Leveraging Implementation Science to Improve Antibiotic Stewardship in the Emergency Department: Evidence and Future Directions

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Why Antibiotic Stewardship?

• Inappropriate antibiotic use is a Medi-Cal PRIME quality metric for reimbursement

We got some grants

Alignment!

Patient Safety

Antibiotic Stewardship

Public Health

Infection Control

New National Estimate*

Each year, antibiotic-resistant bacteria and fungi cause at least an estimated:

- **2,868,700** infections
- **35,900** deaths
- **223,900** cases
- **12,800** deaths

*Clostridioides difficile** is related to antibiotic use and antibiotic resistance.
Stewardship in the ED

- Opportunity to focus on quality of care
- Nexus of inpatient and community
- Broad spectrum antibiotics often appropriate
  - Sepsis
  - Clinical pathways
- Antibiotic choice often continued in inpatient setting
Where Do We Want to Be?
Setting National Targets

47 million unnecessary antibiotic prescriptions per year

http://www.pewtrusts.org/~media/assets/2016/05/antibioticuseinoutpatientsettings.pdf;
Antibiotic prescribing per visit by outpatient setting — MarketScan, 2014

Challenges in the ED
May et al. Multisite Exploration of Clinical Decision Making for Antibiotic Use by Emergency Medicine Providers Using Quantitative and Qualitative Methods

1. Survey of 150 ED providers on KAB
2. IDI with 21 providers across 8 sites

Themes:
- Resource/environmental factors
- Access/quality of care received outside ED
- Patient-provider relationship
- Clinical inertia
- Local knowledge generation
How Do We Accomplish our Goals?

Core Elements of Outpatient Antibiotic Stewardship

**Commitment**
Demonstrate dedication to and accountability for optimizing antibiotic prescribing and patient safety.

**Action for policy and practice**
Implement at least one policy or practice to improve antibiotic prescribing, assess whether it is working, and modify as needed.

**Tracking and reporting**
Monitor antibiotic prescribing practices and offer regular feedback to clinicians, or have clinicians assess their own antibiotic prescribing practices themselves.

**Education and expertise**
Provide educational resources to clinicians and patients on antibiotic prescribing, and ensure access to needed expertise on optimizing antibiotic prescribing.
Approaches to stewardship in the ED

- Engage clinicians in existing ASP
- Multidisciplinary collaboration
- Education
- Guidelines and Clinical Pathways
- Peer comparison and other nudges
- Clinical decision support
- Rapid Diagnostics
- Focus on outpatients/care transitions
Clinician Education in Outpatient Setting

- Active programs
- Tailored educational messaging
- Multidisciplinary grand rounds
- Engagement of thought leaders from the specialty/setting
- Unlikely to lead to enduring changes without ongoing oversight
Setting-Specific Guidelines

- Clinical practice guidelines
- Opportunity to tailor based on individual susceptibilities and formulary
- Outpatient antibiograms
- Empiric Antibiotic guidelines
- Education and feedback
- Clinical pathways
Site Pharmacist

- Recent literature suggests pharmacists can be a key component of the clinical care team
- Facilitate appropriate prescribing
- Define outcome measures for outpatient prescribing
- Culture callbacks
Post-prescription Review

- Inpatient strategy
- Telephone follow-up
- Care coordination
- “Wait and see” approach
- Shorten duration of therapy
- Streamlining
- Need additional funds for outpatient settings
Targets for stewardship in the ED

- **Appropriate antibiotics**
  - Pneumonia, UTI, miscellaneous bacterial infections

- **No antibiotics**
  - Bronchitis, bronchiolitis, viral URI, influenza, non-suppurative otitis media, viral pneumonia, asthma, allergy

- **Test for bacterial infection**
  - Pharyngitis (all-cause)

- **Reduction in antibiotics to level of the lowest prescribing region**
  - Sinusitis, suppurative otitis media
  - All other remaining conditions
Clinician Education


- Pre-post study with educational intervention
  - 350 ED outpatients with uncomplicated UTI
- Primary outcome: guideline adherent empiric tx
- Appropriate empiric antibiotic tx increased from 44.8% to 83% (P < .001).
- Driven by increase in nitrofurantoin (cystitis) from 12% to 80% (P < .001).
- No change in 30-day repeat ED visits for UTI
Electronic Order Sets

