# 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

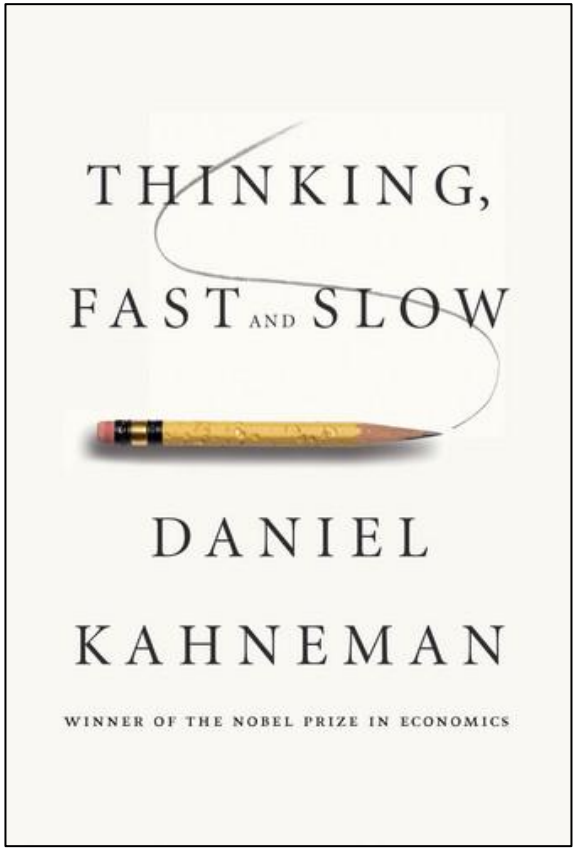
- Background on changing behavior
- Order set partitioning
- Pre-commitment
- BEARI Trial
  - Suggested alternatives
  - Accountable Justification
  - Peer comparison

# 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

| Automatic | Reflective |
| --- | --- |
| Uncontrolled | Controlled |
| Effortless | Effortful |
| Associative | Deductive |
| Fast | Slow |
| Unconscious | Self-aware |
| Experience-based | Rule-based |

# 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

Journal of Experimental Psychology: General
2005, Vol. 134, No. 4, 538–551

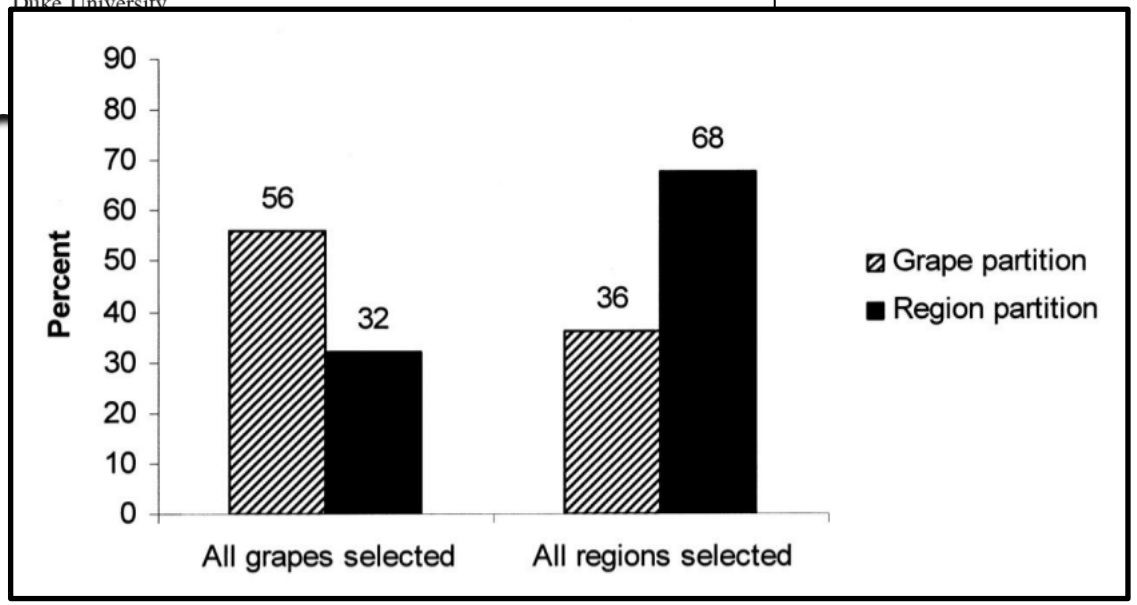
Copyright 2005 by the American Psychological Association
0096-3445/05/$12.00 DOI: 10.1037/0096-3445.134.4.538

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



# Interface Design Effects in Clinical Decision Support

## Nudging Physician Prescription Decisions by Partitioning the Order Set: Results of a Vignette-Based Study

*David Tannenbaum, PhD[1], Jason N. Doctor, PhD[2], Stephen D. Persell, MD, MPH[3], Mark W. Friedberg, MD, MPP[4,5,8], Daniella Meeker, PhD[6], Elisha M. Friesema, BA[3], Noah J. Goldstein, PhD[7], Jeffrey A. Linder, MD, MPH[5,8], and Craig R. Fox, PhD[7]*

[1]UCLA Anderson School of Management, Los Angeles, CA, USA; [2]Leonard D. Schaeffer Center for Health Policy and Economics, University of Southern California, Los Angeles, CA, USA; [3]Division of General Internal Medicine and Geriatrics, Center for Healthcare Studies, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA; [4]RAND, Boston, MA, USA; [5]Harvard Medical School, Boston, MA, USA; [6]Department of Preventive Medicine, Keck School of Medicine, University of Southern California, Los Angeles, CA, USA; [7]UCLA Anderson School of Management, Department of Psychology, David Geffen School of Medicine at UCLA, Los Angeles, CA, USA; [8]Division 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*

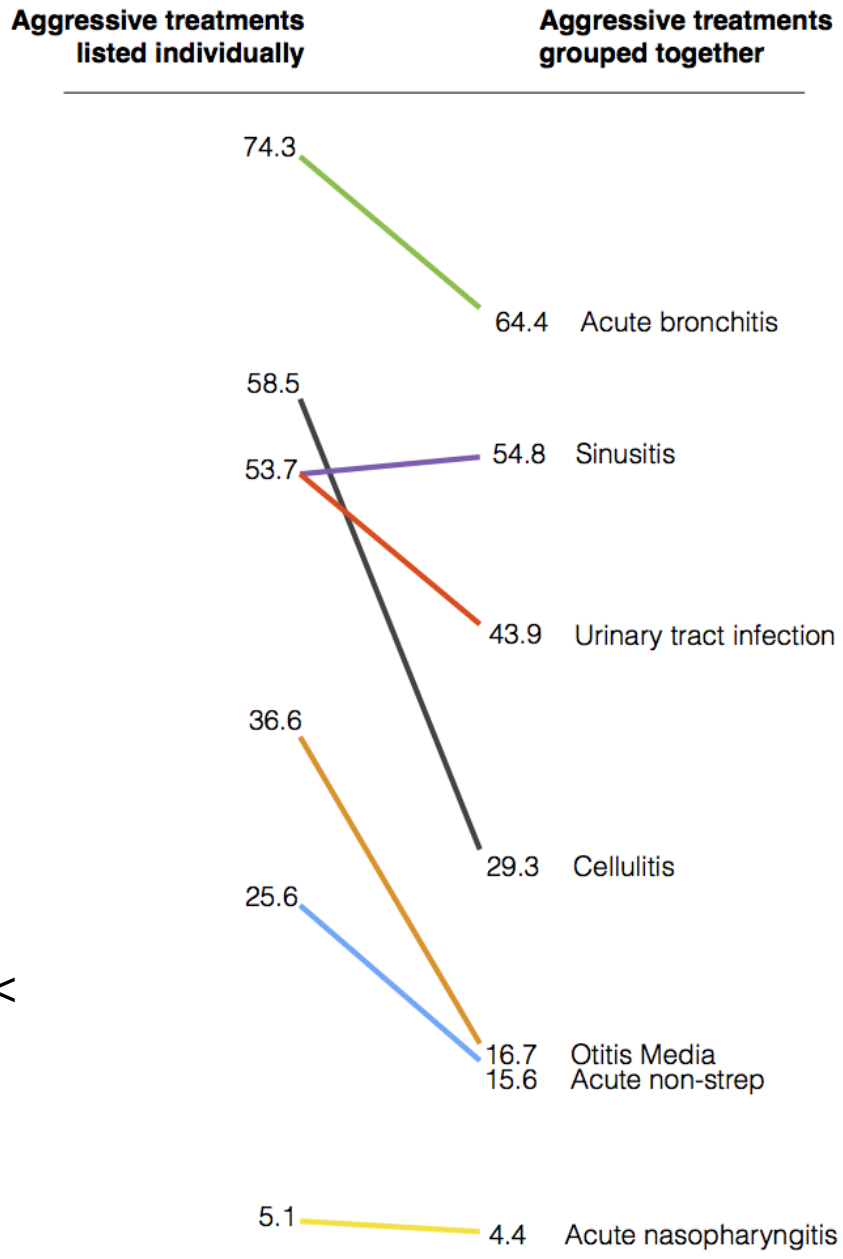
Prescription medications visually grouped

