Applications of Behavioral Economics to Curtail Antibiotic Overuse

July 2016

Daniella Meeker, PhD
Disclosure

• I have no actual or potential conflict of interest in relation to this program or presentation.
Pretest Question 1

• Prescribers emulate the prescribing practices of peers.
  A. True
  B. False
Pretest Question 2

• How does decision fatigue impact prescribing decisions?
  A. The ability to make deliberative decisions or resist ineffective prescribing habits may deplete over the course of a shift
  B. Prescribers who are sleep deprived make worse decisions
  C. Prescription behavior is consistent over the course of a shift
  D. None of the above
Pretest Question 3

• Personal and public commitments are more effective than provider education.
  A. True
  B. False
Pretest Question 4

- Practitioners accurately predict the effectiveness of interventions designed to reduce prescribing
  A. True
  B. False
Outline

• Background on changing behavior
• Order set partitioning
• Pre-commitment
• BEARI Trial
  – Suggested alternatives
  – Accountable Justification
  – Peer comparison
Changing Behavior

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

• *Behavioral model*: decisions fast, automatic, influenced by emotion and social factors
  – Cognitive bias
  – Appeal to clinician self-image
  – Consider social motivation
Cognitive Systems

1. Automatic
2. Reflective
## Two Distinct Cognitive Systems

<table>
<thead>
<tr>
<th>Automatic</th>
<th>Reflective</th>
</tr>
</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>
</tbody>
</table>
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
Overview

1. Interface Design Effects
2. Decision Fatigue
3. Public Commitment
4. Peer Accountability
5. Peer Comparisons
Interface Design Effects in Wine Selection

How Subjective Grouping of Options Influences Choice and Allocation: Diversification Bias and the Phenomenon of Partition Dependence

Craig R. Fox
University of California at Los Angeles

Rebecca K. Ratner
University of North Carolina at Chapel Hill

Daniel S. Lieb
Duke University
Nudging Physician Prescription Decisions by Partitioning the Order Set: Results of a Vignette-Based Study

David Tannenbaum, PhD¹, Jason N. Doctor, PhD², Stephen D. Persell, MD, MPH³, Mark W. Friedberg, MD, MPP⁴.⁵.⁸, Daniella Meeker, PhD⁶, Elisha M. Friesema, BA³, Noah J. Goldstein, PhD⁷, Jeffrey A. Linder, MD, MPH⁵.⁸, and Craig R. Fox, PhD⁷

¹UCLA Anderson School of Management, Los Angeles, CA, USA; ²Leonard D. Schaeffer Center for Health Policy and Economics, University of Southern California, Los Angeles, CA, USA; ³Division of General Internal Medicine and Geriatrics, Center for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA; ⁴RAND, Boston, MA, USA; ⁵Harvard Medical School, Boston, MA, USA; ⁶Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA; ⁷UCLA Anderson School of Management, Department of Psychology, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA; ⁸Division of General Medicine and Primary Care, Brigham and Women’s Hospital, Boston, MA, USA.
Interface Design: Partitioning

Acute Bronchitis

OTC medications visually grouped

Of the drug choices below, please indicate which drugs you would choose in treating this patient. You may select up to three options.

- □ albuterol inhaler
- □ an antibiotic of your choice
- □ robitussin with codeine
- □ tessalon perles

Over-the-counter drugs:
- □ cough lozenge  □ cough spray  □ cough syrup
Interface Design: Partitioning

Acute Bronchitis
Prescription medications visually grouped

Of the drug choices below, please indicate which drugs you would choose in treating this patient. You may select up to three options.

- cough lozenge
- cough spray
- cough syrup

Prescription drugs:
- albuterol inhaler
- an antibiotic of your choice
- robitussin with codeine
- tessalon merles
- 84 primary care clinicians

- 7 vignettes

- Randomized (aggressive grouped? Y/N)
  - Rx/OTC grouped
  - Broad/Narrow Spectrum grouped

- Also randomized order of vignettes and positioning of grouped items

- Overall, 12% decrease in choosing aggressive treatment when grouped (p < .01)
Overview

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Extraneous factors in judicial decisions

Shai Danziger\textsuperscript{a,1}, Jonathan Levav\textsuperscript{b,1,2}, and Liora Avnaim-Pesso\textsuperscript{a}

\textsuperscript{a}Department of Management, Ben Gurion University of the Negev, Beer Sheva 84105, Israel; and \textsuperscript{b}Columbia Business School, Columbia University, New York, NY 10027

Edited* by Daniel Kahneman, Princeton University, Princeton, NJ, and approved February 25, 2011 (received for review December 8, 2010)

