Antimicrobial Mindfulness

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Objectives

- Provide an overview on antimicrobial stewardship programs (ASP)
- Describe the role of antimicrobial stewardship and infection prevention in limiting antimicrobial resistance
- Discuss future objectives of stewardship especially in the presence of an increasing influx of multidrug resistant (MDR) organisms
“Microbes are educated to resist penicillin and a host of penicillin-fast organisms is bred out…
In such cases, the thoughtless person playing with penicillin is morally responsible for the death of the man who finally succumbs to infection with the penicillin-resistant organism. I hope this evil can be averted.”

Goals of Antimicrobial Stewardship

- Improve patient outcomes
- Optimize selection, dose and duration of Rx
- Reduce adverse drug events including secondary infection (e.g., C. difficile infection)
- Limit emergence of antimicrobial resistance
- Reduce length of stay
- Reduce health care expenditures

How best can we achieve these goals?

Initial IDSA/SHEA Antimicrobial Stewardship Guidelines

- A multidisciplinary ASP team should include an **ID physician and pharmacist** and other key stakeholders as determined by the institution
- Two core strategies were recommended
  - Prospective audit with intervention and feedback
  - Formulary restriction and preauthorization
- Other recommended strategies
  - Education
  - Order sets, guidelines and clinical pathways
  - De-escalation, dose optimization, IV to PO conversion

IDSA=Infectious Diseases Society of America
SHEA=Society for Healthcare Epidemiology of America
Antimicrobial Stewardship Team

Clin Infect Dis 2007;44:159-177
Antibiotic Exposure is Along a Continuum

Antibiotic Days: think of the patient’s total lifetime accumulation of antibiotics
ASP and Infection Prevention

- Work closely to review certain patient cases to identify where anti-infective agents could have been optimized
- Assist in identifying patients that may need the attention of an Infection Prevention Specialist
- Communicate anti-infective shortages
- Part of Infection Prevention meetings
- Example: C.difficile…
Estimated Annual U.S. Burden of C. difficile

- 453,000 CDI cases\(^1\)
  - 293,000 healthcare-associated
    - 107,000 hospital-onset
    - 104,000 nursing home-onset
    - 81,000 community-onset, healthcare-facility associated
  - 160,000 community-associated
    - 82% associated with outpatient healthcare exposure

Overall, 94% of CDI cases related to healthcare
- 29,000 deaths
- $4.8 billion in excess healthcare costs\(^2\)

Estimated U.S. Burden of CDI, According to the Location of Stool Collection and Inpatient Health Care Exposure, 2011.

CO-HCA: Community onset healthcare-associated
NHO: Nursing home onset
HO: Hospital onset

C. Difficile - Risk Factors

- Antibiotic exposure
  - Most important modifiable risk factor
- Hospitalization
  - ~ 2% colonized in general population but can be ~ 10x higher in hospitalized
- Advanced age
- Cancer chemotherapy
- GI surgery or procedures
- Gastric acid suppressive therapy (PPI use)

Human GI Microbiome

- Ecosystem of microbes in GI tract
- Most important mechanism against *C. difficile* disease
- Antibiotic exposure has a lasting impact on it
  - 85-90% of CDI occurs within 30 days of antibiotic use
  - CDI risk is 7-10x for following 3 months after antibiotics
- Concept of “collateral damage”

Lessa et al. NEJM 2015;372(9):825-834.
Clinical Presentation

- **Asymptomatic carriage**
  - <2-5% healthy adults
  - 20% in patients in hospital for over a week
- **Diarrhea without pseudomembranes**
- **Pseudomembranous colitis**
  - Abd pain, leukocytosis, fever
- **Fulminant colitis in ~3%**
  - Risk of perforation, megacolon, or death
Control in Healthcare

- Spores shed in environment need to be managed
  - Isolation (contact) of patients – ideally in own room
  - Effective early treatment to limit shedding
  - Hand hygiene with soap and water
    - Spores not affected by antimicrobial hand gels – BIG ISSUE!!
  - Effective environmental cleaning
    - Cleansing with 1:10 hypochlorite solution or 10% bleach
  - Don’t forget common use equipment and other objects
Antimicrobial Stewardship Role