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

1. Interface Design Effects
2. **Decision Fatigue**
3. Public Commitment
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# Decision Fatigue: Judicial Decisions Revert to Path of Least Resistance

PNAS

## Extraneous factors in judicial decisions

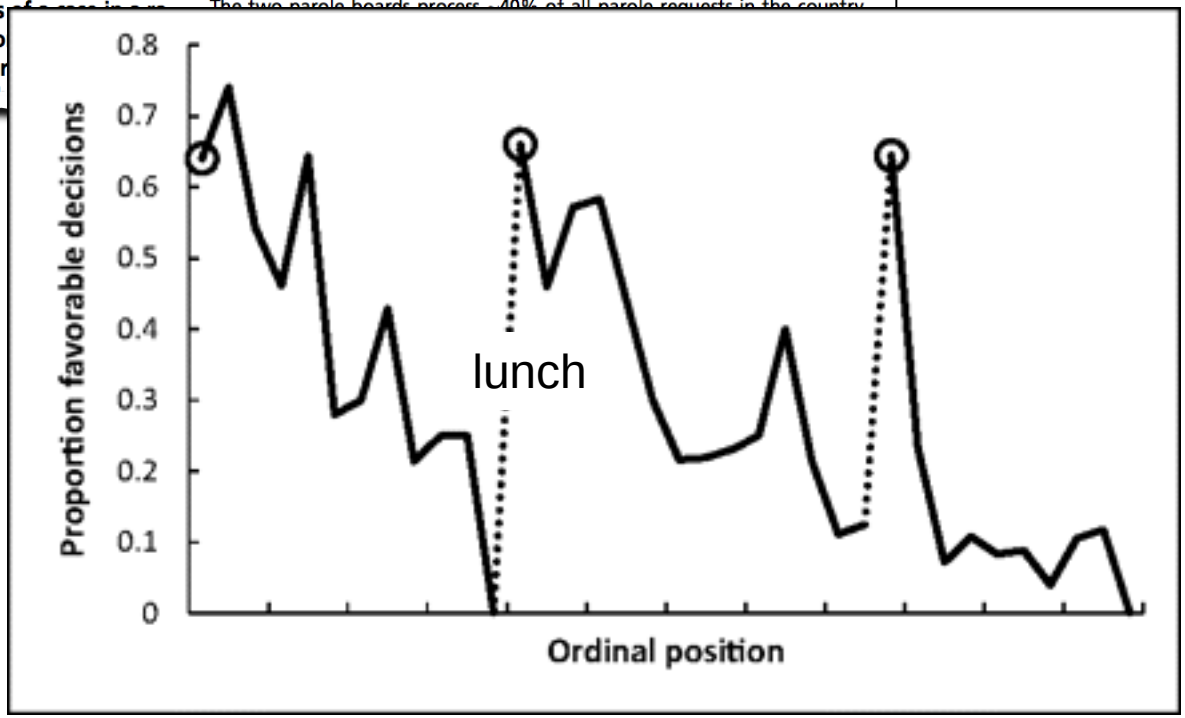
Shai Danziger[a,1], Jonathan Levav[b,1,2], and Liora Avnaim-Pesso[a]

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

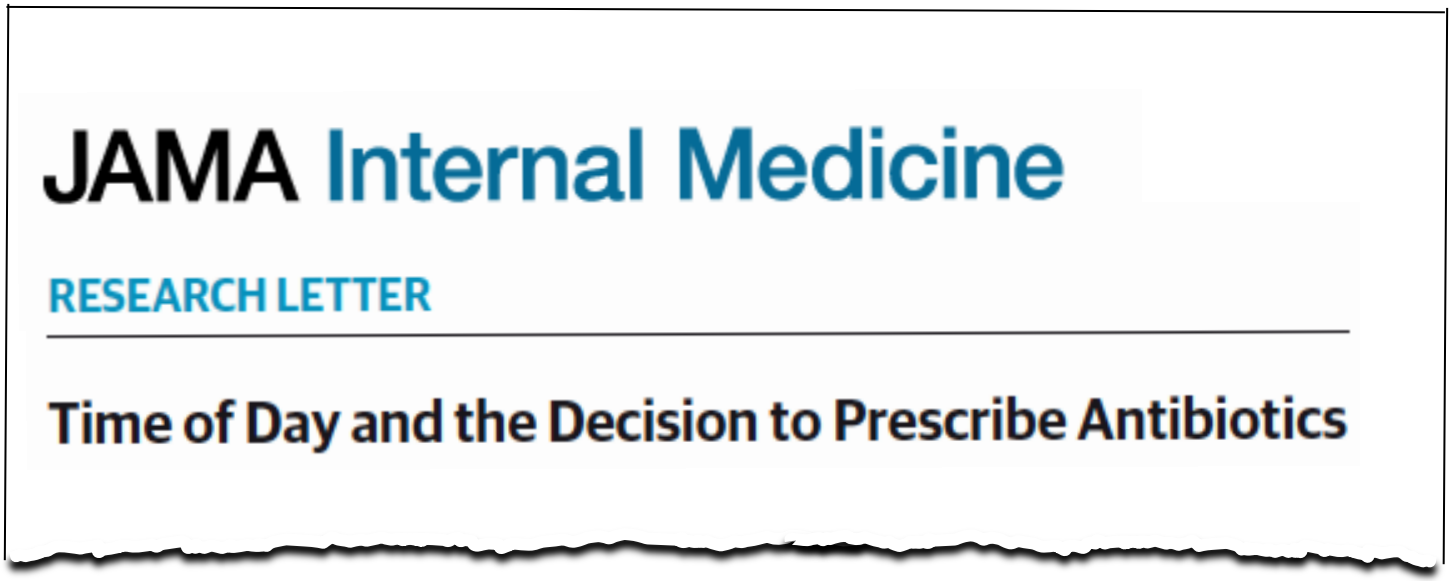
Edited* by Daniel Kahneman, Princeton University, Princeton, NJ, and approved February 25, 2011 (received for review December 8, 2010)

**Are judicial rulings based solely on laws and facts? Legal formalism holds that judges apply legal reasons to the facts of a case in a ra tional, mechanical, and deliberative manner. In co ists argue that the rational application of legal r**

(29.3%), 50 Jewish-Israeli females (4.5%), and 9 Arab-Israeli females (0.9%). The two parole boards process ~40% of all parole requests in the country



