antimicrobial
  - Genotypic: Presence and/or expression of genes

- Origin
  - Intrinsic: Inherent in the pathogen (e.g., impermeability; spores, cell wall - efflux);
  - Acquired: Acquisition of a genetic elements that results in “resistance” (e.g., altered target site, enzymatic inactivation, efflux, overproduction of target)

- Mechanism(s)
  - Altered target site, enzymatic inactivation, efflux, overproduction of target, absence of enzyme/metabolic pathway)
MICROBIAL RESISTANCE TO BIOCIDES

Expert Report
Comprehensive Rev Food Sci Food Safety
2006;5:71
INTRINSIC RESISTANCE

HIGH RESISTANCE

PRIONS (CJD, BSE)

COCCIDIA (Cryptosporidium spp.)

SPORES (Bacillus, Clostridium difficile)

MYCOBACTERIA (Mycobacterium tuberculosis, MAI)

CYSTS (Giardia)

SMALL NON-ENVELOPED VIRUSES (poliovirus)

TROPHOZOITES (Acanthamoeba spp.)

GRAM-NEGATIVE BACTERIA (Pseudomonads, Providencia spp.)

FUNGI (Candida spp., Aspergillus spp.)

LARGE NON-ENVELOPED VIRUSES (adenoviruses)

GRAM-POSITIVE BACTERIA (Staphylococcus aureus, enterococci)

LARGE ENVELOPED VIRUSES (HIV)

LOW RESISTANCE

Mallard J-Y. J Appl Microbiol 2002;92:16S
COMMON REASONS FOR BIOCIDE FAILURE

- Use of an inappropriate product (i.e., pathogens if intrinsically resistant)
- Application of the product improperly (i.e., incorrect duration, concentration, pH, temperature)
- Failure to remove inorganic debris (i.e., improper cleaning) prior to disinfection
- Insufficient contact of the disinfectant with the surface to be treated
- Insufficient availability of active product

Weber DJ, Rutala WA. ICHE 2006;27:1107-1119
SIMILARITIES AND DIFFERENCES BETWEEN ANTIBIOTIC AND BIOCIDE RESISTANCE

- **Similarities**
  - Intrinsic (e.g., spores resistant to alcohols) and extrinsic resistance (e.g., efflux pumps for heavy metals) well described
  - Similar mechanisms of resistance (e.g., impermeability, efflux pumps)
  - Biofilms impair inactivation/killing
  - Inactivation dependent of concentration and duration of contact

- **Differences**
  - Most antibiotics inhibit a specific target in a biosynthetic process
  - Most biocides have multiple concentration-dependent targets, with subtle effects occurring at low concentration and more damaging ones at higher concentrations
DEFINITIONS:
ANTIMICROBIAL RESISTANCE

Antibiotic resistance

- Objective is to predict clinical outcome (i.e., success or failure) of treatment
- Measured *in vitro* by determining the MIC (minimum inhibitory concentration). Resistant strains are not inhibited by the usual achievable systemic concentrations of the agents.
- NCCLS 2002 (now CLSI): The implication of the “susceptible” category implies that an infection due to the strain may be appropriately treated with the dosage of the antimicrobial agent recommended for the type of infection and infecting species.
QUATERNARY AMMONIUM BIOCIDES

- Resistance mechanism = Qac A/B gene
  - May be plasmid or chromosomal mediated
  - Found in *S. aureus* (MSSA, MRSA); detection rate has varied from <2% (US) to >80% (Asia)
  - Also found in Gram negative bacilli
  - Level of resistance conferred is below use concentrations of CHG and Quats
- Cross-resistance between CHG and Quats, and antimicrobials not convincingly demonstrated (some studies have shown a correlation between qac A/B presence and increased frequency of antimicrobial resistance)
- Gerba: “Nonspecific action of Quats makes the development of resistance unlikely; multi-target nature of Quats means that mutation within a single target unlikely to result in treatment failure.

