Campaign to Prevent Antimicrobial Resistance

Centers for Disease Control and Prevention
National Center for Infectious Diseases
Division of Healthcare Quality Promotion

Clinicians hold the solution!

- Link to: Campaign to Prevent Antimicrobial Resistance Online
- Link to: Federal Action Plan to Combat Antimicrobial Resistance
Antimicrobial Resistance: Key Prevention Strategies

Susceptible Pathogen

Prevent Transmission

Antimicrobial Resistance

Optimize Use

Antimicrobial Use

Prevent Infection

Infection

Effective Diagnosis and Treatment
Key Prevention Strategies

- Prevent infection
- Diagnose and treat infection effectively
- Use antimicrobials wisely
- Prevent transmission

Clinicians hold the solution!
12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

1. Vaccinate
2. Get the catheters out
3. Target the pathogen
4. Access the experts
5. Practice antimicrobial control
6. Use local data
7. Treat infection, not contamination
8. Treat infection, not colonization
9. Know when to say “no” to vanco
10. Stop treatment when cured
11. Isolate the pathogen
12. Contain your contagion

Prevent Transmission
Use Antimicrobials Wisely
Diagnose and Treat Effectively
Prevent Infection
Prevent Infection
Step 1: Vaccinate

Fact:
Predischarge influenza and pneumococcal vaccination of at-risk hospital patients AND influenza vaccination of healthcare personnel will prevent infections.
### Need for Healthcare Personnel Immunization Programs: Influenza Vaccination Rates (1996-1997)

<table>
<thead>
<tr>
<th>Category</th>
<th>% Vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td>All adults ≥ 65 yrs of age</td>
<td>63%</td>
</tr>
<tr>
<td>Healthcare personnel at high risk*</td>
<td>38%</td>
</tr>
<tr>
<td>All healthcare personnel**</td>
<td>34%</td>
</tr>
</tbody>
</table>

* One or more high-risk medical conditions including diabetes, current cancer treatment, or chronic heart, lung, or kidney disease.

** Healthcare workers included persons currently employed in healthcare occupations, regardless of setting, and persons currently employed in healthcare settings without a healthcare occupation.

Source: 1997 National Health Interview Survey

Link to: ACIP Influenza Immunization Recommendations
Prevent Infection

Step 1: Vaccinate

Fact: Predischarge influenza and pneumococcal vaccination of at-risk hospital patients and influenza vaccination of healthcare personnel will prevent infections.

Actions:

- Give influenza/S. pneumoniae vaccine to at-risk patients before discharge
- Get influenza vaccine annually

[Links to: ACIP Influenza immunization recommendations, CDC facts about influenza and pneumococcal vaccine, ACIP: Vaccine standing orders]
Fact:

Catheters and other invasive devices are the #1 exogenous cause of hospital-acquired infections.
Biofilm on Intravenous Catheter Connector 24 Hours After Insertion

Scanning Electron Micrograph

Link to: Biofilms and device-associated infections
**Prevent Infection**

**Step 2: Get the catheters out**

**Fact:** Catheters and other invasive devices are the #1 exogenous cause of hospital-acquired infections.

**Actions:**

- use catheters only when essential
- use the correct catheter
- use proper insertion and catheter-care protocols
- remove catheters when not essential

Link to: [Urinary catheter infection prevention](#)  
Coming soon…[guidelines for preventing catheter-associated bloodstream infections](#)
Fact:
Appropriate antimicrobial therapy (correct regimen, timing, dosage, route, and duration) saves lives.
Inappropriate Antimicrobial Therapy: Prevalence Among Intensive Care Patients

Inappropriate Antimicrobial Therapy
(n = 655 ICU patients with infection)

- Community-acquired infection: 17.1%
- Hospital-acquired infection: 34.3%
- Hospital-acquired infection after initial community-acquired infection: 45.2%

### Susceptibility Testing Proficiency:
48 Clinical Microbiology Laboratories

<table>
<thead>
<tr>
<th>Test Organism</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methicillin-resistant <em>Staphylococcus aureus</em></td>
<td>100%</td>
</tr>
<tr>
<td>Vancomycin-resistant <em>Enterococcus faecium</em></td>
<td>100%</td>
</tr>
<tr>
<td>Fluoroquinolone-resistant <em>Pseudomonas aeruginosa</em></td>
<td>100%</td>
</tr>
<tr>
<td>Erythromycin-resistant <em>Streptococcus pneumoniae</em></td>
<td>97%</td>
</tr>
<tr>
<td>Carbapenem-resistant <em>Serratia marcescens</em></td>
<td>75%</td>
</tr>
<tr>
<td>Extended-spectrum beta-lactamase <em>Klebsiella pneumoniae</em></td>
<td>42%</td>
</tr>
</tbody>
</table>

Fact: Appropriate antimicrobial therapy saves lives.