# Decision Fatigue in Clinical Orders



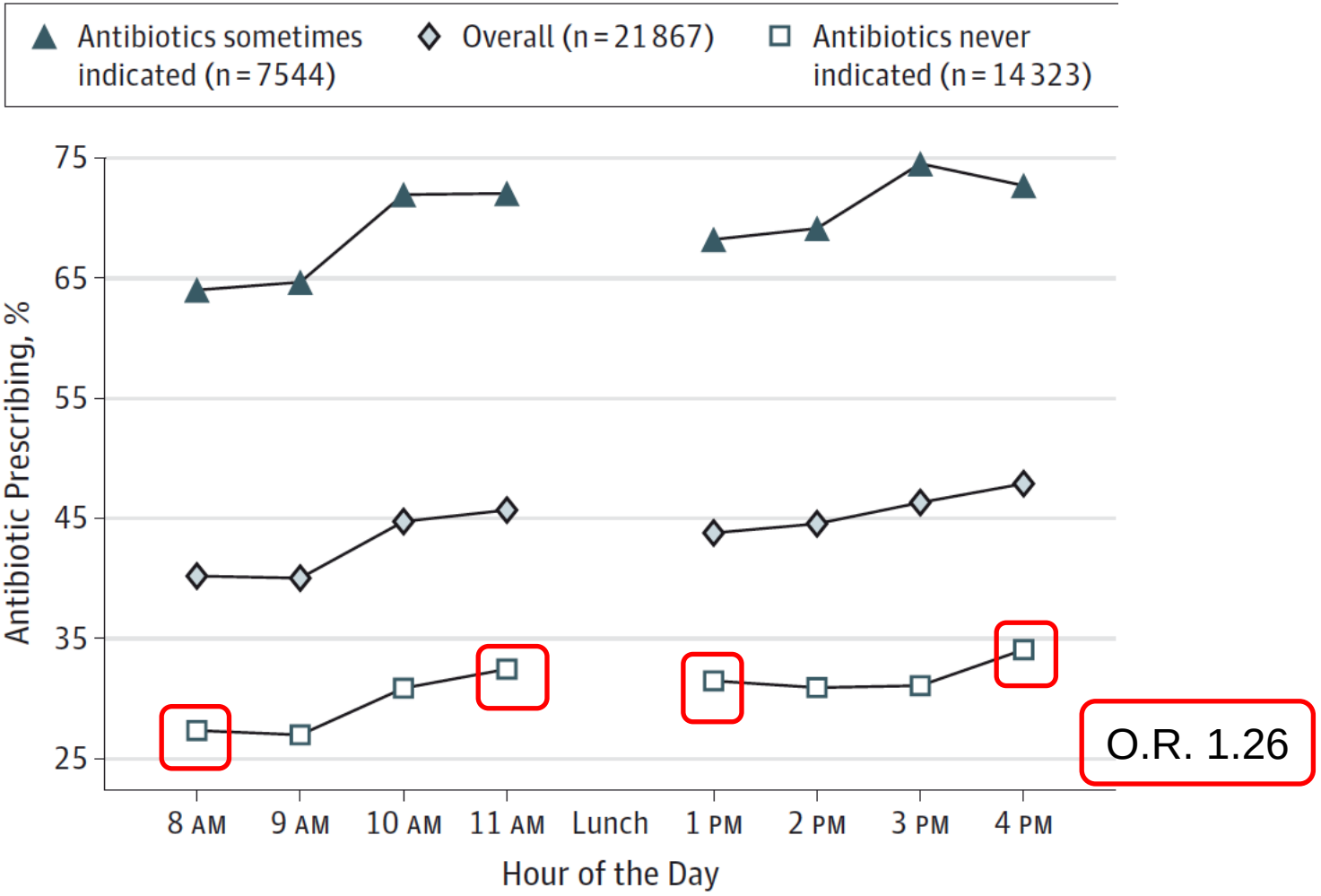
JAMA Internal Medicine

RESEARCH LETTER

Time of Day and the Decision to Prescribe Antibiotics

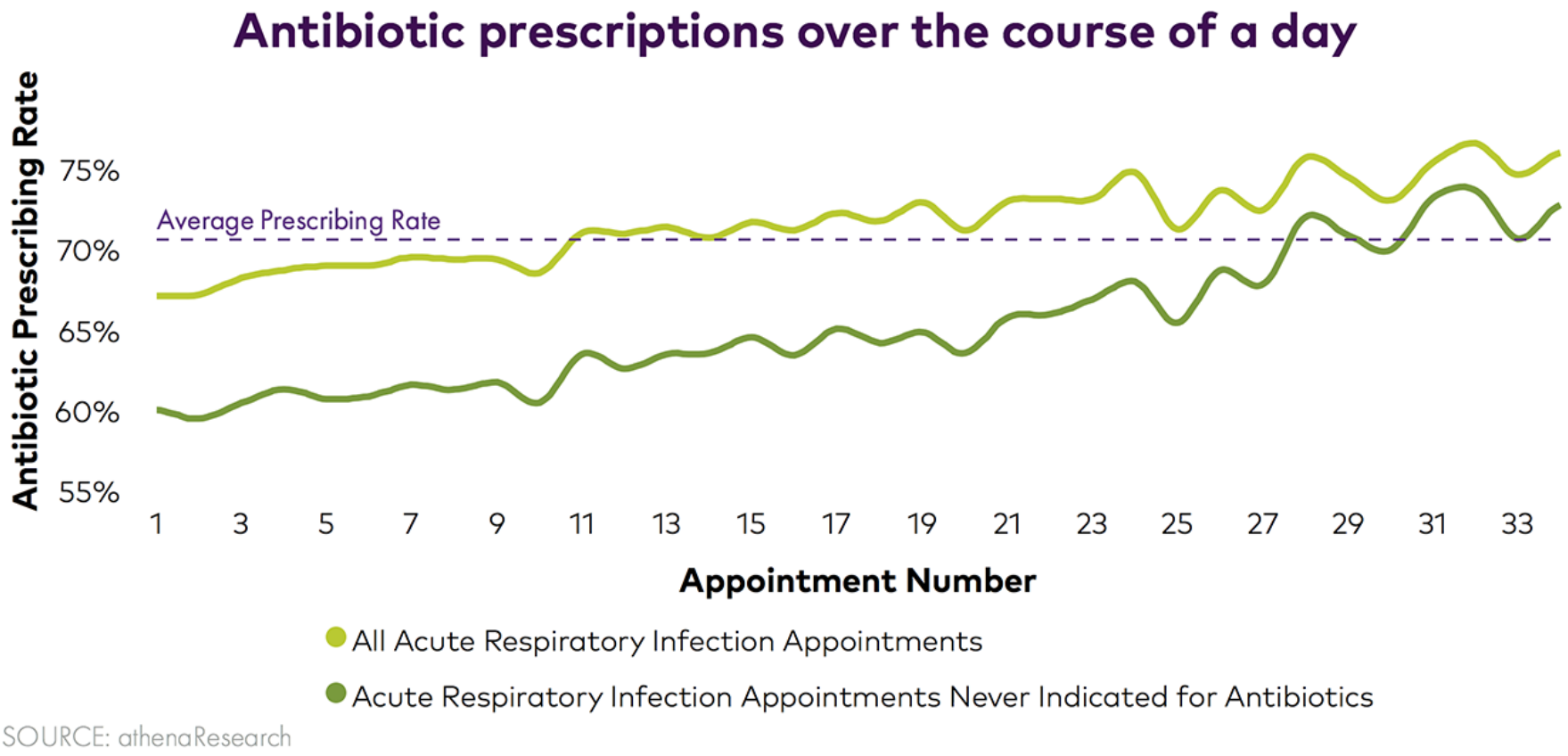
Linder JA, Doctor JN, Friedberg MW, Nieva HR, Birks C, Meeker D, Fox CR. JAMA internal medicine. 2014 Dec 1;174(12):2029-31.

# Prescribing as the day wears on




***JAMA – Internal Medicine, 174, 2029-2031, 2014.***

# Replication: Athena Research




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

# Overview

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

# Public Commitment

## Public Commitment as a Motivator for Weight Loss

**Prashanth U. Nyer**
Chapman University

**Stephanie Dellande**
University of New Orleans

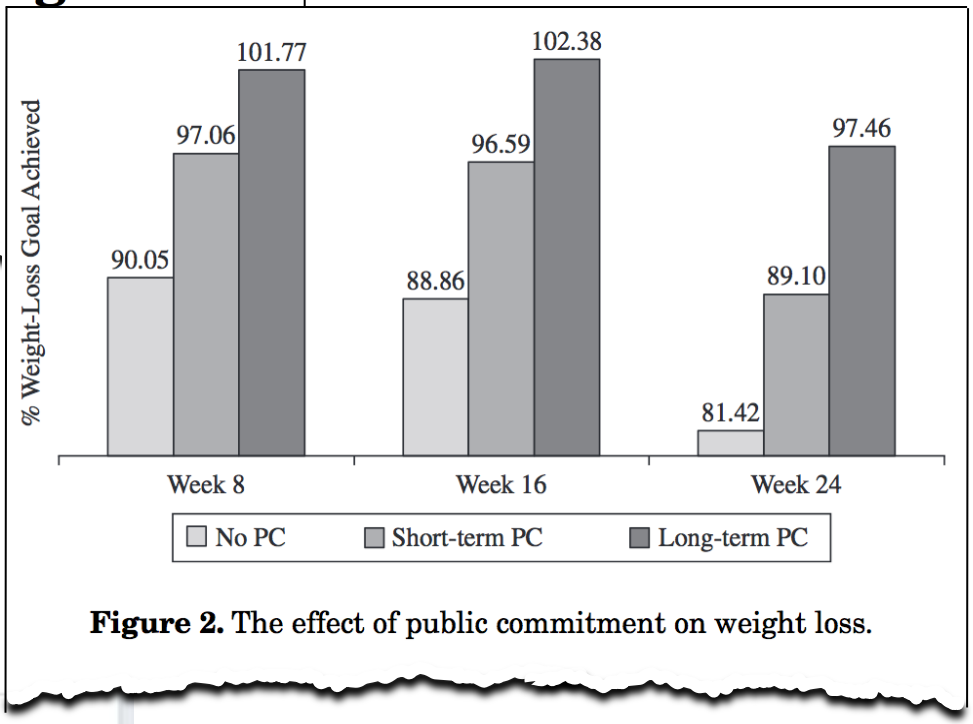



**Figure 2.** The effect of public commitment on weight loss.

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

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 do
you should or should not take antibiotics.

When you have a cough, sore throat, or othe
the best possible treatments. If an antibioti
doctor will explain this to you, a

Your health is very important to us. As your d
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,

QueensCare

## El Uso Seguro de Antibióticos:
## 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 deseables.

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 trabajarán cuando ustedes en realidad necesitan que funcionen. Por

mejor para usted.

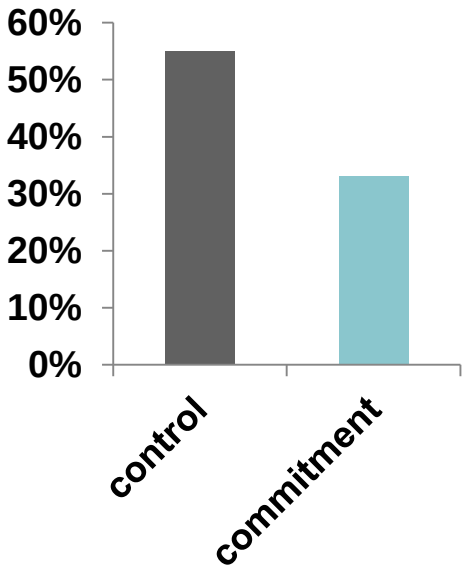
Su salud es importante para nosotros. Como sus doctores, nosotros prometemos tratar su enfermedad en la mejor manera posible. También nos comprometemos a evitar recetar antibióticos cuando sean probables de hacer más daño que bien.