- Judicious use of antimicrobials both in type and length
- At time of CDI diagnosis – re-evaluate need for non-CDI abx
- Assist in proper treatment of CDI
  - Realize ~15-25% relapse possible in following 2 months
- Possible restriction of some antimicrobial and PPI use
- In our facility, manage fecal microbiota transplantation
Formulary Restrictive Approach

- Require approval by ID physician or pharmacist
- Found to be highly effective in preventing CDI, especially in the geriatric population
- Longer interventions and those involving 3rd generation cephalosporins and quinolones more effective

Stewardship Effects of MDROs

- We know that antimicrobial use increases antimicrobial resistance over time
- However more difficult to demonstrate that stewardship has profound affect on resistance rates
  - Studies have numerous variables, numerous targets (ie. many MDROs), and not standardized & of limited duration
  - Populations are in constant flux

Wagner B et al. *Infect Control Hosp Epidemiol* 2014;35: 1209-28,
Fluoroquinolone Use and Resistance among Gram-Negative Isolates, 1993-2000

National ICU Surveillance Study

Neuhauser, et al. JAMA 2003; 289:885
Antimicrobial Use and Resistance Example in Oncology

Discontinuation of fluoroquinolone prophylaxis for 6 months

FQREC=fluoroquinolone-resistant E. coli

Kern WV. Eur J Clin Microbiol Infect Dis 2005;24:111-8
• First national snapshot of burdens and threat on this issue in U.S.
• The use of antibiotics is the single most important factor leading to antibiotic resistance
• Up to 50% of all antibiotics prescribed are not needed or are not optimally effective as prescribed
• Each year 2 million people acquire drug resistant bacteria directly resulting in an estimated 23,000 deaths

White House June 2015 Forum

NATIONAL ACTION PLAN FOR COMBATING ANTIBIOTIC-RESISTANT BACTERIA

MARCH 2015

UNIVERSITY OF SOUTH FLORIDA
Antibiotic Development: Dry Pipeline

Total Number of New Antibacterial Agents

- 0 2 4 6 8 10 12 14 16
- 1983-1987
- 1988-1992
- 1993-1997
- 1998-2002
- 2003-2007
- 2008-2012

ANTIBIOTIC DEVELOPMENT IS DWINDLING

Source: The Epidemic of Antibiotic-Resistant Infections. CID 2008;46 (15 January)
What we do clinically

Broad empiric coverage  \( \infty \)  Risk of Complications

Certainty of Diagnosis

Note that this is a dynamic process and should always be re-evaluated.
Challenges of Prescribing Antibiotics in Nursing Homes and SNFs

- How do prescribers make decisions about abx order?
  - Rely on others assessments; 67% ordered over phone

- Limited documentation of assessments
  - 43% of NH initiated antibiotic courses had no documentation of infection in medical record

- Data/ Labs – difficulty obtaining and interpreting to inform

- Other pressures – families, patient and other staff influence

IRRESPONSIBILITY

No Single Raindrop Believes it is to Blame for the Flood.

www.despair.com
Areas of High Yield to Reduce Resistance

- Asymptomatic bacteriuria and respiratory tract disease
- Do not culture open draining wounds – tells us what is colonized and tempts treatment
- Altered mental status not all due to infection – assess!
- Shorter courses reduce resistance and found still effective – urine, lungs, etc.
Factors that affect MDRO’s

- Patient Environment
- Colonized Patient
- Hand Hygiene
- Antimicrobial Stewardship

MDRO Infection
Elements for Success

- Individualizing ASP to our institution’s needs
- Effective communication
- Providing positive feedback to pharmacy and medical staff members
- Respecting those who want to practice autonomy in their respective area
  - Balance restrictive approach to autonomy of prescriber
ASP and Microbiology