- **Hecker et al, PLoS One 2014**
  - Electronic UTI order set then 2 months of feedback
  - Women 18-65 with UTI diagnosis
  - Outcomes: adherence, antibiotic use, accuracy
  - Adherence increased from 44% to 68% (period 1) to 82% (period 2) (P≤.015).
  - Rx of FQ for uncomplicated cystitis decreased from 44% to 14% (period 1) to 13% (period 2) (P<.001 and 0.7).
## Antibiograms

### Table 3: ED Antibiograms for *E. Coli* from Uncomplicated UTI Compared to All ED Antibiograms

<table>
<thead>
<tr>
<th>Antibiogram</th>
<th>Interpretation</th>
<th>Emergency Department, Uncomplicated UTI</th>
<th>Emergency Department, All Urine Cultures</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Tested</td>
<td>% positive</td>
<td>Tested</td>
</tr>
<tr>
<td>Ampicillin/Sulbactam</td>
<td>Non-susceptible</td>
<td>51</td>
<td>39.2</td>
<td>869</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>60.8</td>
<td>57.1</td>
</tr>
<tr>
<td>Cefazolin</td>
<td>Non-susceptible</td>
<td>53</td>
<td>13.2</td>
<td>877</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>86.8</td>
<td>89.5</td>
</tr>
<tr>
<td>Ceftriaxone</td>
<td>Non-susceptible</td>
<td>52</td>
<td>3.8</td>
<td>869</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>96.2</td>
<td>97.6</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>Non-susceptible</td>
<td>53</td>
<td>9.4</td>
<td>869</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>90.6</td>
<td>74.8</td>
</tr>
<tr>
<td>Nitro</td>
<td>Non-susceptible</td>
<td>51</td>
<td>3.9</td>
<td>866</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>96.1</td>
<td>91.7</td>
</tr>
<tr>
<td>TMP-SMX</td>
<td>Non-susceptible</td>
<td>53</td>
<td>26.4</td>
<td>869</td>
</tr>
<tr>
<td></td>
<td>Susceptible</td>
<td></td>
<td>73.6</td>
<td>66.4</td>
</tr>
</tbody>
</table>
How can improve our antibiotic prescribing practices?

- Identify effective interventions to improve outpatient antibiotic prescribing
- Adapt them to the local context
- Use rigorous implementation science methods
- Disseminate for broader uptake (scale and spread)
Model for Improvement

- What are we trying to accomplish?
- How will we know that a change is an improvement?
- What change can we make that will result in improvement?

Implementation Science

1. Diagnose Performance Gap
2. Based on Explanatory Theory
3. Evaluate Changes
4. Design Intervention
5. Based on Prescriptive Theory
6. Implement Intervention

Act
Plan
Study
Do
Background

- Changing healthcare landscape
- Implementation strategies need to be tested in common healthcare delivery models
  - implementation science expertise is lacking
  - providers accustomed to an environment of quality improvement and emphasis on value-based care
Changing Behavior

JAMA Internal Medicine
Original Investigation
Nudging Guideline-Concordant Antibiotic Prescribing
A Randomized Clinical Trial

Daniela Meeker, PhD; Tara K. Knight, PhD; Mark W. Friedberg, MD, MPP; Jeffrey A. Lindor, MD, MPH;
Noah J. Goldstein, PhD; Craig R. Fox, PhD; Alan Rothfield, MD; Guillermo Diaz, MD; Jason N. Doctor, PhD
# Two Distinct Cognitive Systems

<table>
<thead>
<tr>
<th>Automatic</th>
<th>Reflective</th>
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</thead>
<tbody>
<tr>
<td>Uncontrolled</td>
<td>Controlled</td>
</tr>
<tr>
<td>Effortless</td>
<td>Effortful</td>
</tr>
<tr>
<td>Associative</td>
<td>Deductive</td>
</tr>
<tr>
<td>Fast</td>
<td>Slow</td>
</tr>
<tr>
<td>Unconscious</td>
<td>Self-aware</td>
</tr>
<tr>
<td>Experience-based</td>
<td>Rule-based</td>
</tr>
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</table>
Evidence-Based Quality Improvement