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

Atentamente,

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.

# Results: Public commitment




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

Abbreviation: ARI, acute respiratory infection.

[a] Adjusted for demographic characteristics and insurance status.

[b] *P*=.02 for the difference.

***JAMA – Internal Medicine, 174, 425-431, 2014.***

# Overview

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

JAMA The Journal of the American Medical Association

ORIGINAL CONTRIBUTION

# 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

Daniella Meeker, Jeffery Linder, Mark W. Friedberg, Stephen D. Persell, Craig R. Fox, Noah J. Goldstein, Alan F. Rothfeld, Joel Hay, Jason N. Doctor

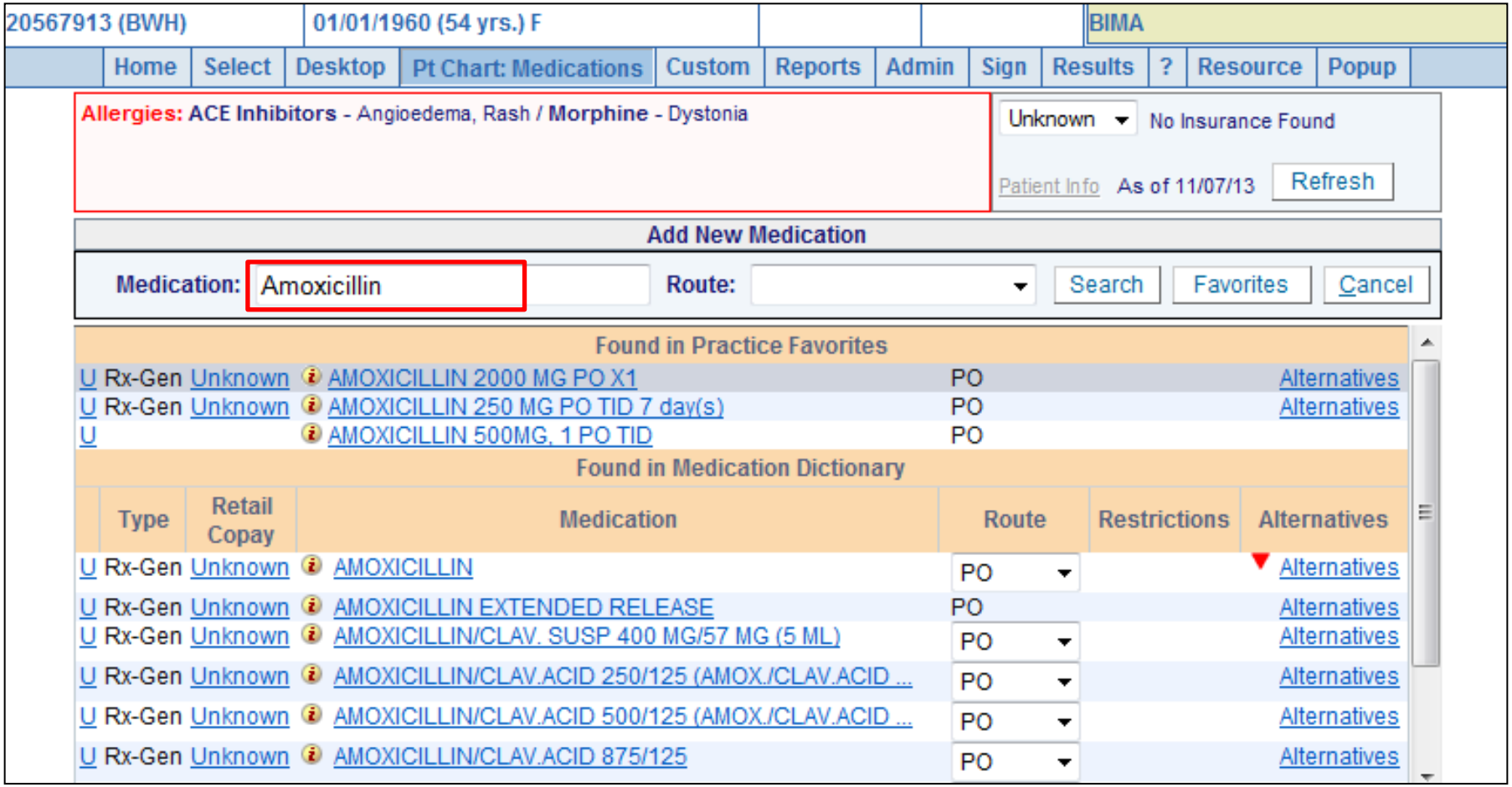
# Pragmatic Randomized Trial

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

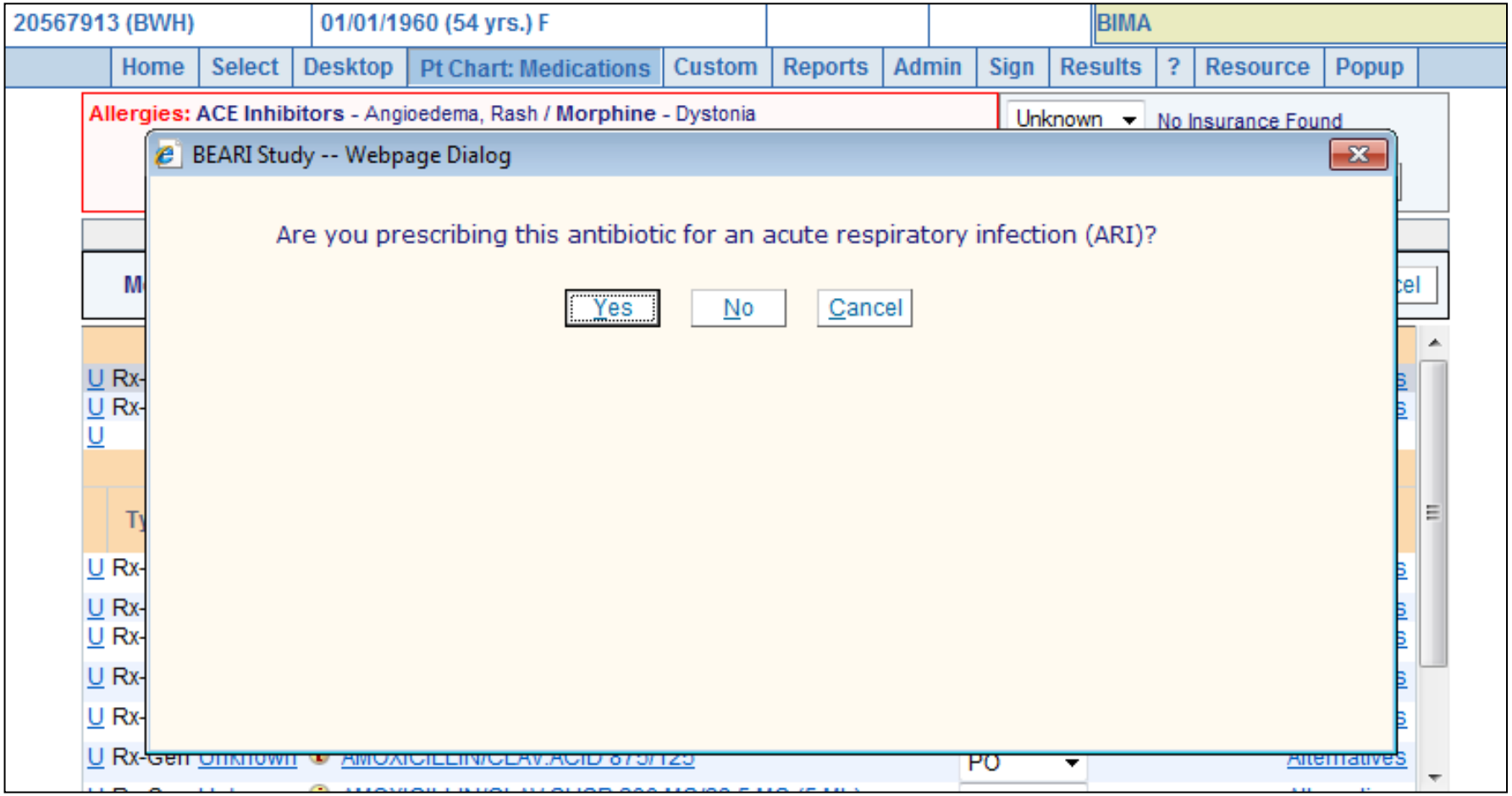
# Interventions

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

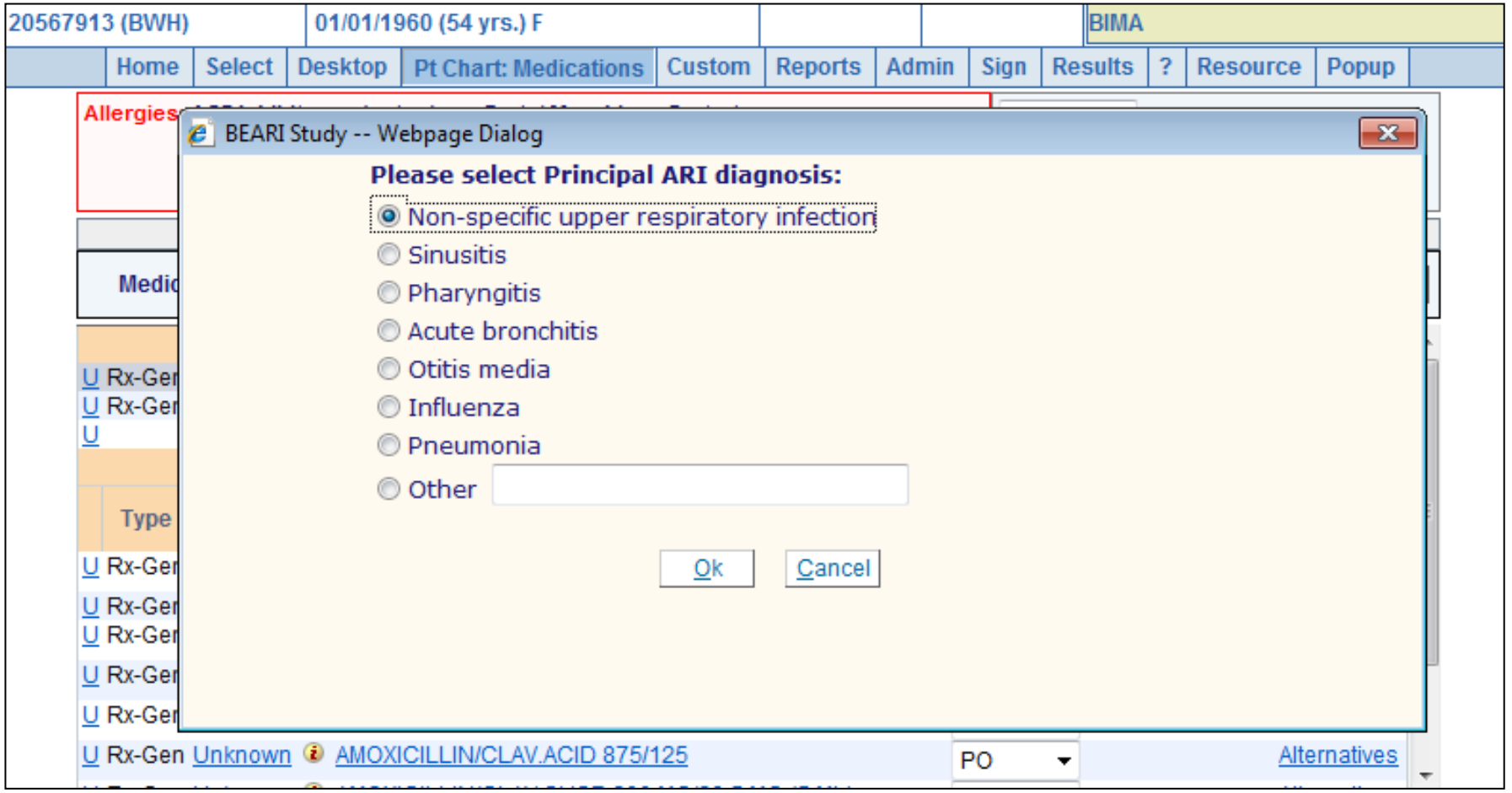
# Intervention 1: Suggested Alternatives



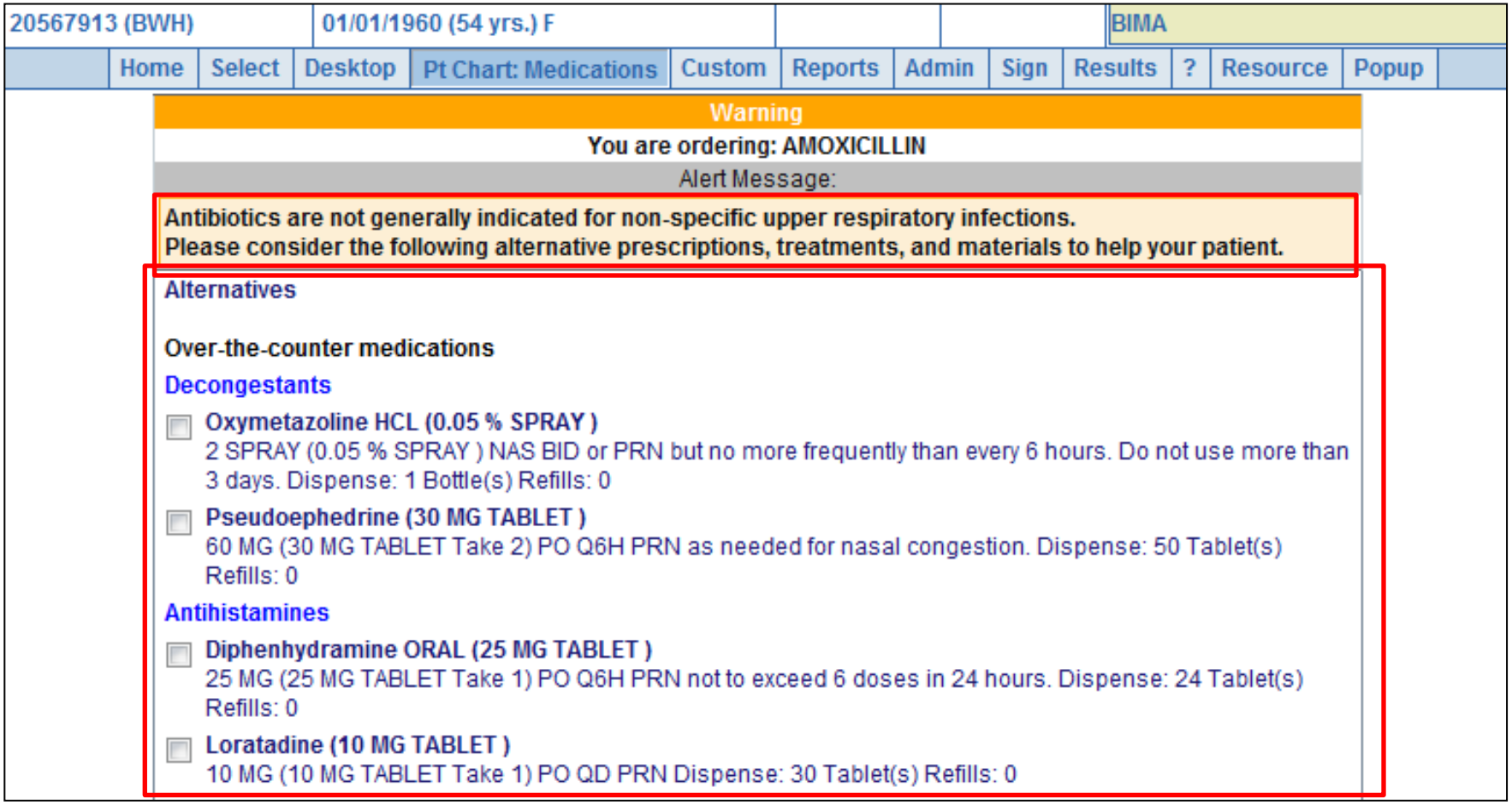
# Intervention 1: Suggested Alternatives