QUESTION 1

Does the use of disinfectants/antiseptics result in disinfectant/antiseptic resistance?
Clinically relevant resistance was only occasionally demonstrated and involved antibiotics of limited current use (e.g., chloramphenicol resistance in *E. coli*). Multidrug resistance was not demonstrated.
LAB DEVELOPED STRAINS WITH REDUCED SUSCEPTIBILITY TO GERMICIDE THAT DEMONSTRATED DECREASED SUSCEPTIBILITY TO ANTIBIOTICS

<table>
<thead>
<tr>
<th>Bacteria (gene)</th>
<th>Germicide</th>
<th>Ab Resistance</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>P. stutzeri</td>
<td>Chlorhexidine</td>
<td>Triclosan, Gent*, Rif^, Erythro^, Amp^</td>
<td>Tattawasart 1999</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>Chlorhexidine</td>
<td>Triclosan, Gent, Rif, Erythro, Amp</td>
<td>Tattawasart 1999</td>
</tr>
<tr>
<td>M. smegmatis (InhA)</td>
<td>Triclosan</td>
<td>INH</td>
<td>McMurray 1999</td>
</tr>
</tbody>
</table>

* Clinically significant based on NCCLS, ^ No standard

Clinically relevant resistance was only occasionally demonstrated and involved antibiotics of limited current use (e.g., gentamicin resistance to P. stutzeri). Multidrug resistance not demonstrated.
DOES HOME USE OF GERMICIDES LEAD TO ANTIBIOTIC RESISTANT PATHOGENS IN THE ENVIRONMENT

- Aim: To describe the relationship between antibiotic resistance in environmental isolates relative to the use of germicides
- Methods: Bacterial isolates collected from homes of 30 users and non-users of germicides (Quats, triclosan, PCMX, pine oil)
- Results: In general isolates from the homes of germicide users were not more antibiotic resistant

Table 4 Comparative antibiotic resistance in target bacterial isolates from clinical samples in user homes and non-user homes according to standard susceptibility test panels

<table>
<thead>
<tr>
<th></th>
<th>Nonuser resistant/total isolates</th>
<th>User resistant/total isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gram-positive cocci</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Enterococcus sp.</em></td>
<td>3/4 (75-0%)</td>
<td>4/4 (100-0%)</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>3/3 (100-0%)</td>
<td>4/4 (100-0%)</td>
</tr>
<tr>
<td><em>Staphylococcus sp.</em></td>
<td>32/45 (71-1%)</td>
<td>40/52 (76-9%)</td>
</tr>
<tr>
<td><em>Viridans Streptococcus</em></td>
<td>2/32 (6-3%)</td>
<td>7/36 (19-4%)</td>
</tr>
<tr>
<td><strong>Gram-negative rods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pseudomonas aeruginosa</em></td>
<td>3/3 (100-0%)</td>
<td>0/0 NA</td>
</tr>
<tr>
<td>Other <em>Enterobacteriaceae</em></td>
<td>11/13 (84-6%)</td>
<td>1/1 (100-0%)</td>
</tr>
</tbody>
</table>

*Resistance to 1–2 antibiotics.  
†Resistance to 2 antibiotics. 
‡Resistance to 1–5 antibiotics.  
$Resistance to 1–3 antibiotics.

Possible to develop mutants with reduced susceptibility to disinfectants and antiseptics that demonstrate decreased susceptibility or resistance to antibiotics. 

As the concentration of disinfectants used in practice greatly exceed the MICs observed, the clinical relevance is questionable. 

Clinically relevant resistance was only occasionally demonstrated and involved antibiotics of limited current use (e.g., chloramphenicol resistance in *E. coli*).
Some strains show decreased susceptibility to both germicides (CHG, QUAT) and antibiotics (tetracycline).

To date no evidence that using antiseptics or disinfectants selects for antibiotic-resistant organisms or that mutants survive in nature

Germicides should only be used where there are scientific studies demonstrating benefit
QUESTION 1

Does the use of disinfectants/antiseptics result in disinfectant/antiseptic resistance?