Actions:

- culture the patient
- target **empiric therapy** to likely pathogens and local antibiogram
- target **definitive therapy** to known pathogens and antimicrobial susceptibility test results

Link to: IDSA guidelines for evaluating fever in critically ill adults
Diagnose and Treat Infection Effectively

Step 4: Access the experts

Fact:
Infectious diseases expert input improves the outcome of serious infections.
Infectious Diseases Expert Resources

Infectious Diseases Specialists

Healthcare Epidemiologists

Clinical Pharmacists

Clinical Microbiologists

Infection Control Professionals

Clinical Pharmacologists

Surgical Infection Experts

Optimal Patient Care

12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

Step 4: Access the experts
Diagnose and Treat Infection Effectively

Step 4: Access the experts

Fact: Infectious diseases expert input improves the outcome of serious infections.

Action:

✓ consult infectious diseases experts about patients with serious infections

Link to: SHEA / IDSA: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals
Fact:
Programs to improve antimicrobial use are effective.
Methods to Improve Antimicrobial Use

- Passive prescriber education
- Standardized antimicrobial order forms
- Formulary restrictions
- Prior approval to start/continue
- Pharmacy substitution or switch
- Multidisciplinary drug utilization evaluation (DUE)
- Interactive prescriber education
- Provider/unit performance feedback
- Computerized decision support/online ordering

Link to: SHEA / IDSA: Guidelines for the Prevention of Antimicrobial Resistance in Hospitals
Computerized Antimicrobial Decision Support

- Local clinician-derived consensus guidelines embedded in computer-assisted decision support programs
- 62,759 patients receiving antimicrobials over 7 years

<table>
<thead>
<tr>
<th></th>
<th>1988</th>
<th>1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medicare case-mix index</td>
<td>1.7481</td>
<td>2.0520</td>
</tr>
<tr>
<td>Hospital mortality</td>
<td>3.65%</td>
<td>2.65%</td>
</tr>
<tr>
<td>Antimicrobial cost</td>
<td>$122.66</td>
<td>$51.90</td>
</tr>
<tr>
<td>Properly timed</td>
<td>40%</td>
<td>99.1%</td>
</tr>
</tbody>
</table>

- Stable antimicrobial resistance
- Adverse drug events decreased by 30%

Use Antimicrobials Wisely

Step 5: Practice antimicrobial control

Fact: Programs to improve antimicrobial use are effective.

Action:

✓ engage in local antimicrobial use quality improvement efforts


Link to: Methods to improve antimicrobial use and prevent resistance
Fact:
The prevalence of resistance can vary by time, locale, patient population, hospital unit, and length of stay.
Trimethoprim/Sulfamethoxazole (TMP/SMX) Resistance Among Bacterial Patient Isolates*

San Francisco General Hospital

0 10 20 30 40 50 60

Percent Resistant Patient Isolates


Non-HIV units (n = 28,966 patient isolates)
HIV units (n = 1,920 patient isolates)
Prevalence of TMP/SMX use among AIDS patients

* 30,886 patient isolates
Staphylococcus aureus
Escherichia coli
Enterobacter spp.
Klebsiella pneumoniae
Morganella spp.
Proteus spp.
Serratia spp.
Citrobacter spp.
Use Antimicrobials Wisely

Step 6: Use local data

Fact: The prevalence of resistance can vary by locale, patient population, hospital unit, and length of stay.

Actions:

- know your local antibiogram
- know your patient population

Link to: NCCLS Proposed Guidance for Antibiogram Development
Fact:

A major cause of antimicrobial overuse is “treatment” of contaminated cultures.
## Blood Culture Contamination Benchmarks

(649 institutions; 570,108 blood cultures)

<table>
<thead>
<tr>
<th></th>
<th>Contamination Rate* (percentile)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10th</td>
</tr>
<tr>
<td>Hospitalized adults</td>
<td>5.4</td>
</tr>
<tr>
<td>Hospitalized children</td>
<td>7.3</td>
</tr>
<tr>
<td>Neonates</td>
<td>6.5</td>
</tr>
</tbody>
</table>

* percent of cultures contaminated


Link to: [College of American Pathologist contaminated blood culture survey](#)
Positive Blood Cultures Obtained Through Central Venous Catheters Do Not Reliably Predict True Bacteremia*

<table>
<thead>
<tr>
<th></th>
<th>Catheter Sample</th>
<th>Peripheral Vein Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Predictive Value</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>63%</td>
<td>73%</td>
</tr>
<tr>
<td>Negative</td>
<td>99%</td>
<td>98%</td>
</tr>
</tbody>
</table>