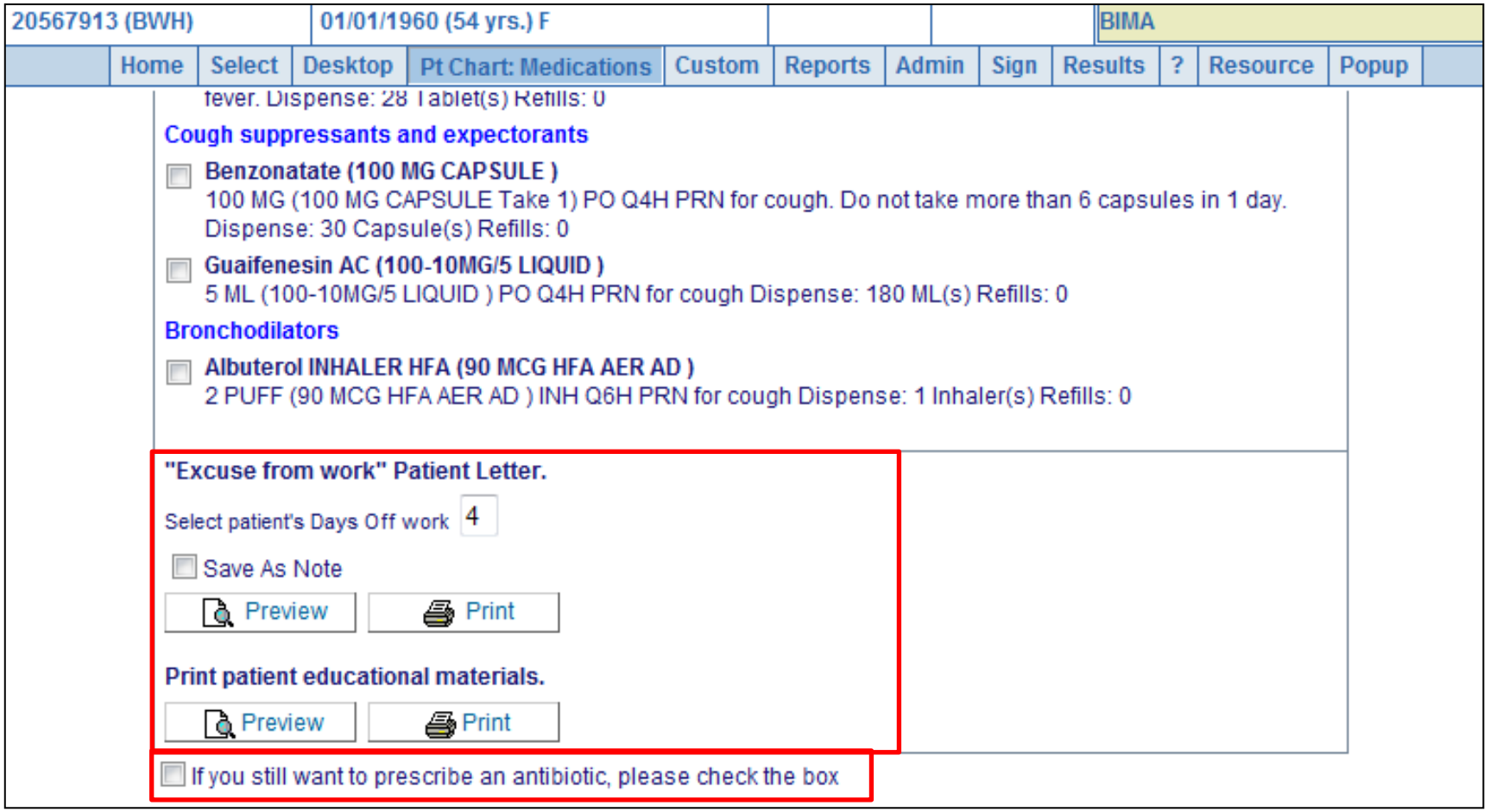
# Intervention 1: Suggested Alternatives



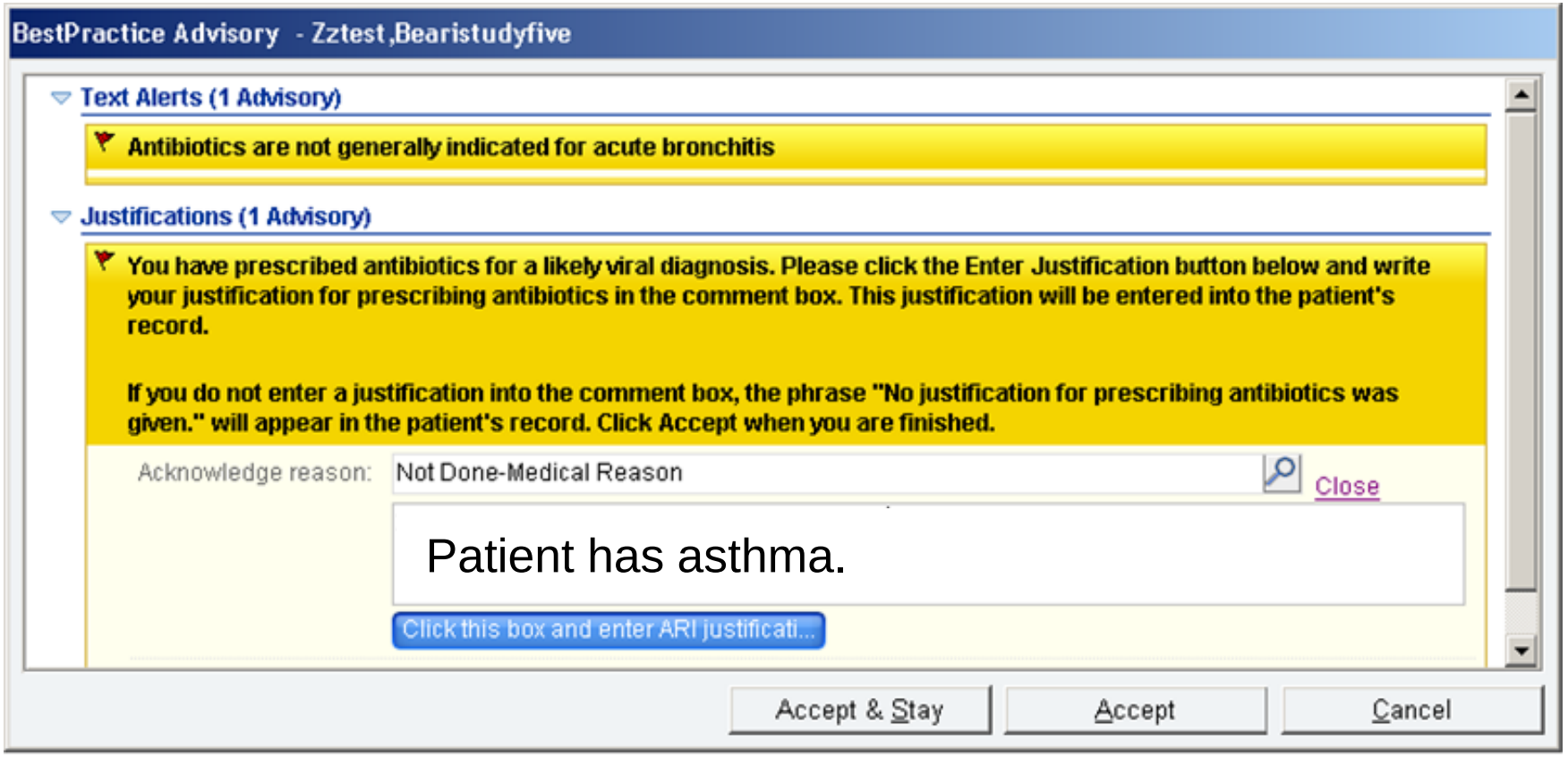
# Intervention 1: Suggested Alternatives



# Intervention 1: Suggested Alternatives



# Intervention 2: Peer Accountability




*EHR System: Epic*

# Intervention 3: Peer Comparison

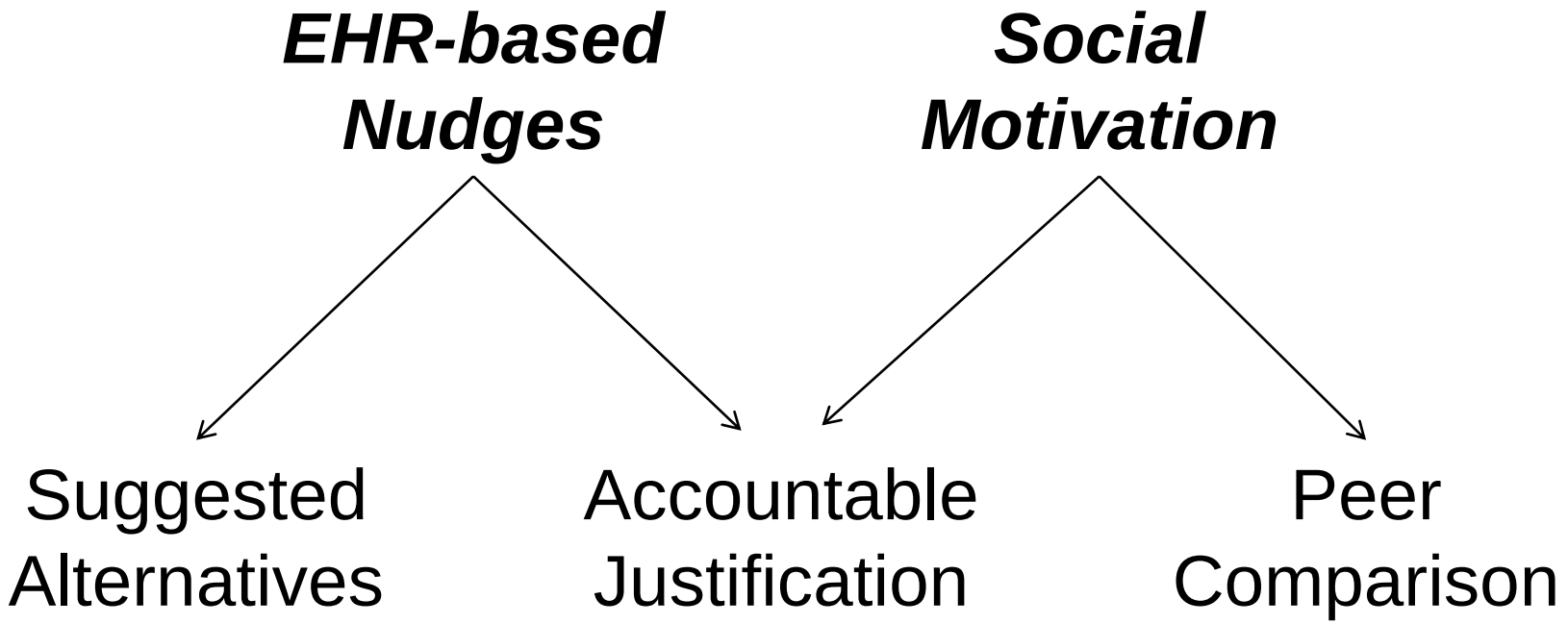
***"You are a Top Performer"***

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



# 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.

| | CHOICE A | CHOICE B |
|---|---|---|
| EHR Alternative Prescribing Screen | ON | ON |
| Required Justification Note | OFF | OFF |
| Peer Performance Feedback | ON | OFF |
| Pay for Performance | $100/month | $200/month |
| Additional ARI Therapy Explanation Time | 5 minutes per visit | 0 minutes per visit |
| | | |
| MY CHOICE | | X |