- Educational methods — decisions based on knowledge
  - Guidelines
  - Clinical decision support

- Behavioral methods — decisions influenced by psychosocial factors
  - Communications training
  - Public commitments

- Mixed theoretical basis
  - Audit and feedback with comparisons to peers
  - Academic detailing (one-on-one education)
MITIGATE ANTIMICROBIAL STEWARDSHIP TOOLKIT

https://tinyurl.com/mitigatetoolkit
**EMERGENT THEMES FROM SEMI-STRUCTURED INTERVIEWS**

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Facilitators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient expectations for antibiotics</td>
<td>Provider education during resident didactics, nursing briefings, department meetings</td>
</tr>
<tr>
<td>Providers lack of knowledge of existing guidelines</td>
<td>Incorporation of patient education materials into the triage and discharge processes</td>
</tr>
<tr>
<td>Under-utilization of existing patient education materials</td>
<td>Routine display of bilingual patient education materials in triage areas and patient exam rooms</td>
</tr>
<tr>
<td>Maintaining awareness of the stewardship program over time</td>
<td>Systematic placement of stewardship material amongst provider spaces</td>
</tr>
</tbody>
</table>

**TRIANGULATION WITH SURVEY RESPONSES**

Antibiotics are most frequently overprescribed for:
- Acute Bronchitis
- Sinusitis
- Pharyngitis

Barriers to stewardship:
- Patient expectations (78%)
- Lack of clear guidelines (29%)
- Lack of access to guidelines (23%)

Preferred method of stewardship:
- Provision of guidelines (71%)
- Electronic decision support (52%)
- Provider education (37%)
- Individual feedback (19%)
Evidence

Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial

Daniella Meeker, PhD; Jeffrey A. Linder, MD, MPH; Craig R. Fox, PhD; Mark W. Friedberg, MD, MPP; Stephen D. Persell, MD, MPH; Noah J. Goldstein, PhD; Tara K. Knight, PhD; Juel W. Hay, PhD; Jason N. Doctor, PhD

JAMA Internal Medicine
Original Investigation
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Nudge: Social Norms

Electric Bill Example

Energy Used Last Month: 637 kWh
Electricity Bill: $22.82

Your Energy Use compared to your neighbors:

Clinician Feedback

Acute respiratory infections (ICD-10)
- Abx not appropriate (e.g. acute bronchitis)
- Abx sometimes appropriate (e.g. pharyngitis)

Antibiotics prescribed (RxNorm)

Modifying conditions (ICD-10)
- Comorbid conditions (COPD, HIV/AIDS)
- Other infections (UTI, pneumonia)
Dear Dr. X,

You were not a top performer in antibiotic stewardship for likely viral infections last week.

You wrote too many unnecessary prescriptions.

Based on your most recent activity, you wrote X prescriptions of Y acute respiratory infection cases that didn’t warrant antibiotics.

Sincerely,

The MITIGATE antibiotic stewardship team
Dear Dr. X,

Congratulations! You were a top performer in antibiotic stewardship for likely viral infections last month.

You were in the top 10% of providers.

Based on your most recent activity, you wrote X prescriptions of Y acute respiratory infection cases that didn’t warrant antibiotics.

Sincerely,
The MITIGATE antibiotic stewardship team
Nudge: Identifiability

Provider Education

Personalized Feedback

Patient Education

Department Feedback

Program Champion

Provider Commitment-Enhanced Patient Education

Results: SSTI stewardship

*Difference of -3.0 (-0.6, -5.3) days (95% CI adjusted for provider cluster effects)
Nudge: Consistency

...We know that giving is important to you, as you have given in the past:

<table>
<thead>
<tr>
<th>Last Donation</th>
<th>2017 Gift Amount</th>
<th>2018 Gift Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/27/2017</td>
<td>$100</td>
<td>$0</td>
</tr>
</tbody>
</table>

A Commitment to Our Patients about Antibiotics

Antibiotics only fight infections caused by bacteria. Like all drugs, they can be harmful and should only be used when necessary. Taking antibiotics when you have a virus can do more harm than good: you will still feel sick and the antibiotic could give you a skin rash, diarrhea, a yeast infection, or worse.

