Behavioral insights to improve healthcare quality
Jason N. Doctor, Ph.D.
Associate Professor,
Department of Pharmaceutical & Health Economics
USC School of Pharmacy
Director of Health Informatics,
Leonard D. Schaeffer Center for Health Policy & Economics

Daniella Meeker, Ph.D.
Assistant Professor,
Departments of Preventive Medicine & Pediatrics
USC Keck School of Medicine
Director of Clinical Research Informatics,
Southern California Clinical Translational Sciences Institute
Overview

Applications of Behavioral Economics to curtail inappropriate antibiotic prescribing in primary care

Real World Evidence and Randomized Pragmatic Trials
ex·ter·nal·i·ty
ˌekstərˈnalədē/
noun
ECONOMICS

1. (negative) a type of behavior that imposes costs on other parties that are not taken into account when first making a decision
**internality**

*Inˈtərˌnalədē/
*noun*

**BEHAVIORAL ECONOMICS**

1. (negative) a type of behavior that imposes costs on a person in the long-run that are not taken into account when first making a decision.
What policies can improve the quality of decisions that are produced in healthcare?
Behavioral Science & Policy Timeline

2008
Book “Nudge” by Thaler & Sunstein

Research

Nudge

2010
United Kingdom Nudge Unit Formed

UK BIT

2012

White House Nudge Unit

2014

WH SBST

Unstable Preferences:
Self-control problems
Social norms
Heuristics & Biases
Behavioral Insights

Decision Fatigue
Decision making gets worse with repeated decisions.

Choice Partitioning
We spread our choices over salient consumption options.

Public Commitments
Commitments bind our future self to desires our present self wants to fulfill.

Social Norms
We look to others for how we should act.

Justifications
We want others to approve of our behavior.
1. Decision Fatigue

Decision making gets worse with repeated decisions
If you have to force yourself to do something you are less willing or able to exert self-control when the next challenge comes around. — Daniel Kahneman
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. However, the two panels here (see figure) illustrate that 29.3% of all panel decisions in the courts are not based solely on legal reasons. Instead, judges are influenced by extraneous factors, such as the political affiliation of the parties involved, the ideological stance of the judge, and the social status of the parties. These factors can significantly impact the outcome of a case, even when legal reasons appear to be the primary drivers of the decision.
12.6% of outpatient visits result in an antibiotic prescription

50% of these are inappropriate

34,000,000 inappropriate outpatient prescriptions per year
Time of Day and the Decision to Prescribe Antibiotics

- Antibiotics sometimes indicated (n = 7544)
- Overall (n = 21867)
- Antibiotics never indicated (n = 14323)
Replication: Athena Research

Antibiotic prescriptions over the course of a day

Antibiotic Prescribing Rate

- 75%
- 70%
- 65%
- 60%
- 55%

Appointment Number

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

Average Prescribing Rate

SOURCE: athenaResearch

https://insight.athenahealth.com/expert-forum-decision-fatigue-antibiotics/
2. Choice Partitioning

People spread their choices over salient consumption options
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

![Graph showing percentage of grapes and regions selected](image)
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
Study
84 primary care clinicians

7 vignettes

Randomized (aggressive or nonaggressive grouped together)

Also randomized order of vignettes and positioning of grouped items

Overall, 12% decrease in choosing aggressive treatment when grouped (p < .01)
3. Public Commitment

Commitments bind the future self to desires the present self wants to fulfill.
Public Commitment

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.
Public Commitment

JAMA Internal Medicine
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
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 cold symptoms, the best possible treatments. If an antibiotic is not appropriate, your doctor will explain this to you.

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]

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.

El Uso Seguro de Antibioticos:
Una Carta de su Grupo Médico

Estimado Paciente:

Queremos compartir información importante con usted sobre los antibióticos.

Los antibióticos como la penicilina ayudan a combatir infecciones debido a bacterias que pueden causar serias enfermedades. Pero estas medicinas también tienen efectos secundarios como erupciones de la piel, diarrea, o infecciones por hongos de levadura. Si sus síntomas son debidos a un virus y no por una bacteria, no se mejorará con un antibiótico, y usted aún puede obtener estos efectos secundarios no deseados.

Los antibióticos también pueden hacer la bacteria más resistente a ellas. Esto hará que infecciones en el futuro sean más difíciles de tratar. Eso significa que los antibióticos no trabajaran cuando ustedes en realidad necesitan que funcionen. Por este importante, nosotros prometemos evitar antibióticos cuando sean probable de hacer más daño que bien.