No clinically significant resistance!
QUESTION 2

Do antibiotic resistant bacteria exhibit altered susceptibility to disinfectants/antiseptics?
<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Study</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutala et al.</td>
<td>1997</td>
<td>Susceptibility of antibiotic-susceptible and antibiotic-resistant hospital bacteria to disinfectants</td>
<td>Examples of antibiotic-susceptible and antibiotic-resistant <em>Staphylococcus aureus</em>, enterococci and <em>Pseudomonas aeruginosa</em> had similar susceptibilities to phenolic and quaternary ammonium compounds</td>
</tr>
<tr>
<td>Sakagami and Kajimura</td>
<td>2002</td>
<td>Bactericidal activities of disinfectants against vancomycin-resistant enterococci</td>
<td>No differences in bactericidal time for activity against VRE vs vancomycin-susceptible enterococci. VRE strains demonstrating slightly reduced susceptibility to germicides were readily inactivated at concentrations of germicides used in hospitals</td>
</tr>
<tr>
<td>Rutala et al.</td>
<td>2006</td>
<td>Bacterial contamination of keyboards: efficacy and functional impact of disinfectants</td>
<td>Disinfectants containing alcohol, chlorine, phenol or quaternary ammonium were effective at removing MRSA, <em>P. aeruginosa</em> and VRE on contaminated computer keyboards. Excellent sustained activity of quaternary ammonium-containing products against VRE and <em>P. aeruginosa</em> for up to 48 h</td>
</tr>
<tr>
<td>Wisplinghoff et al.</td>
<td>2007</td>
<td>Resistance to disinfectants in epidemiologically defined clinical isolates of <em>Acinetobacter baumannii</em></td>
<td>Susceptibility of different strains of <em>A. baumannii</em> to disinfectants; 10 outbreak-related strains highly resistant to multiple antibiotics vs 10 sporadic multi-susceptible isolates. No significant differences between different disinfectants for both outbreak-related and sporadic <em>A. baumannii</em></td>
</tr>
<tr>
<td>Koo et al.</td>
<td>2012</td>
<td>Multidrug-resistant NDM-1 <em>Klebsiella</em> outbreak and infection control in endoscopic urology</td>
<td>Routine disinfection methods were effective to control outbreaks of highly resistant organisms such as NDM-1 <em>Klebsiella</em> spp.</td>
</tr>
<tr>
<td>Robustillo Rodela et al.</td>
<td>2012</td>
<td>Emergence and outbreak of carbapenemase-producing KPC-3 <em>Klebsiella pneumoniae</em> in Spain, September 2009 to February 2012: control measures</td>
<td>Routine disinfectants were effective against highly resistant carbapenemase-producing <em>K. pneumoniae</em> isolates</td>
</tr>
<tr>
<td>Campos et al.</td>
<td>2012</td>
<td>Isolation, molecular characteristics and disinfection of methicillin-resistant <em>Staphylococcus aureus</em> from ICU units in Brazil</td>
<td>Study of <em>S. aureus</em> isolates in two Brazilian ICUs: 36% were resistant to oxacillin; all tested disinfectants were effective against <em>S. aureus</em> isolates; no difference in resistance to disinfectants was found between MRSA and meticillin-susceptible <em>S. aureus</em></td>
</tr>
</tbody>
</table>

VRE, vancomycin-resistant enterococci; MRSA, meticillin-resistant *Staphylococcus aureus*; ICU, intensive care unit.
ASSESSMENT OF GERMICIDE SUSCEPTIBILITY FOR VRE VS VSE

- Aim: To assess the susceptibility of VRE and VSE to hospital disinfectants
- Design: Microbial suspension tests with Quat, phenolic or iodophor
- Results: No difference in germicide susceptibility noted for VRE and VSE

**FIGURE 1.** Survival of vancomycin-resistant enterococci and vancomycin-sensitive enterococci in a 1:35 further dilution of the Hi-Tor use-dilution over 5 minutes of sampling.

**FIGURE 2.** Survival of vancomycin-resistant enterococci and vancomycin-sensitive enterococci in a 1:64 further dilution of the Hi-Tor use-dilution over 5 minutes of sampling.