Are judicial rulings based solely on laws and facts? Legal formalism holds that judges apply legal reasons to the facts of a case. The two-page board receives 48% of all appeals requests in the country. The proportion of favorable decisions varies with the ordinal position of the case. The dotted line represents the baseline proportion of favorable decisions.
Decision Fatigue in Clinical Orders

Prescribing as the day wears on

JAMA – Internal Medicine, 174, 2029-2031, 2014.
Replication: Athena Research

Antibiotic prescriptions over the course of a day

SOURCE: athenaResearch

https://insight.athenahealth.com/expert-forum-decision-fatigue-antibiotics/
Overview

1. Interface Design Effects
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3. Public Commitment
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5. Peer Comparisons
Public Commitment as a Motivator for Weight Loss

Prashanth U. Nyer
Chapman University

Stephanie Dellande
University of New Orleans

Figure 2. The effect of public commitment on weight loss.

Meals and Miles
Thursday

I'm running 8 miles on Saturday and riding my bike 50 miles on Monday. Hoping if I put these things out there, that they will actually happen. :)

State your own workout goals below. Let's help hold each other accountable through the holiday weekend.
Meeker D, Knight TK, Friedberg MW, Linder JA, Goldstein NJ, Fox CR, Rothfeld A, Diaz G, Doctor JN.
Safe Antibiotic Use:  
A Letter From Your Medical Group

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 virus-related symptoms, you should not take antibiotics. The doctor will explain this to you, and they will give you other treatments.

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]
Results: Public commitment

![Bar chart showing public commitment percentages]

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Poster Condition</th>
<th></th>
<th>Control Condition</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Final Measurement</td>
<td>Baseline</td>
<td>Final Measurement</td>
</tr>
<tr>
<td>Inappropriate prescribing rate, % (95% CI)</td>
<td>43.5 (38.5 to 49.0)</td>
<td>33.7 (25.1 to 43.1)</td>
<td>42.8 (38.1 to 48.1)</td>
<td>52.7 (44.2 to 61.9)</td>
</tr>
<tr>
<td>Absolute percentage change, baseline to final</td>
<td>-9.8 (0.0 to -19.3)</td>
<td></td>
<td></td>
<td>9.9 (0.0 to 20.2)</td>
</tr>
<tr>
<td>measurement (95% CI)</td>
<td></td>
<td>(95% CI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference in differences between poster</td>
<td></td>
<td>-19.7 (-5.8 to -33.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>condition and control (95% CI)</td>
<td></td>
<td>b</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviation: ARI, acute respiratory infection.

*a* Adjusted for demographic characteristics and insurance status.

b* P*=.02 for the difference.

Overview

1. Interface Design Effects
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5. Peer Comparisons
Effect of Behavioral Interventions on Inappropriate Antibiotic Prescribing Among Primary Care Practices: A Randomized Clinical Trial

Daniella Meeker, PhD; Jeffery 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
Pragmatic Randomized Trial

Evaluate 3 interventions based on behavioral economics to reduce inappropriate antibiotic prescribing for acute respiratory infections.
Interventions

1. Suggested Alternatives (Traditional BPA)
2. Peer Accountability
3. Peer Comparison
Intervention 1: Suggested Alternatives

Allergies: ACE Inhibitors - Angioedema, Rash / Morphine - Dystonia

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:
- AMOXICILLIN
- AMOXICILLIN EXTENDED RELEASE
- AMOXICILLIN/CLAV SUSP 400 MG/57 MG (5 ML)
- AMOXICILLIN/CLAV ACID 250/125 (AMOX/CLAV ACID ...
- AMOXICILLIN/CLAV ACID 500/125 (AMOX/CLAV ACID ...
- AMOXICILLIN/CLAV ACID 875/125

Alternatives

Unknown
No Insurance Found
Intervention 1: Suggested Alternatives

Are you prescribing this antibiotic for an acute respiratory infection (ARI)?

[Yes] [No] [Cancel]
Intervention 1: Suggested Alternatives

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

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

Patient has asthma.

EHR System: Epic
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
  - Accountable Justification

- **Social Motivation**
  - Peer Comparison
Physician Intervention Design Preferences

Consider each of the following Choice pairs. Please select the version most likely to reduce your ARI antibiotic prescribing. You may only indicate one choice per pair.