- Antibiogram development and resistance trends
- Assist in evaluating certain patients to ensure optimal therapy
- Developing selective reporting of drugs in susceptibility panels
- Microbiology part of Antimicrobial Subcommittee
- Evaluating rapid diagnostics and how its use can impact patient care – culture independent pathogen detection – MALDI-TOF
Tools for ASP

- **Rapid Diagnostics**
  - Blood Culture Identification (BCID) Panel
    - 27 Targets
  - Respiratory Panel
    - 20 Targets
  - Gastrointestinal Panel
    - 21 Targets
  - CNS Panel
  - Pneumonia / LRTI Panel
    - pending

- Increasing number of panels available commercially
Two Approaches for Rapid Pathogen Detection in Blood

- Rapid identification and resistance detection in positive blood culture bottles – several kits available now or near future
- Rapid direct detection of pathogens directly from blood samples – no culture step – only 1 kit FDA cleared with at least 2 others in development
Rapid ID/Resistance from Positive BC Bottle – kits available / in development

- Luminex Verigene – GP and GN panels
- Biofire BCID – just one covering GP/GN
- iCubate GP (GN in trials now)
- Genmark – GP/GN/Fungus – CE cleared should be in trials soon in US
- Accelerate Pheno – uses FISH to ID pathogen and direct monitoring of growth to detect resistance
FilmArray Blood Culture Identification (BCID) Panel

The FilmArray Pouch and Analysis Report

**Simple:** Two minutes of hands-on time  
**Easy:** No precise measuring or pipetting required  
**Fast:** Turnaround time of about 1 hour  
**Comprehensive:** 27 target BCID panel
**FilmArray Blood Culture Identification (BCID) Panel**

### Gram + Bacteria
- *Enterococcus*
- *Listeria monocytogenes*
- *Staphylococcus*
  - *Staphylococcus aureus*
- *Streptococcus*
  - *Streptococcus agalactiae*
  - *Streptococcus pyogenes*
  - *Streptococcus pneumoniae*

### Gram – Bacteria
- *Acinetobacter baumannii*
- *Haemophilus influenzae*
- *Neisseria meningitidis*
- *Pseudomonas aeruginosa*

### Yeast
- *Candida albicans*
- *Candida glabrata*
- *Candida krusei*
- *Candida parapsilosis*
- *Candida tropicalis*

### Antibiotic Resistance
- *mecA - methicillin resistant*
- *vanA/B - vancomycin resistant*
- *KPC - carbapenem resistant*

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**BCID PANEL (IVD)**

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**BIOFIRE DIAGNOSTICS, INC.**

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**USF HEALTH**

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**UNIVERSITY OF SOUTH FLORIDA**
Evaluation of FilmArray BCID

- 206 blood culture bottles analyzed
  - 153/167 (91.6%) identified monomicrobial growth
    - 13/167 (7.8%) microorganisms not covered in panel
    - 6/167 (3.6%) FilmArray detected an additional microorganism compared to blood culture
    - 3/206 (1.5%) FilmArray was invalid
- Results were reproducible

Altun et al, Clinical Evaluation of the FilmArray BCID in Identification of Bacteria and Yeasts from Positive Blood Culture Bottles, JCM, 2013
### Respiratory Pathogens

#### Viruses
- Adenovirus
- Coronavirus HKU1
- Coronavirus NL63
- Coronavirus 229E
- Coronavirus OC43
- Human Rhinovirus/Enterovirus
- Influenza A
- Influenza A/H1
- Influenza A/H1-2009
- Influenza A/H3
- Influenza B
- Parainfluenza 1
- Parainfluenza 2
- Parainfluenza 3
- Parainfluenza 4
- Respiratory

#### Bacteria
- Campylobacter (jejuni, coli and upsaliensis)
- Clostridium difficile (toxin A/B)
- Plesiomonas shigelloides
- Salmonella
- Yersinia enterocolitica
- Vibrio (parahaemolyticus, vulnificus and cholerae)
- Vibrio cholerae
- Diarrheagenic E. coli/Shigella
  - Enterocaggregative E. coli (EAEC)
  - Enteropathogenic E. coli (EPEC)
  - Enterotoxigenic E. coli (ETEC) lt/st
  - Shiga-like toxin-producing E. coli (STEC) stx1/stx2
    - E. coli O157
  - Shigella/Enteroinvasive E. coli (EIEC)