SUSCEPTIBILITY OF ANTIBIOTIC-RESISTANT PATHOGENS OF GERMICIDES

No relationship between antibiotic resistance and disinfectant resistance

**Susceptibility of Antibiotic-Resistant and Antibiotic-Susceptible Bacteria to a Phenolic and Quaternary Ammonium Disinfectant**

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Phenolic (1:256)</th>
<th>Phenolic (1:128)</th>
<th>Quaternary Ammonium (1:64)</th>
<th>Quaternary Ammonium (1:32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staphylococcus aureus</td>
<td>Susceptible</td>
<td>2</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Resistant</td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Staphylococcus epidermidis</td>
<td>Susceptible</td>
<td>10*</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Resistant</td>
<td>2</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>Susceptible</td>
<td>3*</td>
<td>23*</td>
<td>14*</td>
</tr>
<tr>
<td></td>
<td>Resistant</td>
<td>4</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Klebsiella pneumoniae</td>
<td>Susceptible</td>
<td>1*</td>
<td>0*</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Resistant</td>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>Susceptible</td>
<td>2</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Resistant</td>
<td>4</td>
<td>7*</td>
<td>4*</td>
</tr>
<tr>
<td>Enterococcus species</td>
<td>Resistant</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Salmonella choleraeaeus</td>
<td>Susceptible</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

* P<0.05, comparing susceptible versus resistant strains for each disinfectant at same concentration.
† Number of positive penicillins per 90 replicates.
‡ P<0.001, comparing susceptible versus resistant strain for each disinfectant at same concentration.

Antibiotic resistance does not correlate to increased resistance to disinfectants

TABLE 2

<table>
<thead>
<tr>
<th>Product</th>
<th>VSE 0.5 min</th>
<th>VSE 5 min</th>
<th>VRE 0.5 min</th>
<th>VRE 5 min</th>
<th>MSSA 0.5 min</th>
<th>MSSA 5 min</th>
<th>MRSA 0.5 min</th>
<th>MRSA 5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vesphen IIse</td>
<td>&gt;4.3</td>
<td>&gt;4.3</td>
<td>&gt;4.8</td>
<td>&gt;4.8</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Clorox</td>
<td>&gt;5.4</td>
<td>&gt;5.4</td>
<td>&gt;4.9</td>
<td>&gt;4.9</td>
<td>&gt;5.0</td>
<td>&gt;5.0</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Lysol Disinfectant</td>
<td>&gt;4.3</td>
<td>&gt;4.3</td>
<td>&gt;4.8</td>
<td>&gt;4.8</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Lysol Antibacterial</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.5</td>
<td>&gt;5.1</td>
<td>&gt;5.1</td>
<td>&gt;4.6</td>
<td>&gt;4.6</td>
</tr>
<tr>
<td>Vinegar</td>
<td>0.1</td>
<td>5.3</td>
<td>1.0</td>
<td>3.7</td>
<td>+1.1</td>
<td>+0.9</td>
<td>+0.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Abbreviations: MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-susceptible *S aureus*; VRE, vancomycin-resistant *Enterococcus*; VSE, vancomycin-susceptible *Enterococcus*. Data represent mean of two trials (n=2). Values preceded by “<“ represent the limit of detection of the assay. Assays were conducted at a temperature of 20°C and a relative humidity of 45%. Results were calculated as the log of Nd/No, where Nd is the titer of bacteria surviving after exposure and No is the titer of the control.

QUESTION 2

Do antibiotic resistant bacteria exhibit altered susceptibility to disinfectants/antiseptics?

No clinically significant resistance (reduced susceptibility)!
QUESTION 3

What about the susceptibility of antibiotic-resistant organisms to disinfectants at very low concentrations?
### SUSCEPTIBILITY OF ANTIBIOTIC-RESISTANT AND SUSCEPTIBLE BACTERIA TO GERMICIDES

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Effect on Germicide Susceptibility</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Reduced Suscep</td>
<td></td>
</tr>
<tr>
<td>MRSA</td>
<td>Phenol, chlorhexidine</td>
<td>Al-Masaudi 1988</td>
</tr>
<tr>
<td>MRSA</td>
<td>QACs</td>
<td>Al-Masaudi 1991</td>
</tr>
<tr>
<td>VRE</td>
<td>Chlorine, alcohol, glutaraldehyde</td>
<td>Bradley 1996</td>
</tr>
<tr>
<td>VRE</td>
<td>None</td>
<td>Anderson 1997</td>
</tr>
<tr>
<td>MRSA, VRE</td>
<td>Phenol, QAC</td>
<td>Rutala 1997</td>
</tr>
<tr>
<td>GNR</td>
<td>CHG</td>
<td>Koljalg 2002</td>
</tr>
<tr>
<td>VRE</td>
<td>Aldehydes, alcohols, iodines, biguanide group</td>
<td>Sakagami 2002</td>
</tr>
</tbody>
</table>

