Behavioral Economic Principles to Understand and Change Physician Behavior

NIH Collaboratory Grand Rounds

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Outline

- Antibiotic prescribing
- Behavioral science
- Preliminary behavioral interventions
- BEARI (Behavioral Economics/Acute Respiratory Infection) Trial
Background: Acute Respiratory Infections

- 10% of all ambulatory visits
- 44% of antibiotics

- Inappropriate antibiotic prescribing
  - Costs
  - Antibiotic-resistant bacteria
  - Changing the microbiome
  - Adverse drug events
Antibiotic Prescribing in the US

Figure. Antibiotic Prescribing for Acute Bronchitis in the United States by Site of Care, 1996-2010

- N = 3153 representing 31 million visits

Barnett and Linder. JAMA 2014
Antibiotic Prescribing in the US

- Adults with sore throat, 1997-2010
- N = 8191 representing 92 million visits

Antibiotic Prescribing

- 506 antibiotic prescriptions per 1000 people
  - 30% unnecessary
  - 50% of ARI prescribing unnecessary
- US: 833 per 1000 people
- Sweden: 388 → 250 per 1000 people

Original Investigation

Prevalence of Inappropriate Antibiotic Prescriptions Among US Ambulatory Care Visits, 2010-2011

Katherine E. Fleming-Dutra, MD; Adam L. Hersh, MD, PhD; Daniel J. Shapiro; Monina Bartoces, PhD; Eva A. Enns, PhD; Thomas M. File Jr, MD; Jonathan A. Finkelstein, MD, MPH; Jeffrey S. Gerber, MD, PhD; David Y. Hyun, MD; Jeffrey A. Linder, MD, MPH; Ruth Lynfield, MD; David J. Margolis, MD, PhD; Larissa S. May, MD, MSPH; Daniel Merenstein, MD; Joshua P. Metlay, MD, PhD; Jason G. Newland, MD, MEd; Jay F. Piccirillo, MD; Rebecca M. Roberts, MS; Guillermo V. Sanchez, MPH, PA-C; Katie J. Suda, PharmD, MS; Ann Thomas, MD, MPH; Teri Moser Woo, PhD; Rachel M. Zetts; Lauri A. Hicks, DO
Changing Behavior

• Limited success of prior interventions

• *Implicit model:* clinicians reflective, rational, and deliberate
  – “Educate” and “remind” interventions

• *Behavioral model:* decisions fast, automatic, influenced by emotion and social factors
  – Use cognitive biases
  – Appeal to clinician self-image
  – Consider social motivation
Imbalance in Factors Related to Antibiotic Prescribing

Factors Driving Antibiotic Prescribing: Immediate and Emotionally Salient
- Belief that a patient wants antibiotics
- Perception that it is easier and quicker to prescribe antibiotics than explain why they are unnecessary
- Habit
- Worry about serious complications and “just to be safe” mentality

Factors Deterring Antibiotic Prescribing: More Remote and Less Emotionally Salient
- Risks of adverse reactions and drug interactions
- Recognizing the need for antibiotic stewardship
- Desire to deter low-value care and decrease unnecessary health care spending
- Prefer to follow guidelines

Nudges Target Automatic Thinking

- **Nudge**: gentle, non-intrusive persuaders which influence choice in a certain direction
  - Different frames, default rules, feedback mechanisms, social cues
  - Can be ignored
  - A good nudge will only affect choice when there are not strong reasons for the decision
  - “Libertarian paternalism”
Original Investigation

Nudging Guideline-Concordant Antibiotic Prescribing
A Randomized Clinical Trial

Daniella Meeker, PhD; Tara K. Knight, PhD; Mark W. Friedberg, MD, MPP; Jeffrey A. Linder, MD, MPH;
Noah J. Goldstein, PhD; Craig R. Fox, PhD; Alan Rothfeld, MD; Guillermo Diaz, MD; Jason N. Doctor, PhD

IMPORTANCE "Nudges" that influence decision making through subtle cognitive mechanisms have been shown to be highly effective in a wide range of applications, but there have been few experiments to improve clinical practice.