#### Parasites
- Cryptosporidium
- Cyclospora cayetanensis
- Entamoeba histolytica
- Giardia lamblia

#### Viruses
- Adenovirus F 40/41
- Astrovirus
- Norovirus GI/GII
- Rotavirus A
- Sapovirus (I, II, IV and V)
Shortcomings of PCR Panels

- Lack of culture
  - There is a lack of sensitivity data
    - Thus an inability to assess for resistance other than mecA, VRE, KPC
  - Only gives information ‘Yes, I am here’
  - Still need to do “old style” microbiology for bacteria
Rapid Diagnostics: Mass Spectrometry

- Matrix-assisted laser desorption/ ionization time of flight mass spectrometry (MALDI-TOF-MS)
  - Identification is based on protein fingerprints
    - There is no culture so there is no added information available about sensitivity to drugs
    - Additional prep steps for yeasts compared to bacteria that are time consuming
    - Need stewardship to interpret the results and potentially de-escalate therapy as in all rapid diagnostics

Alam et al, Comparative evaluation of 1,3 β-d-glucan, mannan and anti-mannan antibodies and Candida species-specific snPCR in pts with candidemia, BMC ID, 2007
Evaluating ASPs

- Measuring the efficacy of an ASP is where a lot of programs struggle
- Limited literature on evaluating ASPs
- Financial
  - Opportunity to improve
  - Need to account for all costs
- Microbiological
  - Resistance trends can be measured
- Clinical outcomes

*Expert Rev Anti Infect Ther 2016; 14(6): 569-575*
Joint Commission Standards

- The hospital’s antimicrobial stewardship program uses organization-approved multidisciplinary protocols
  - Examples: fecal microbiota transplant protocol, C. difficile guidelines
- The hospital collects, analyzes, and reports data on its antimicrobial stewardship program
  - Feedback on resistance patterns and developing strategies to counter resistance
- The hospital takes action on improvement opportunities identified in its antimicrobial stewardship program
- In effect January 1st, 2017

https://www.jointcommission.org/topics/hai_antimicrobial_stewardship.aspx
CMS Guidelines

- The hospital has written policies and procedures whose purpose is to improve antibiotic use (antibiotic stewardship)

- The hospital has designated a leader (e.g., physician, pharmacist, etc.) responsible for program outcomes of antibiotic stewardship activities at the hospital

- The hospital’s antibiotic stewardship policy and procedures requires practitioners to document in the medical record or during order entry an indication for all antibiotics, in addition to other required elements such as dose and duration

CMS Guidelines

- The hospital has a formal procedure for all practitioners to review the appropriateness of any antibiotics prescribed after 48 hours from the initial orders (e.g., antibiotic time out)
- The hospital monitors antibiotic use (consumption) at the unit and/or hospital level
- Adding antimicrobial stewardship standards for acute care and critical access
- May be going into effect June 2019 but under review

How to change our approach to Stewardship?

- **Engrain it early → start during medical school**
  - World Health Organization (WHO) states that stewardship is an ‘integral part of antimicrobial resistance containment activities’

- **Antibiotics are prescribed by many persons**
  - Junior residents more so than senior residents
  - General physicians, Surgeons, OB-GYN
    - Only a small percentage of the whole is prescribed by Infectious Diseases