CHG, chlorhexidine; QAC, quaternary ammonium compound; MRSA, methicillin-resistant <em>S. aureus</em>; VRE, vancomycin resistant enterococcus
PLASMA-MEDIATED RESISTANCE TO GERMICIDES IN STAPHYLOCOCCI

<table>
<thead>
<tr>
<th>Biocide</th>
<th>MSSA (ppm)</th>
<th>MRSA (ppm)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAK</td>
<td>&lt;1</td>
<td>6</td>
<td>Townsend 1983</td>
</tr>
<tr>
<td>Cetrimide</td>
<td>1.5</td>
<td>2.5-5</td>
<td>Al-Masaudi 1991</td>
</tr>
<tr>
<td>CHG</td>
<td>0.9</td>
<td>4.2</td>
<td>Brumfit 1985</td>
</tr>
<tr>
<td>Cresol</td>
<td>750</td>
<td>1250</td>
<td>Al-Masaudi 1991</td>
</tr>
</tbody>
</table>
Aim: To assess whether failure of decolonization related to low-level mupirocin resistance plus genotypic CHG resistance (qacA/B gene detection by PCR)

Design: Nested case-control study

Results: Presence of combined mupirocin and CHG resistance a predictive factor for failure of decolonization therapy (intranasal mupirocin plus CHG baths)

Limitation: CHG susceptibility not determined

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Adjusted OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined mupirocin and chlorhexidine resistance</td>
<td>3.4 (1.5–7.8)</td>
<td>.004</td>
</tr>
<tr>
<td>Age (per 1-year increment)</td>
<td>1.04 (1.02–1.1)</td>
<td>.001</td>
</tr>
<tr>
<td>Prior hospitalization (previous 2 years)</td>
<td>2.4 (1.1–5.7)</td>
<td>.04</td>
</tr>
<tr>
<td>Wound or pressure sore</td>
<td>5.7 (1.8–17.6)</td>
<td>.003</td>
</tr>
<tr>
<td>Exposure to MRSA-inactive antibiotic</td>
<td>3.1 (1.3–7.2)</td>
<td>.01</td>
</tr>
<tr>
<td>Central venous catheterization</td>
<td>5.7 (1.4–23.9)</td>
<td>.02</td>
</tr>
</tbody>
</table>

Harbarth S, et al. JHI 2014;87:194-202
QUESTION 3

What about the susceptibility of antibiotic-resistant organisms to disinfectants at very low concentrations?

No clinically significant resistance (reduced susceptibility)!
USES OF GERMICIDES: OVERWHELMING EVIDENCE OF EFFICACY

- Water purification (chlorine compounds)
- Hand hygiene
- Sterilization of critical medical equipment
- High-level disinfection of semicritical medical equipment
- Low-level disinfection of environmental surfaces
- Skin antisepsis: CHG treatment (bathing) of ICU patients, prior to surgery or insertion of indwelling medical devices

BENEFITS OF GERMICIDES: REDUCTION IN HAIs (meta-analyses)

55% reduction in CLABSI with CHG treatment

37% reduction in CLABSI with impregnated central lines, silver-sulfadiazine
Disinfectants Resistance: Is There a Relationship Between Use and Resistance

Antibiotic use and overuse is the main driving force of antibiotic resistance

- Does the use of disinfectants/antiseptics result in disinfectant and/or antiseptic resistance? No
- Do antibiotic resistant bacteria exhibit altered susceptibility to disinfectants/antiseptics? No
- Do disinfectants and/or antiseptics precipitate antibiotic resistance? No
- Does the use of germicides decrease human disease? Yes

Conclusion

- Benefit of continued use of antiseptics and disinfectants, benefits overwhelming superior to risks
THANK YOU!!