OBJECTIVE To investigate the use of a behavioral "nudge" based on the principle of public commitment in encouraging the judicious use of antibiotics for acute respiratory infections (ARIs).
Dear Patient,

We want to give you some important information about antibiotics.

Antibiotics, like penicillin, fight infections due to bacteria that can cause some serious illnesses. But these medicines can cause side effects like skin rashes, diarrhea, or yeast infections. If your symptoms are from a virus and not from bacteria, you won’t get better with an antibiotic, and you could still get these bad side effects.

Antibiotics also make bacteria more resistant to them. This can make future infections harder to treat. This means that antibiotics might not work when you really need them. Because of this, it is important that you only use an antibiotic when it is necessary to treat your illness.

How can you help? Carefully follow your doctor’s instructions. You should or should not take antibiotics.

When you have a cough, sore throat, or other illness, the best possible treatments. If an antibiotic is necessary, your doctor will explain this to you and why.

Your health is very important to us. As your doctors, we promise to treat your illness in the best way possible. We are also dedicated to avoid prescribing antibiotics when they are likely to do more harm than good.

If you have any questions, please feel free to ask your doctor, nurse, or pharmacist.

Sincerely,

[Signatures]
Public Commitment: Methods

- Randomized 14 clinicians
  - Stratified by high and low-prescribing
- 48 week baseline
- 12 week intervention
- 954 non-antibiotic-appropriate ARI visits
Public Commitment: Results

Adjusted difference-in-differences: -20% (-6% to -33%)
CDC funded Replications: IDPH & NYSDH

PDSB Campaign Goals
- Increase provider and patient knowledge & provide resources about antibiotic resistance and use

Phase 1 Participation
- March 2015 → Present
  - 55 practices representing > 385 providers

CDC Core Elements Outpatient Antibiotic Stewardship (2017)

EU Draft Guidelines for Antibiotic Stewardship

The NYS Department of Health recently rolled out a "Get Smart Guarantee" poster for healthcare providers to pledge to only prescribe antibiotics when they are needed.
Original Investigation

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; Joel W. Hay, PhD; Jason N. Doctor, PhD

IMPORTANCE Interventions based on behavioral science might reduce inappropriate antibiotic prescribing.
CDS and HIT often Disappoint

- Electronic health records with clinical decision support
  - Touted as a solution to problems of medical safety, cost, and quality

- Many EHR/CDS implementations
  - Do not achieve expected improvements
  - Implicitly assume clinicians follow a standard economic/behavioral model
Specific Aim

• To evaluate 3 behavioral interventions to reduce inappropriate antibiotic prescribing for acute respiratory infections
  – 3 health systems using 3 different EHRs
Interventions

1. Suggested Alternatives
2. Accountable Justification
3. Peer Comparison
**Intervention 1: Suggested Alternatives**

**Medication:** Amoxicillin

**Found in Practice Favorites**
- AMOXICILLIN 2000 MG PO X1
- AMOXICILLIN 250 MG PO TID 7 day(s)
- AMOXICILLIN 500MG, 1 PO TID

**Found in Medication Dictionary**

<table>
<thead>
<tr>
<th>Type</th>
<th>Retail Copay</th>
<th>Medication</th>
<th>Route</th>
<th>Restrictions</th>
<th>Alternatives</th>
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<td>PO</td>
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</table>
Intervention 1: Suggested Alternatives
## Intervention 1: Suggested Alternatives

### BEARI Study -- Webpage Dialog

**Please select Principal ARI diagnosis:**

- Non-specific upper respiratory infection
- Sinusitis
- Pharyngitis
- Acute bronchitis
- Otitis media
- Influenza
- Pneumonia
- Other

![Screenshot of BEARI Study -- Webpage Dialog](image)

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**Northwestern Medicine**

Feinberg School of Medicine
Intervention 1: Suggested Alternatives

**Warning**
You are ordering: AMOXICILLIN

**Alert Message:**
Antibiotics are not generally indicated for non-specific upper respiratory infections. Please consider the following alternative prescriptions, treatments, and materials to help your patient.