Si tiene cualquier pregunta, pregúntele a su doctor, enfermera, o farmacéutico.

Atentamente,
Results: Public commitment

![Bar chart showing commitment vs control]

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Poster Condition</th>
<th>Control Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></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>
</tr>
<tr>
<td>Absolute percentage change, baseline to final measurement (95% CI)</td>
<td>−9.8 (0.0 to −19.3)</td>
<td></td>
</tr>
<tr>
<td>Difference in differences between poster condition and control (95% CI)</td>
<td></td>
<td>−19.7 (−5.8 to −33.04)$^b$</td>
</tr>
</tbody>
</table>

Abbreviation: ARI, acute respiratory infection.

$^a$ Adjusted for demographic characteristics and insurance status.

$^b$ $P$=.02 for the difference.

4. & 5. Social Norms & Justifications

We look to others for how we should act. We want others to approve of our behavior.
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
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
Intervention 1: Suggested Alternatives

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

[Yes]  [No]  [Cancel]
Intervention 1: Suggested Alternatives
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>Medication Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cough suppressants and expectorants</strong></td>
<td>☐ Benzonatate (100 MG CAPSULE) 100 MG (100 MG CAPSULE Take 1) PO Q4H 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) 5 ML (100-10MG/5 LIQUID) PO Q4H PRN for cough Dispense: 180 ML(s) Refills: 0</td>
</tr>
<tr>
<td><strong>Bronchodilators</strong></td>
<td>☐ Albuterol INHALER HFA (90 MCG HFA AER AD) 2 PUFF (90 MCG HFA AER AD) INH Q6H PRN 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: 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

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

• 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>
</tr>
<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><strong>Age, mean</strong></td>
<td>49</td>
<td>47</td>
<td>48</td>
<td>46</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>65</td>
<td>70</td>
<td>66</td>
<td>68</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>88</td>
<td>86</td>
<td>88</td>
<td>87</td>
</tr>
<tr>
<td><strong>Latino</strong></td>
<td>35</td>
<td>32</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td><strong>Private insurance</strong></td>
<td>60</td>
<td>59</td>
<td>58</td>
<td>58</td>
</tr>
</tbody>
</table>
Main Results: Suggested Alternatives

\[ p = 0.88 \]
Main Results: Accountable Justification

$p < .001$
Main Results: Peer Comparison

\[ p = <.001 \]
Persistence

• Evaluated prescribing for 12 months after interventions were turned off
• Difference of differences comparing 18-month treatment period to 12-month follow-up period
## Intervention Persistence

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention</th>
<th>Intervention</th>
<th>Post-intervention</th>
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<tbody>
<tr>
<td>% antibiotic prescribing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suggested alternatives</td>
<td>22</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Accountable justifications</td>
<td>23</td>
<td>5</td>
<td>8</td>
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<tr>
<td>Peer comparison</td>
<td>20</td>
<td>4</td>
<td>5</td>
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<tr>
<td>Limitations</td>
<td>Strengths</td>
<td></td>
<td></td>
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<tr>
<td>-----------------------------------</td>
<td>----------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limited to enrollees</td>
<td>Randomized controlled trial</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependent on EHR and billing data</td>
<td>Large size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 different EHRs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions and Implications

- *Social motivation appears effective*
- *Interventions show durable effects post-intervention*
Future: Replication, Dissemination, and Scaling
CDC funded Replications: IDPH & NYSDH

**PDSB Campaign Goals**

- Increase **provider and patient knowledge** & provide **resources** about antibiotic resistance and use

**Phase I 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.
pSCANNER Network - Connecting 21M patient’s EHR Data with outcomes and health services researchers

- 5 University of California Medical Centers
- Cedars Sinai
- Pacific NW Rural Health Practice-Based Research Network
- Los Angeles Department of Health Services
- 5 multi-site FQHCs
- Children’s Hospital of Los Angeles
- Keck Medicine of USC
What kind of data?

Electronic health records
Medical claims
Health information exchange
Patient reported outcomes
What are the data uses?

- Quality measurement and reporting
- Observational research
- Clinical trials
- Patient surveys
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Thank you!

Questions?

You can find me at:
@jn_doctor
jdoctor@usc.edu