Medical Students’ Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers? L. Abbo et al., CID, June 2013
<table>
<thead>
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<th>perceptions and attitudes</th>
<th>all (n=311)</th>
<th>a (n=120)</th>
<th>b (n=66)</th>
<th>c (n=125)</th>
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<td>95%</td>
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<td>98%</td>
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<td>strong knowledge of antimicrobials is important in my environment</td>
<td>92%</td>
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<td>90%</td>
<td>92%</td>
<td>89%</td>
<td>88%</td>
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* x² test.
* Fisher exact test.
### Nosocomial, Non Urinary

| Gram Positive | Penicillin | Ampicillin | Oxacillin | Ceftriaxone | Cefotaxime | Meropenem | Gentamicin | Ciprofloxacin | Levofloxacin | Imipenem | Synercid | Vancomycin | Daptomycin* | Linezolid | Teicoplanin | Vancomycin | Tetracycline | Tigecycline | Trimethoprim/Sulfamethoxazole |
|---------------|------------|------------|-----------|-------------|------------|-----------|------------|--------------|--------------|-----------|---------|----------|------------|--------------|-----------|------------|------------|--------------|-------------|---------------------|
| Bacillus      | 30         | 20         | 30        | 34          | 57         | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Corynebacterium| 11         | 18         | 50        | 76          | 17         | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Coryne striatum| 116        | 3          | 9         | 34          | 8          | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Vanc Sens Ent. faecalis | 277     | 99         | 100       | 100         | 100        | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Vanc Res Ent. faecalis | 23      | 100        | 100       | 100         | 100        | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Vanc Sens Ent. fecium | 33       | 42         | 100       | 100         | 100        | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Vanc Res. Ent. faecium | 71       | 0          | 100       | 100         | 100        | 100       | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Beta Hem Strep A | 19       | 100        | 100       | 76          | 81         | 74        | 100        | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Beta Hem Strep B | 141      | 100        | 100       | 50          | 86         | 35        | 99         | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Staph. aureus MSSA | 586      | 25         | 100       | 99          | 91         | 79        | 56         | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Staph. aureus MRSA | 1050     | 0          | 100       | 93          | 64         | 88        | 9          | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Staph. epidermidis MSSSE | 169     | 20         | 100       | 91          | 80         | 96        | 47         | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Staph. epidermidis MRSE | 443      | 0          | 100       | 59          | 40         | 88        | 17         | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Staph. lugdunensis | 34        | 35         | 86         | 100         | 82         | 96        | 79         | 100           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Str. pneumonia | 30        | 50         | 95        | 84          | 44         | 50        | 87         | 53           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |
| Strep. anginosus | 71        | 99         | 73         | 100        | 100       | 82        | 69         | 76           | 100           | 100       | 100     | 100      | 100           |              |             |             |              |              |                     |

*Organisms with <100 isolates tested may not have statistically valid results. **Colistin and Daptomycin only tested on request. Number of isolates is low.
### Community Acquired, Non Urinary

<table>
<thead>
<tr>
<th>Organism</th>
<th>No. Isolates</th>
<th>PENICILLIN</th>
<th>AMPICILLIN</th>
<th>MOXACILLIN</th>
<th>CEFTRIAZONE</th>
<th>CEFOXITIN</th>
<th>IMPENEM</th>
<th>MEROPENEM</th>
<th>GENTAMICIN</th>
<th>CLINDAMYCIN</th>
<th>ERYTHROMYCIN</th>
<th>LEVOFLOXACIN</th>
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<th>SYNERcid</th>
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<th>DAPTOmycin*</th>
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<td>73</td>
<td>97</td>
<td>70</td>
<td>100</td>
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</table>

*Organisms with <100 isolates tested may not have statistically valid results. **Colistin and Daptomycin only tested on request. Number of isolates is low.*
“Respondents who referred to physicians or pharmacists and those who utilized IDSA guidelines, had statistically significantly higher knowledge scores compared to students who did not use those resources.”