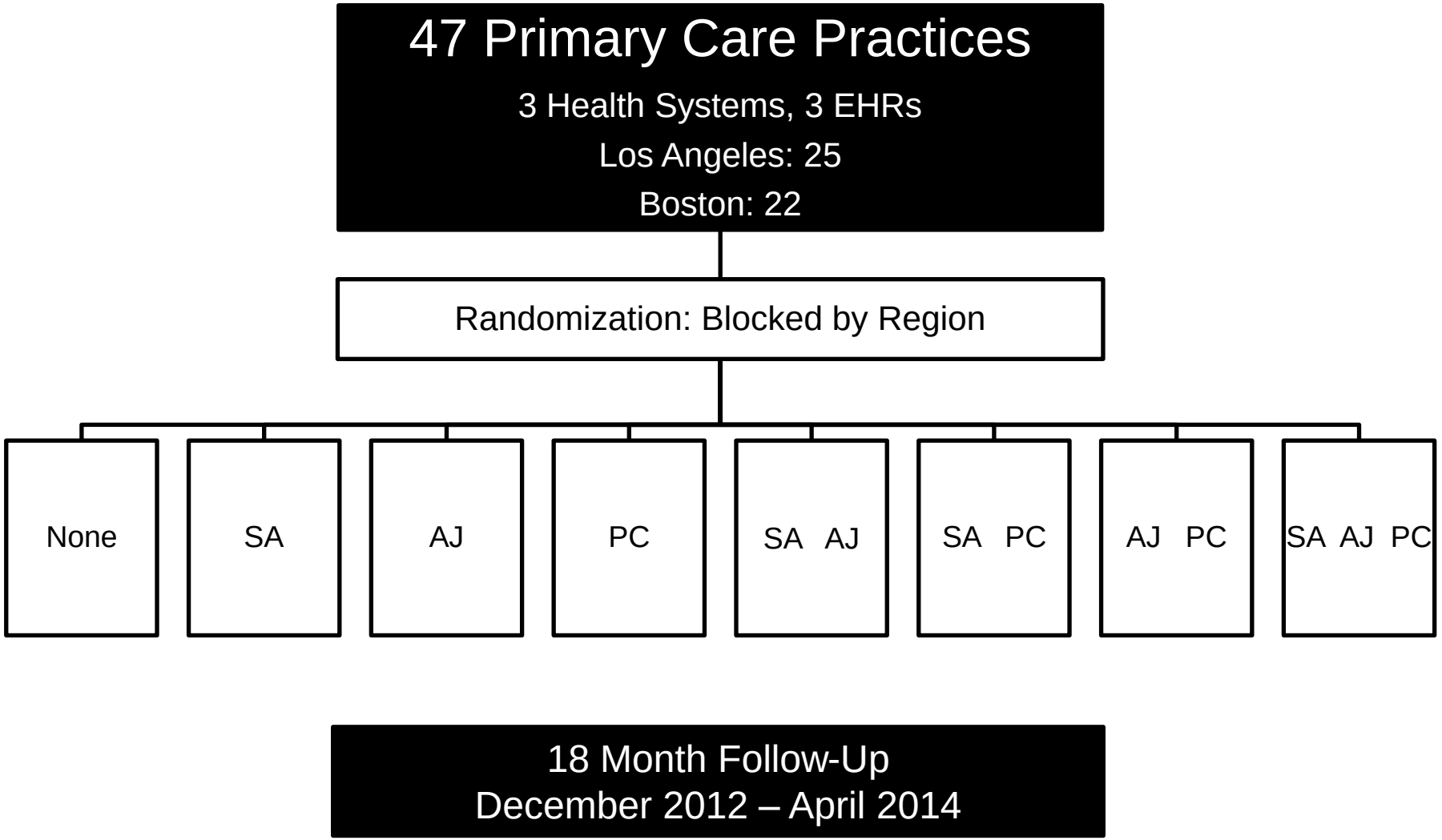
We will now give you 10 choice pairs and ask you to indicate your choice preference for each pair sequentially. Please select the version most likely to reduce your ARI antibiotic prescribing.

# Physicians believe traditional alerts will be as effective as $1400 P4P

| Willingness to Pay | Monthly | Annually |
|---|---|---|
| ★★★★★ Suggested Alternatives | -$120.52 | -$1,446.28 |
| ★☆☆☆☆ Peer Accountability | $12.98 | $155.81 |
| ★★★☆☆ Peer Comparison | -$73.84 | -$886.09 |
| ★★★☆☆ Additional Time | -$13.55 | -$162.61 |

…and they are ***willing to pay*** $150/year to avoid peer accountability interventions.

# Methods: Practices and Randomization



# 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

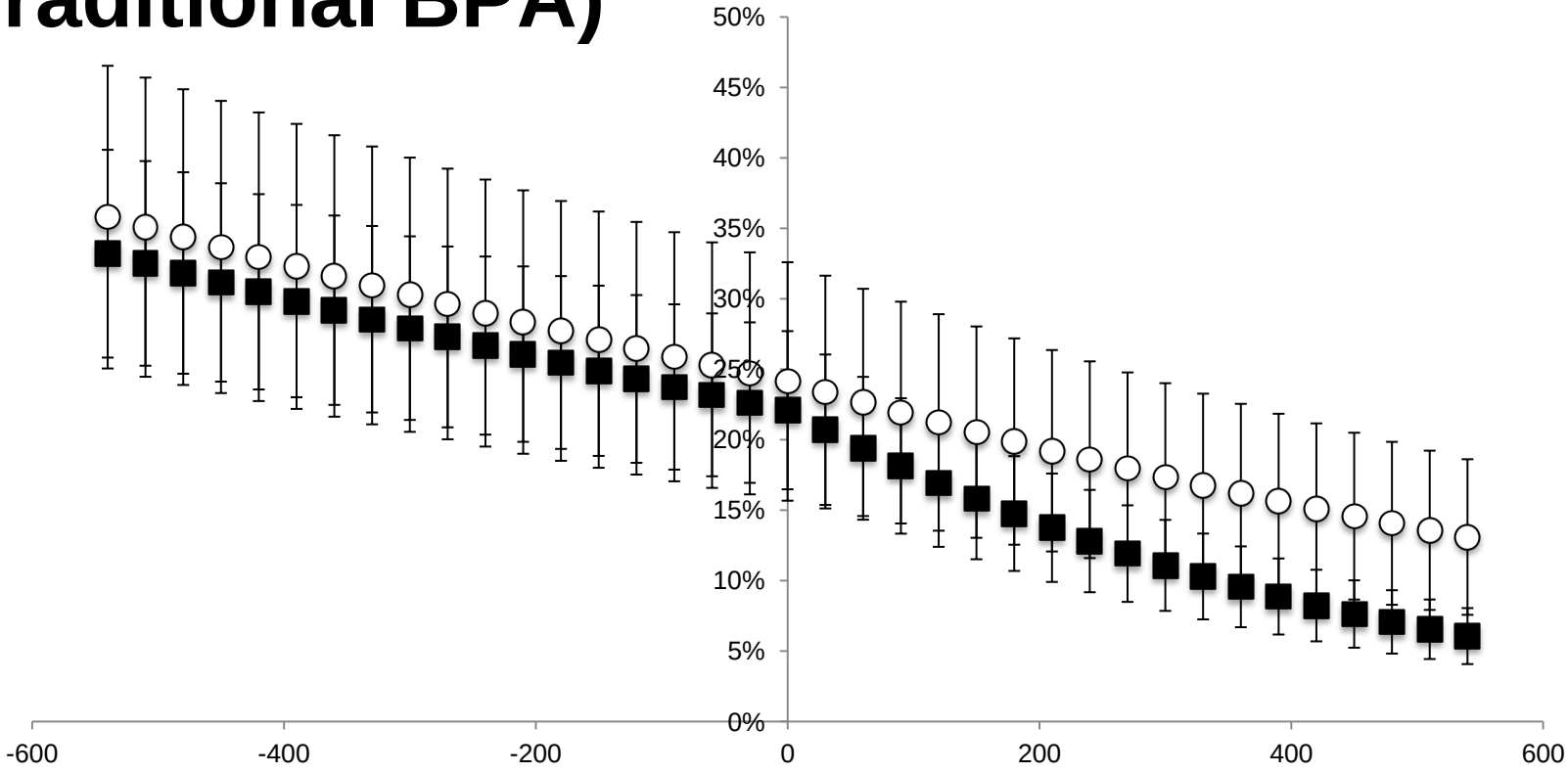
# Results: Clinicians (N = 248)

| | Control | Suggested Alternatives | Accountable Justification | Peer Comparison |
|---|---|---|---|---|
| Age, mean | 47 | 49 | 48 | 48 |
| | | | % | |
| Female | 48 | 68 | 61 | 61 |
| Clinician Type | | | | |
| Physician | 81 | 79 | 81 | 80 |
| PA or NP | 19 | 21 | 19 | 20 |