**Alternatives**

**Over-the-counter medications**

**Decongestants**
- Oxymetazoline HCL (0.05 % SPRAY )
  2 SPRAY (0.05 % SPRAY ) NAS BID or PRN but no more frequently than every 6 hours. Do not use more than 3 days. Dispense: 1 Bottle(s) Refills: 0
- Pseudoephedrine (30 MG TABLET )
  60 MG (30 MG TABLET Take 2) PO Q6H PRN as needed for nasal congestion. Dispense: 50 Tablet(s) Refills: 0

**Antihistamines**
- Diphenhydramine ORAL (25 MG TABLET )
  25 MG (25 MG TABLET Take 1) PO Q6H PRN not to exceed 6 doses in 24 hours. Dispense: 24 Tablet(s) Refills: 0
- Loratadine (10 MG TABLET )
  10 MG (10 MG TABLET Take 1) PO QD PRN Dispense: 30 Tablet(s) Refills: 0
## Intervention 1: Suggested Alternatives

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<th>Medication</th>
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<td><strong>Cough suppressants and expectorants</strong></td>
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<td></td>
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<tr>
<td>Benzonatate (100 MG CAPSULE)</td>
<td>100 MG (100 MG CAPSULE Take 1) PO Q4H PRN for cough. Do not take more than 6 capsules in 1 day.</td>
<td>Dispense: 30 Capsule(s)</td>
<td>Refills: 0</td>
<td></td>
</tr>
<tr>
<td>Guaifenesin AC (100-10MG/5 LIQUID)</td>
<td>5 ML (100-10MG/5 LIQUID) PO Q4H PRN for cough</td>
<td>Dispense: 180 ML(s)</td>
<td>Refills: 0</td>
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<tr>
<td><strong>Bronchodilators</strong></td>
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<tr>
<td>Albuterol INHALER HFA (90 MCG HFA AER AD)</td>
<td>2 PUFF (90 MCG HFA AER AD) INH Q6H PRN for cough</td>
<td>Dispense: 1 Inhaler(s)</td>
<td>Refills: 0</td>
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</tbody>
</table>

**“Excuse from work” Patient Letter.**

Select patient's Days Off work: 4

- Save As Note
- Preview
- Print

Print patient educational materials.

- Preview
- Print

- If you still want to prescribe an antibiotic, please check the box
Intervention 2: Accountable Justification

Patient has asthma.
Interventions 1 and 2: Combined

Patient insists on antibiotics.
Intervention 3: Peer Comparison

“You are a Top Performer”
You are in the top 10% of clinicians. You wrote 0 prescriptions out of 21 acute respiratory infection cases that did not warrant antibiotics.

“You are not a Top Performer”
Your inappropriate antibiotic prescribing rate is 15%. Top performers' rate is 0%. You wrote 3 prescriptions out of 20 acute respiratory infection cases that did not warrant antibiotics.
Interventions: Summary

EHR-based Nudges
- Suggested Alternatives

Social Motivation
- Accountable Justification
- Peer Comparison
Methods: Practices and Randomization

47 Primary Care Practices

3 Health Systems, 3 EHRs
Los Angeles: 25
Boston: 22

18 Month Follow-Up
December 2012 – April 2014
Methods: Enrollment

• *Invited:* 355 clinicians

• *Enrolled:* 248 (70%)
  – Consent
  – Education
  – Practice-specific orientation to intervention
  – Honorarium
Methods: Primary Outcome

• **Antibiotic prescribing for non-antibiotic-appropriate diagnoses**
  – Non-specific upper respiratory infections
  – Acute bronchitis
  – Influenza