Your health is important to us. As your healthcare providers, we promise to provide the best possible treatment for your condition. If an antibiotic is not needed, we will explain this to you and will offer a treatment plan that will help. We are dedicated to prescribing antibiotics only when they are needed, and we will avoid giving you antibiotics when they might do more harm than good.

If you have any questions, please feel free to ask us.

Sincerely,
Public Commitment

“We need to talk about your flair”
<table>
<thead>
<tr>
<th>All-Setting Acute Care Modifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bilingual patient education posters, brochures and handouts from CDC Get Smart campaign materials</strong></td>
</tr>
<tr>
<td><strong>Provider public commitment flair (badges; pins) and signing of commitment logs</strong></td>
</tr>
<tr>
<td><strong>Monthly individualized provider feedback and peer comparison of antibiotic prescribing practices</strong></td>
</tr>
<tr>
<td><strong>Stewardship program education in monthly department meetings &amp; daily nurse briefings</strong></td>
</tr>
<tr>
<td><strong>Viral prescription pads &amp; discharge workstations supplied with educational handouts for patients to fit clinical workflow</strong></td>
</tr>
</tbody>
</table>
## Implementation Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Acute care examples</th>
<th>Behavioral Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provider education</strong></td>
<td>Staff meeting educational presentations on stewardship as patient safety, smartphone apps</td>
<td>Knowledge translation, injunctive social norm</td>
</tr>
<tr>
<td><strong>Patient education</strong></td>
<td>CDC GetSmart waiting room posters, Choosing Wisely brochures given at triage, viral prescriptions</td>
<td>Priming, managing expectations, injunctive social norm</td>
</tr>
<tr>
<td><strong>Provider Commitment</strong></td>
<td>Physician-worn “flair” (pens, pins, etc.) that is thematically consistent with the CDC GetSmart posters and brochures</td>
<td>Consistency w/ prior commitment professional self-image</td>
</tr>
<tr>
<td><strong>Physician champion</strong></td>
<td>Designated physician at each site who will lead provider education and be an advocate for antimicrobial stewardship</td>
<td>Accountability to peer leader</td>
</tr>
<tr>
<td><strong>Departmental Feedback</strong></td>
<td>Monthly aggregate of antibiotic prescribing practices for ARI from electronic health record data provided to departmental leadership</td>
<td>Hawthorne Effect; descriptive norm</td>
</tr>
<tr>
<td><strong>Provider feedback and education</strong></td>
<td>Case-based educational rounds with a stewardship consulting service, available by consultation for patient-related issues</td>
<td>Social learning, modeling behavior</td>
</tr>
<tr>
<td><strong>Peer-comparison using personalized Audit and Feedback</strong></td>
<td>Personalized monthly performance ranking receiving designation of being a “top performer” (top decile) or “not a top performer” for appropriate prescribing delivered by email* or provider dashboard</td>
<td>Descriptive social norms, professional self-image</td>
</tr>
<tr>
<td><strong>Electronic clinical decision support</strong></td>
<td>Provider dashboards, antibiotic justification during order entry, viral ARI order sets to facilitate supportive care measures</td>
<td>Descriptive social norms, injunctive norms, managing expectations</td>
</tr>
</tbody>
</table>
Reduction in Inappropriate Rx
Implementation outcomes

- **Acceptability**
  - 84% agree antibiotic stewardship is important
  - 10% believe stewardship interferes with usual practice

- **Fidelity**
  - 100% of interviews
  - 52.4% of pre-implementation surveys

- **Adoption**
  - 99% public commitment signatures
  - 92.6% display of public commitment flair
Emergency Department Encounters - Viral URI

Outpatient Antibiotic Stewardship
Limitations

- Sites all academically-affiliated and located in 2 states
  - Local context and culture will differ elsewhere
- Did not look at sustainment or harms
  - Other implementation theories exist that emphasize other aspects of practice change
- Toolkit is publicly available
- Testing for scale and spread
Trends of acute respiratory tract infection prescribing in rural urgent care setting
Trends of acute respiratory tract infection prescribing in rural urgent care setting
LESSONS LEARNED

- Nudges
  - Formal commitment (consistency)
  - Local champion (identifiability)
  - Comparisons (social norms)
- Clinician buy-in
  - Low hanging fruit
- Operational support
- Implementation science and QI =framework for evidence-based program implementation
ANY QUESTIONS?