<table>
<thead>
<tr>
<th>Resources</th>
<th>All</th>
<th>School A</th>
<th>School B</th>
<th>P Value*</th>
<th>Score n = 298</th>
<th>± SD</th>
<th>P Value**</th>
</tr>
</thead>
<tbody>
<tr>
<td>UpToDate</td>
<td>90%</td>
<td>88%</td>
<td>92%</td>
<td>.690</td>
<td>51%</td>
<td>0.180</td>
<td>.998</td>
</tr>
<tr>
<td>iPhone or smartphone application</td>
<td>88%</td>
<td>91%</td>
<td>88%</td>
<td>&lt;.0001</td>
<td>52%</td>
<td>0.178</td>
<td>.798</td>
</tr>
<tr>
<td>Hospital pharmacists</td>
<td>80%</td>
<td>70%</td>
<td>90%</td>
<td>.001</td>
<td>52%</td>
<td>0.183</td>
<td>.052</td>
</tr>
<tr>
<td>Non-infectious diseases physicians</td>
<td>80%</td>
<td>77%</td>
<td>84%</td>
<td>.369</td>
<td>52%</td>
<td>0.180</td>
<td>.057</td>
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<tr>
<td>Infectious diseases specialists</td>
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<td>71%</td>
<td>70%</td>
<td>.481</td>
<td>53%</td>
<td>0.179</td>
<td>.003</td>
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<tr>
<td>Medical journals</td>
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<td>50%</td>
<td>90%</td>
<td>.208</td>
<td>51%</td>
<td>0.179</td>
<td>.952</td>
</tr>
<tr>
<td>Peers (other students)</td>
<td>54%</td>
<td>52%</td>
<td>57%</td>
<td>.708</td>
<td>52%</td>
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<td>.653</td>
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<tr>
<td>Sanford guide</td>
<td>49%</td>
<td>40%</td>
<td>72%</td>
<td>&lt;.001</td>
<td>52%</td>
<td>0.189</td>
<td>.295</td>
</tr>
<tr>
<td>Infectious Diseases Society of America guidelines</td>
<td>29%</td>
<td>28%</td>
<td>24%</td>
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<td>55%</td>
<td>0.199</td>
<td>.013</td>
</tr>
<tr>
<td>Other guidelines by professional organizations</td>
<td>48%</td>
<td>36%</td>
<td>57%</td>
<td>.002</td>
<td>53%</td>
<td>0.173</td>
<td>.131</td>
</tr>
<tr>
<td>Textbooks or study guides</td>
<td>48%</td>
<td>53%</td>
<td>49%</td>
<td>.898</td>
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<td>0.178</td>
<td>.608</td>
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<td>Wikipedia</td>
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<td>56%</td>
<td>38%</td>
<td>&lt;.0001</td>
<td>40%</td>
<td>0.166</td>
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<tr>
<td>Pharmaceutical representatives</td>
<td>3%</td>
<td>6%</td>
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<td>.053</td>
<td>49%</td>
<td>0.175</td>
<td>.628</td>
</tr>
</tbody>
</table>

Abbreviation: SD, standard deviation.
* χ² test.
* Kruskal-Wallis test.
* Fisher exact test.

Medical Students' Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers? L. Abbo et al., CID, June 2013
Antibiotic resources our medical students are using ...

**Medical Students’ Perceptions and Knowledge about Antimicrobial Stewardship: How are We Educating our Future Prescribers?** L. Abbo et al., CID, June 2013

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**Table 3. Resources Used for Learning About Antimicrobial Prescribing and Antimicrobial Resistance (Percentage Who Often or Sometimes Use Source), and Mean Knowledge Score for Respondents Who Used the Resources Compared to Respondents Who Do Not Use Those Resources**