• **Excluded:** chronic lung disease, concomitant infection, immunosuppression

• **Data Sources:** EHR and billing data
Methods: Analysis

• **Piecewise hierarchical model**
  – Clinician and practice-level clustering
  – 18-month baseline period
  – 18-month intervention
  – Modeled differences in the trajectory of antibiotic prescribing starting at month zero
  – Evaluated interactions
## Results: Clinicians (N = 248)

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<tr>
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<th>Peer Comparison</th>
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<tr>
<td>%</td>
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<tr>
<td>Female</td>
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<td>Clinician Type</td>
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<td>81</td>
<td>80</td>
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<tr>
<td>PA or NP</td>
<td>19</td>
<td>21</td>
<td>19</td>
<td>20</td>
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<tr>
<td>Baseline Inappropriate Antibiotic Prescribing Rate</td>
<td>39</td>
<td>31</td>
<td>32</td>
<td>25</td>
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</table>
## Results: Visits (N = 16,959)

<table>
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<th></th>
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<tr>
<td>Age, mean</td>
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<td>47</td>
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<tr>
<td>%</td>
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<tr>
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<td>White</td>
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<tr>
<td>Latino</td>
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<td>Private insurance</td>
<td>60</td>
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</table>
Main Results: Suggested Alternatives

-5\% \quad p = 0.66
Main Results: Accountable Justification

-7%  p < .001
Main Results: Peer Comparison

-5%  p = <.001
Limitations

• Limited to enrollees

• Dependent on EHR and billing data

Strengths

• Randomized controlled trial

• Large size

• 3 different EHRs
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Persistence of Effects

Letters

RESEARCH LETTER

Effects of Behavioral Interventions on Inappropriate Antibiotic Prescribing in Primary Care 12 Months After Stopping Interventions

Inappropriate antibiotic prescribing contributes to antibiotic resistance and leads to adverse events.\(^1\) A cluster-randomized trial of 3 behavioral interventions\(^2\) intended to reduce inappropriate prescribing found that 2 of the 3 interventions were effective.\(^3\) This study examines the persistence of effects 12 months after stopping the interventions.

Methods | We randomized 47 primary care practices in Boston, Massachusetts, and Los Angeles, California, and

Results | There were 14,753 visits for antibiotic-inappropriate ARIs during the baseline period, 16,959 during the intervention period, and 7,489 during the postintervention period. During the postintervention period, the rate of inappropriate antibiotic prescribing decreased in control clinics from 14.2% to 11.8% (absolute difference, −2.4%); increased from 7.4% to 8.8% (absolute difference, 1.4%) for suggested alternatives (difference-in-differences, 3.8% [95% CI, −10.3% to 17.9%]; \(P = .55\)); increased from 6.1% to 10.2% (absolute difference, 4.1%) for accountable justification (difference-in-differences, 6.5 [95% CI, 4.2% to 8.8%]; \(P < .001\)); and increased from 4.8% to 6.3% (absolute difference, 1.5%) for peer comparison (difference-in-differences, 3.9% [95% CI, 1.1% to 6.7%]; \(P < .005\)) (Figure). During the postintervention pe-
Persistence: Accountable Justification

Linder. JAMA 2017
Persistence: Peer Comparison

Linder. JAMA 2017
Imbalance in Factors Related to Antibiotic Prescribing

Factors Driving Antibiotic Prescribing: Immediate and Emotionally Salient
- Belief that a patient wants antibiotics
- Perception that it is easier and quicker to prescribe antibiotics than explain why they are unnecessary
- Habit
- Worry about serious complications and “just to be safe” mentality

Factors Deterring Antibiotic Prescribing: More Remote and Less Emotionally Salient
- Risks of adverse reactions and drug interactions
- Recognizing the need for antibiotic stewardship
- Desire to deter low-value care and decrease unnecessary health care spending
- Prefer to follow guidelines

Summary: Behavioral Interventions

- **Doctors are people too**
- **Doctoring is an emotional, social activity**

- **Behavioral principles**
  - Decision fatigue
  - Pre-commitment
  - Accountable justifications
  - Peer comparison
Thank You

Questions? Conversation?

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