# Results: Visits (N = 16,959)

| | Control | Suggested Alternatives | Accountable Justification | Peer Comparison |
|---|---|---|---|---|
| Age, mean | 49 | 47 | 48 | 46 |
| | | | % | |
| Female | 65 | 70 | 66 | 68 |
| White | 88 | 86 | 88 | 87 |
| Latino | 35 | 32 | 30 | 36 |
| Private insurance | 60 | 59 | 58 | 58 |

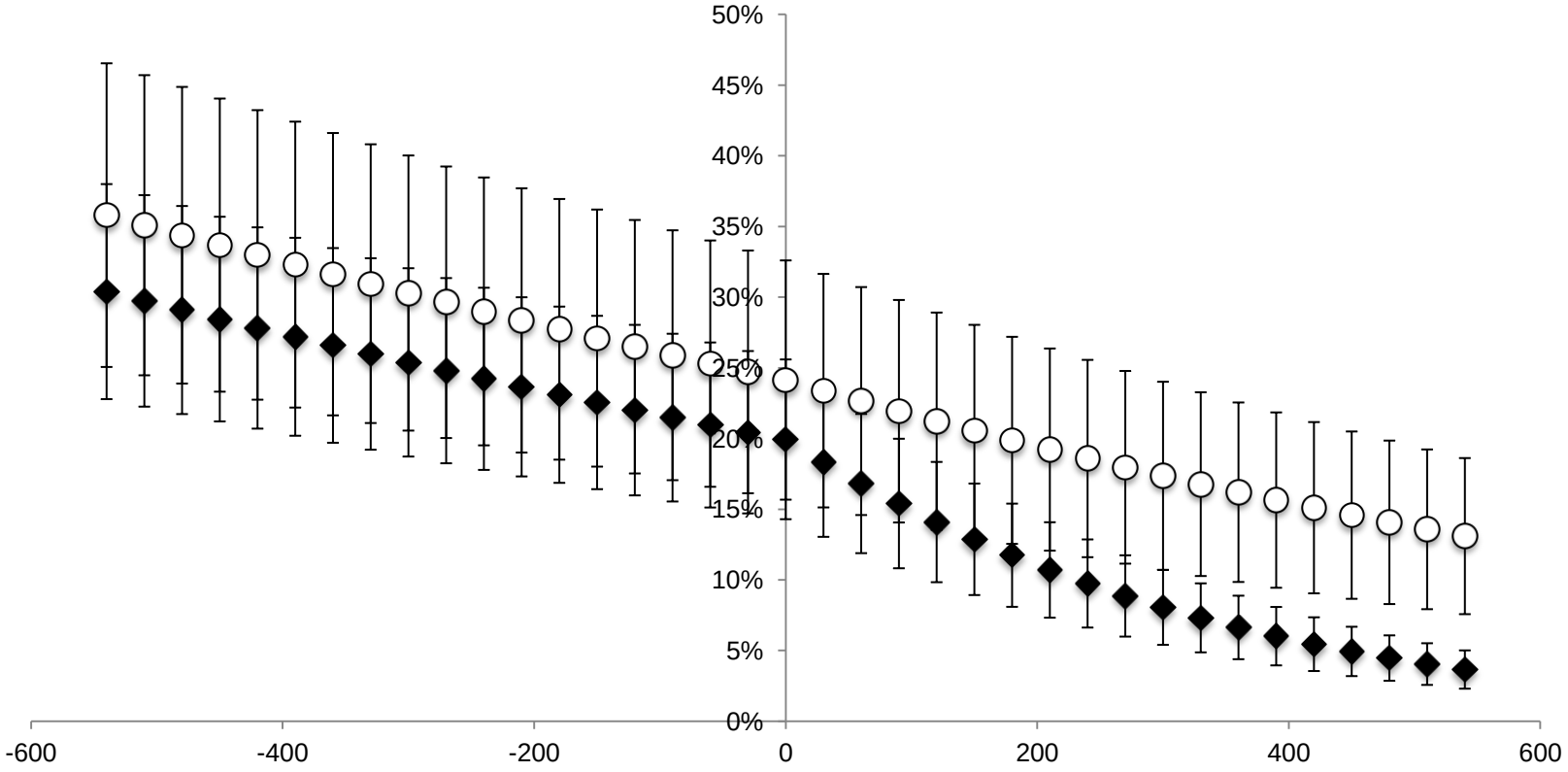
# Main Results: Suggested Alternatives (Traditional BPA)




Physician Rating: ★★★★★

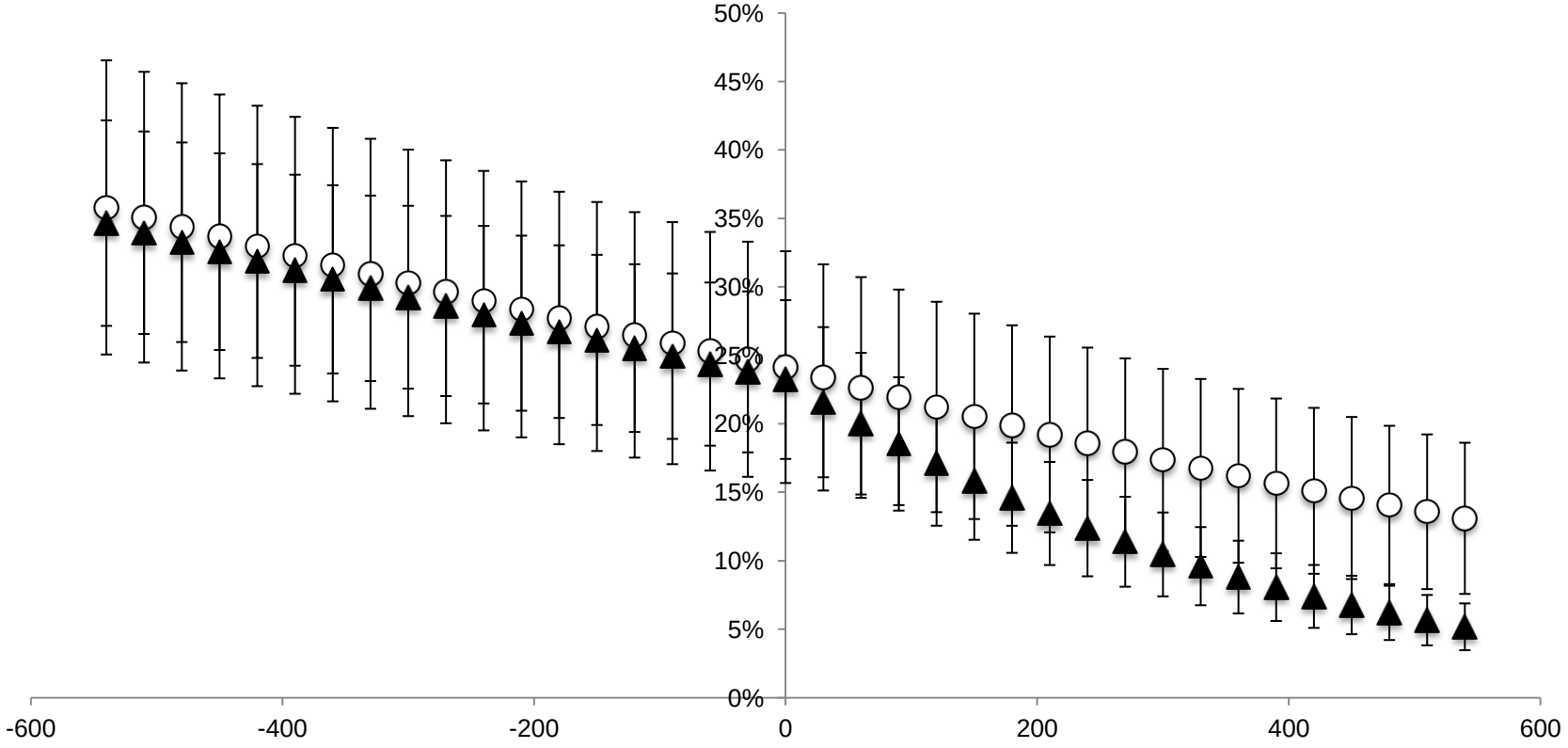
**-5.0%  p = 0.66**

# Main Results: Peer Comparison




**-5.2%  p = <.001**

# Main Results: Accountable Justification




Physician Rating: ★☆☆☆☆

**-7.0%  p < .001**

## Limitations

- Limited to enrollees
- Dependent on EHR and billing data

## Strengths

- Randomized controlled trial
- Large size
- 3 different EHRs

# 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…***

# Team and Acknowledgments

# Acknowledgements

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Richard Chesler
Tara Knight

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Noah Goldstein, PhD

***RAND***
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Daniella Meeker, PhD
Chad Pino

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Elisha Friesema

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Charlene Chen
Gloria Rodriguez
Auroop Roy
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