<table>
<thead>
<tr>
<th>Resources</th>
<th>All n = 305</th>
<th>School A n = 117</th>
<th>School B n = 64</th>
<th>School C n = 124</th>
<th>P Value*</th>
<th>All Mean Knowledge Score n = 298 ± SD</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>UpToDate</td>
<td>90%</td>
<td>89%</td>
<td>92%</td>
<td>89%</td>
<td>&lt;0.001</td>
<td>690 ± 51%</td>
<td>.018 .998</td>
</tr>
<tr>
<td>iPhone or smartphone application</td>
<td>83%</td>
<td>91%</td>
<td>67%</td>
<td>85%</td>
<td>&lt;0.001</td>
<td>52% ± 52%</td>
<td>.078 .998</td>
</tr>
<tr>
<td>Hospital pharmacists</td>
<td>80%</td>
<td>70%</td>
<td>71%</td>
<td>81%</td>
<td>.002</td>
<td>51% ± 51%</td>
<td>.078 .998</td>
</tr>
<tr>
<td>Non-infectious diseases physicians</td>
<td>80%</td>
<td>77%</td>
<td>78%</td>
<td>78%</td>
<td>.002</td>
<td>51% ± 51%</td>
<td>.078 .998</td>
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<tr>
<td>Infectious diseases specialists</td>
<td>65%</td>
<td>66%</td>
<td>63%</td>
<td>63%</td>
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<td>51% ± 51%</td>
<td>.078 .998</td>
</tr>
<tr>
<td>Medical journals</td>
<td>65%</td>
<td>66%</td>
<td>63%</td>
<td>63%</td>
<td>.002</td>
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<td>.078 .998</td>
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<tr>
<td>Peers (other students)</td>
<td>64%</td>
<td>62%</td>
<td>53%</td>
<td>53%</td>
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<td>53%</td>
<td>57%</td>
<td>.002</td>
<td>53% ± 53%</td>
<td>.078 .998</td>
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<tr>
<td>Textbooks or study guides</td>
<td>48%</td>
<td>52%</td>
<td>49%</td>
<td>48%</td>
<td>.002</td>
<td>51% ± 51%</td>
<td>.078 .998</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>41%</td>
<td>56%</td>
<td>38%</td>
<td>29%</td>
<td>&lt;0.001</td>
<td>49% ± 49%</td>
<td>.016 .035</td>
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<tr>
<td>Pharmaceutical representatives</td>
<td>7%</td>
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<td>3%</td>
<td>1%</td>
<td>&lt;0.001</td>
<td>49% ± 49%</td>
<td>.016 .035</td>
</tr>
</tbody>
</table>

---

“Students who reported using sources such as Wikipedia overall had lower knowledge scores.”

**USF HEALTH**

**UNIVERSITY OF SOUTH FLORIDA**
As a whole, how do we do rate with our antibiotic choices?

- Treatment indication of antibiotics, choice of antibiotic or duration of therapy is incorrect in up to ______ percentage of cases.
As a whole, how do we do rate with our antibiotic choices?

- Treatment indication of antibiotics, choice of antibiotic or duration of therapy is incorrect in up to _50%_ percentage of cases.
What is the primary purpose of Antimicrobial Stewardship?

- A. Institutional adherence to regulatory standards, such as the Joint Commission
- B. Reduce drug costs
- C. Improve patient outcomes
- D. Managing critical antibiotic shortages
Which of the following are key components to an ASP program?

- A. Pre-authorization of restricted antibiotics
- B. Prospective audit and feedback
- C. Antibiotic cycling
- D. All of the above
- E. A and B
Antibiotic Stewardship Programs Map

Percent of Hospitals with Antibiotic Stewardship Programs by State, 2015*

Nationally, 48.1% of all hospitals have stewardship programs (2,199 of 4,549); the national goal is 100% of hospitals by 2020.

*A hospital stewardship program is defined as a program following all 7 of CDC's Core Elements of Hospital Antibiotic Stewardship Programs.

Source: CDC's National Healthcare Safety Network (NHSN) Survey
Outpatient Antibiotic Prescriptions Map

Community Antibiotic Prescriptions per 1,000 Population by State — 2014

At least 30% of antibiotics prescribed in doctors’ offices, emergency departments and hospital clinics are unnecessary.*

Data sources: IMS Health Xponent 2014.

GET SMART
Know When Antibiotics Work

UNIVERSITY OF SOUTH FLORIDA
STRAIN OF 2000

YOU ARE THE NEXT CLASS OF DRUG-RESISTANT BACTERIA. AS HUMAN CONTINUE TO ABUSE AND OVERUSE ANTIBIOTICS, YOUR RANKS WILL SWELL. SO, GO OUT THERE AND MUTATE! AND REMEMBER: THAT WHICH DOES NOT KILL US MAKES US STRONGER!!!