<table>
<thead>
<tr>
<th>Choice A</th>
<th>Choice B</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHR Alternative Prescribing Screen</td>
<td>ON</td>
</tr>
<tr>
<td>Required Justification Note</td>
<td>OFF</td>
</tr>
<tr>
<td>Peer Performance Feedback</td>
<td>ON</td>
</tr>
<tr>
<td>Pay for Performance</td>
<td>$100/month</td>
</tr>
<tr>
<td>Additional ARI Therapy Explanation Time</td>
<td>5 minutes per visit</td>
</tr>
</tbody>
</table>

We will now give you 10 choice pairs and ask you to indicate your choice preference for each pair sequentially. Please select the version most likely to reduce your ARI antibiotic prescribing.
Physicians believe traditional alerts will be as effective as $1400 P4P

<table>
<thead>
<tr>
<th>Willingness to Pay</th>
<th>Monthly</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>🌟🌟🌟🌟🌟 Suggested Alternatives</td>
<td>-$120.52</td>
<td>-$1,446.28</td>
</tr>
<tr>
<td>🌟🌟🌟🌟 Peer Accountability</td>
<td>$12.98</td>
<td>$155.81</td>
</tr>
<tr>
<td>🌟🌟🌟 Peer Comparison</td>
<td>-$73.84</td>
<td>-$886.09</td>
</tr>
<tr>
<td>🌟🌟 Additional Time</td>
<td>-$13.55</td>
<td>-$162.61</td>
</tr>
</tbody>
</table>

…and they are willing to pay $150/year to avoid peer accountability interventions.
Methods: Practices and Randomization

47 Primary Care Practices
3 Health Systems, 3 EHRs
Los Angeles: 25
Boston: 22

Randomization: Blocked by Region

None    SA    AJ    PC    SA AJ    SA PC    AJ PC    SA AJ PC

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

• **Trajectory Analysis:** Piecewise generalized linear model with a knot at month 0
  – 18-month baseline + 18-month intervention
  – Model testing to evaluate interaction effects

• **Sensitivity Analysis:** Simple Difference in Differences (DD)
  – Marginal probabilities predicted from DD
### Results: Clinicians (N = 248)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Suggested Alternatives</th>
<th>Accountable Justification</th>
<th>Peer Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean</td>
<td>47</td>
<td>49</td>
<td>48</td>
<td>48</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>48</td>
<td>68</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Clinician Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>81</td>
<td>79</td>
<td>81</td>
<td>80</td>
</tr>
<tr>
<td>PA or NP</td>
<td>19</td>
<td>21</td>
<td>19</td>
<td>20</td>
</tr>
</tbody>
</table>
### Results: Visits (N = 16,959)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Suggested Alternatives</th>
<th>Accountable Justification</th>
<th>Peer Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean</td>
<td>49</td>
<td>47</td>
<td>48</td>
<td>46</td>
</tr>
<tr>
<td>%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>65</td>
<td>70</td>
<td>66</td>
<td>68</td>
</tr>
<tr>
<td>White</td>
<td>88</td>
<td>86</td>
<td>88</td>
<td>87</td>
</tr>
<tr>
<td>Latino</td>
<td>35</td>
<td>32</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>Private insurance</td>
<td>60</td>
<td>59</td>
<td>58</td>
<td>58</td>
</tr>
</tbody>
</table>
Main Results: Suggested Alternatives (Traditional BPA)

Physician Rating: ★★★★★

-5.0% \ p = 0.66
Main Results: Peer Comparison

Physician Rating: ★★★☆☆☆

-5.2%  p = <.001
Main Results: Accountable Justification

Physician Rating: ★★★★★

-7.0\% \quad p < .001
<table>
<thead>
<tr>
<th>Limitations</th>
<th>Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limited to enrollees</td>
<td>• Randomized controlled trial</td>
</tr>
<tr>
<td>• Dependent on EHR and billing data</td>
<td>• Large size</td>
</tr>
<tr>
<td></td>
<td>• 3 different EHRs</td>
</tr>
</tbody>
</table>
Conclusions and Implications

- Physicians are people too
- Traditional CDS the least effective
- Social motivation appears effective
- Participatory design for QI may not yield desired results…
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  Hannah Valino
Thank You

Questions?
Post-test Question 1

- Prescribers emulate the prescribing practices of peers.

  A. True
  B. False
Post-test Question 2

• How does decision fatigue impact prescribing decisions?
  A. The ability to make deliberative decisions or resist ineffective prescribing habits may deplete over the course of a shift
  B. Prescribers who are sleep deprived make worse decisions
  C. Prescription behavior is consistent over the course of a shift
  D. None of the above
Post-test Question 3

• Personal and public commitments are more effective than provider education.
  
  A. True
  B. False
Post-test Question 4

• Practitioners accurately predict the effectiveness of interventions designed to reduce prescribing
  A. True
  B. False