* 55 paired cultures from hospitalized hematology/oncology patients

Interpreting a “Positive” Blood Culture

**True Bacteremia:**

- **Unlikely**
  - Corynebacterium spp.
  - Non-anthracis Bacillus spp.
  - Propionibacterium acnes

- **Uncertain**
  - Coagulase-negative staphylococci

- **Likely**
  - S. aureus
  - S. pneumoniae
  - Enterobacteriaceae
  - P. aeruginosa
  - Candida albicans

**Pre-test probability**
- patient risk factors
- prosthetic devices
- clinical evidence

**Post-test probability**
- # positive/# cultures
- compare antibiograms
- compare genotypes

Use Antimicrobials Wisely

Step 7: Treat infection, not contamination

Fact: A major cause of antimicrobial overuse is “treatment” of contaminated cultures.

Actions:

- use proper antisepsis for blood and other cultures
- culture the blood, not the skin or catheter hub
- use proper methods to obtain and process all cultures

Link to: CAP standards for specimen collection and management
Fact:

A major cause of antimicrobial overuse is “treatment” of colonization.
Invasive Bronchoscopic Diagnostic Tests Reduce Antimicrobial Use in Suspected Ventilator-Associated Pneumonia*

<table>
<thead>
<tr>
<th></th>
<th>Invasive Diagnosis</th>
<th>Noninvasive Diagnosis</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimicrobial-free days (at day 28)</td>
<td>11.0</td>
<td>7.5</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Mortality</td>
<td>16.2%</td>
<td>25.8%</td>
<td>.022</td>
</tr>
</tbody>
</table>

*413 patients; 31 intensive care units

Use Antimicrobials Wisely
Step 8: Treat infection, not colonization

Fact: A major cause of antimicrobial overuse is treatment of colonization.

Actions:
- treat pneumonia, not the tracheal aspirate
- treat bacteremia, not the catheter tip or hub
- treat urinary tract infection, not the indwelling catheter

Link to: IDSA guideline for evaluating fever in critically ill adults
Fact:
Vancomycin overuse promotes emergence, selection, and spread of resistant pathogens.

Use Antimicrobials Wisely
Step 9: Know when to say “no” to vanco
Vancomycin Utilization in Hospitals
(defined daily doses per 1,000 patient days)

Source: National Nosocomial Infections Surveillance (NNIS) System

Link to: NNIS Online at CDC
Evolution of Drug Resistance in *S. aureus*

- **Penicillin**
  - *S. aureus* [1950s]
  - Penicillin-resistant *S. aureus*

- **Methicillin**
  - Methicillin-resistant *S. aureus* (MRSA) [1970s]

- **Vancomycin**
  - Vancomycin-resistant enterococci (VRE) [1990s]
  - Vancomycin-intermediate-resistant *S. aureus* [1997]
  - Vancomycin-resistant *S. aureus* (VISA)
Use Antimicrobials Wisely

Step 9: Know when to say “no” to vanco

Fact: Vancomycin overuse promotes emergence, selection, and spread of resistant pathogens.

Actions:

- treat infection, not contaminants or colonization
- fever in a patient with an intravenous catheter is not a routine indication for vancomycin

Link to: CDC guidelines to prevent vancomycin resistance
Fact:
Failure to stop unnecessary antimicrobial treatment contributes to overuse and resistance.

Use Antimicrobials Wisely
Step 10: Stop treatment when infection is cured or unlikely
Use Antimicrobials Wisely
Step 10: Stop antimicrobial treatment

Fact: Failure to stop unnecessary antimicrobial treatment contributes to overuse and resistance.

Actions:
- when infection is cured
- when cultures are negative and infection is unlikely
- when infection is not diagnosed
Prevent Transmission

Step 11: Isolate the pathogen

Fact:
Patient-to-patient spread of pathogens can be prevented.
A Decade of Progress (1990-1999):
Hospital-Acquired Infection Rates in NNIS Intensive Care Units

<table>
<thead>
<tr>
<th>Type of ICU</th>
<th>BSI (%)</th>
<th>VAP (%)</th>
<th>UTI (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical</td>
<td>44%</td>
<td>56%</td>
<td>46%</td>
</tr>
<tr>
<td>Surgical</td>
<td>31%</td>
<td>38%</td>
<td>30%</td>
</tr>
<tr>
<td>Pediatric</td>
<td>32%</td>
<td>26%</td>
<td>59%</td>
</tr>
</tbody>
</table>

BSI = central line-associated bloodstream infection rate
VAP = ventilator-associated pneumonia rate
UTI = catheter-associated urinary tract infection rate

Source: National Nosocomial Infections Surveillance (NNIS) System

Link to: MMWR: Successful Healthcare Infection Prevention: Case History
Prevent Transmission

Step 11: Isolate the pathogen

Fact: Patient-to-patient spread of pathogens can be prevented.

Actions:

- use standard infection control precautions
- contain infectious body fluids (use approved airborne/droplet/contact isolation precautions)
- when in doubt, consult infection control experts

Link to: A VRE prevention success story
Link to: CDC isolation guidelines and recommendations
Fact:
Healthcare personnel can spread antimicrobial-resistant pathogens from patient to patient.
Airborne Transmission of Pathogens From Healthcare Personnel to Patients

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Circumstance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza virus</td>
<td>Lack of vaccination</td>
</tr>
<tr>
<td>Varicella-Zoster virus</td>
<td>Disseminated infection</td>
</tr>
<tr>
<td><em>Mycobacterium tuberculosis</em></td>
<td>Cavitary disease</td>
</tr>
<tr>
<td><em>Bordetella pertussis</em></td>
<td>Undiagnosed prolonged cough</td>
</tr>
<tr>
<td><em>Streptococcus pyogenes</em></td>
<td>Asymptomatic carriage; perioperative transmission</td>
</tr>
<tr>
<td><em>Staphylococcus aureus</em></td>
<td>Viral URI (“cloud” healthcare provider)</td>
</tr>
</tbody>
</table>

Improved Patient Outcomes Associated With Proper Hand Hygiene

Chlorinated lime hand antisepsis

Ignaz Philipp Semmelweis (1818-1865)

Link to: Ignaz Semmelweis
## Impact of Hand Hygiene on Hospital Infections

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Setting</th>
<th>Impact on Infection Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1977</td>
<td>Casewell</td>
<td>adult ICU</td>
<td><em>Klebsiella</em> decreased</td>
</tr>
<tr>
<td>1982</td>
<td>Maki</td>
<td>adult ICU</td>
<td>decreased</td>
</tr>
<tr>
<td>1984</td>
<td>Massanari</td>
<td>adult ICU</td>
<td>decreased</td>
</tr>
<tr>
<td>1990</td>
<td>Simmons</td>
<td>adult ICU</td>
<td>no effect</td>
</tr>
<tr>
<td>1992</td>
<td>Doebbeling</td>
<td>adult ICU</td>
<td>decreased with one versus another hand hygiene product</td>
</tr>
<tr>
<td>1994</td>
<td>Webster</td>
<td>NICU</td>
<td>MRSA eliminated</td>
</tr>
<tr>
<td>1995</td>
<td>Zafar</td>
<td>nursery</td>
<td>MRSA eliminated</td>
</tr>
<tr>
<td>1999</td>
<td>Pittet</td>
<td>hospital</td>
<td>MRSA decreased</td>
</tr>
</tbody>
</table>

ICU = intensive care unit; NICU = neonatal ICU  
MRSA = methicillin-resistant *Staphylococcus aureus*.

Source: Pittet D: *Emerg Infect Dis* 2001;7:234-240

➢ Link to: [Improving hand hygiene](#)
Prevent Transmission

Step 12: Break the chain of contagion

Fact: Healthcare personnel can spread antimicrobial-resistant pathogens from patient to patient.

Actions:

- stay home when you are sick
- contain your contagion
- keep your hands clean
- set an example!

Link to: Health guidelines for healthcare personnel
Coming soon…new guidelines for hand hygiene
12 Steps to Prevent Antimicrobial Resistance: Hospitalized Adults

Clinicians hold the solution…
Take steps NOW to prevent antimicrobial resistance!

1. Get the catheters out
2. Get the catheters out
3. Target the pathogen
4. Access the experts
5. Practice antimicrobial control
6. Use local data
7. Treat infection, not contamination
8. Treat infection, not colonization
9. Know when to say “no” to vanco
10. Stop treatment when cured
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12. Contain your contagion

Prevent Transmission
Use Antimicrobials Wisely
Diagnose and Treat Effectively
Prevent Infection

CDC
Campaign to Prevent Antimicrobial Resistance

Funded by the CDC Foundation with support from Pharmacia Corporation, Premier, Inc., and the Sally S. Potter Endowment Fund.

Endorsed by the American Society for Microbiology, the Infectious Diseases Society of America, and the National Foundation for Infectious Diseases.

Clinicians hold the solution!

Link to: CDC Foundation
Protect patients…protect healthcare personnel…
promote quality healthcare!

Division of Healthcare Quality Promotion
National Center for Infectious Diseases

Link to: Division of Healthcare Quality Promotion Home Page