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Behavioral Economic Approaches to Reduce Outpatient Antibiotic Prescribing

Illinois Antimicrobial Stewardship Summit

July 17, 2018

Jeffrey A. Linder, MD, MPH, FACP

Professor of Medicine and Chief
Division of General Internal Medicine and Geriatrics
Northwestern University Feinberg School of Medicine

jlinder@northwestern.edu @jeffreylinder

Disclosures

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- ***Former grant funding:*** Astellas Pharma, Inc. and Clintrex/Astra Zeneca
- ***Honoraria:*** SHEA (supported by Merck)

Outline

- Antibiotic prescribing
- Behavioral science
- Food for thought and some behavioral science studies
- BEARI (Behavioral Economics/Acute Respiratory Infection) Trial

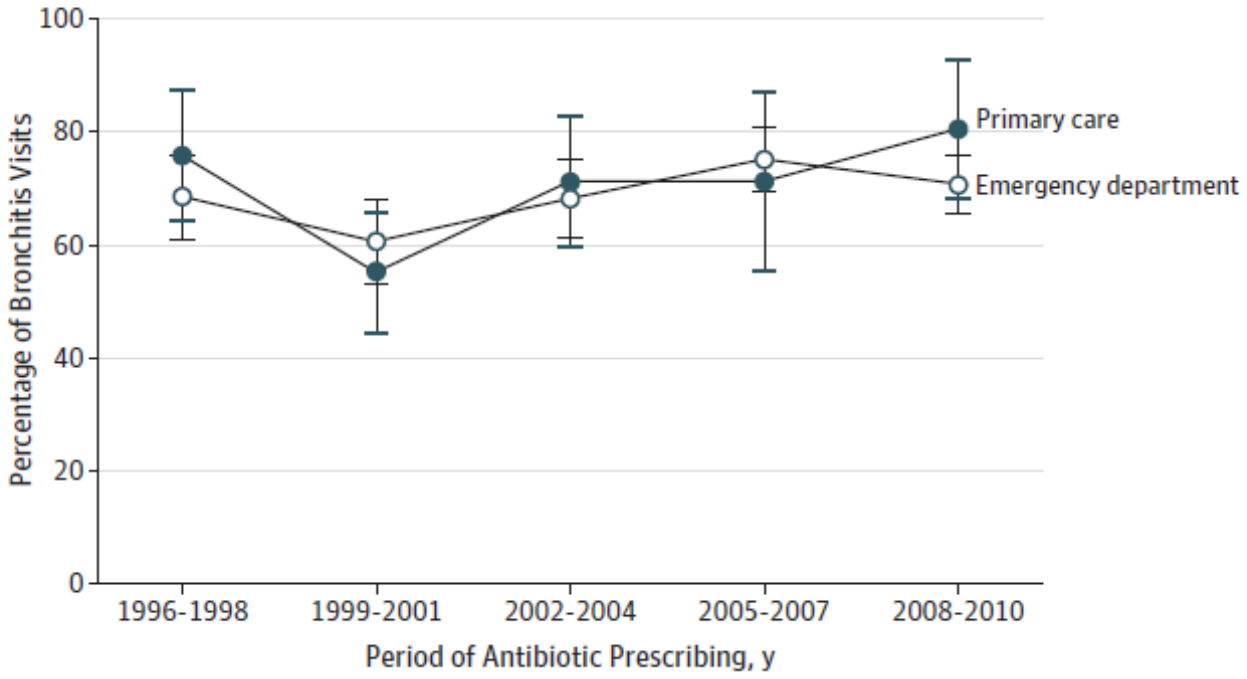
Background: Acute Respiratory Infections

- 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

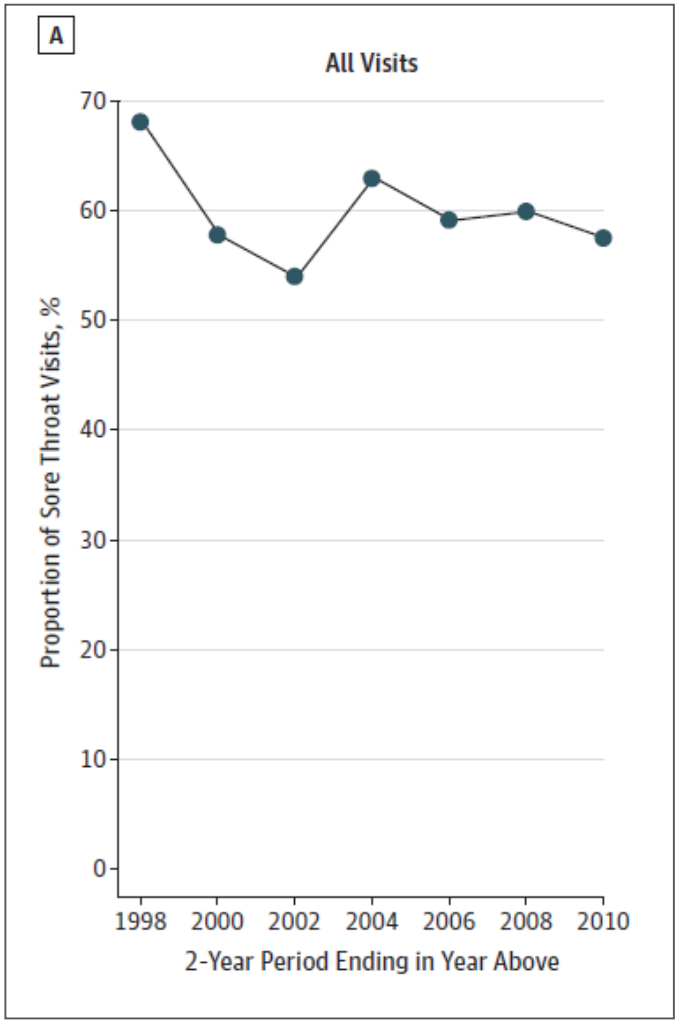
Figure. Antibiotic Prescribing for Acute Bronchitis in the United States by Site of Care, 1996-2010



- 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

Barnett and Linder. JAMA Intern Med 2014

Antibiotic Prescribing

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

- 506 antibiotic prescriptions per 1000 people
  - 30% unnecessary
  - 50% of ARI prescribing unnecessary
- ***US:*** 833 per 1000 people
- ***Sweden:*** 388 → 157 per 1000 people

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
  - Cognitive bias
  - 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

Mehrotra and Linder. JAMA Intern Med 2016

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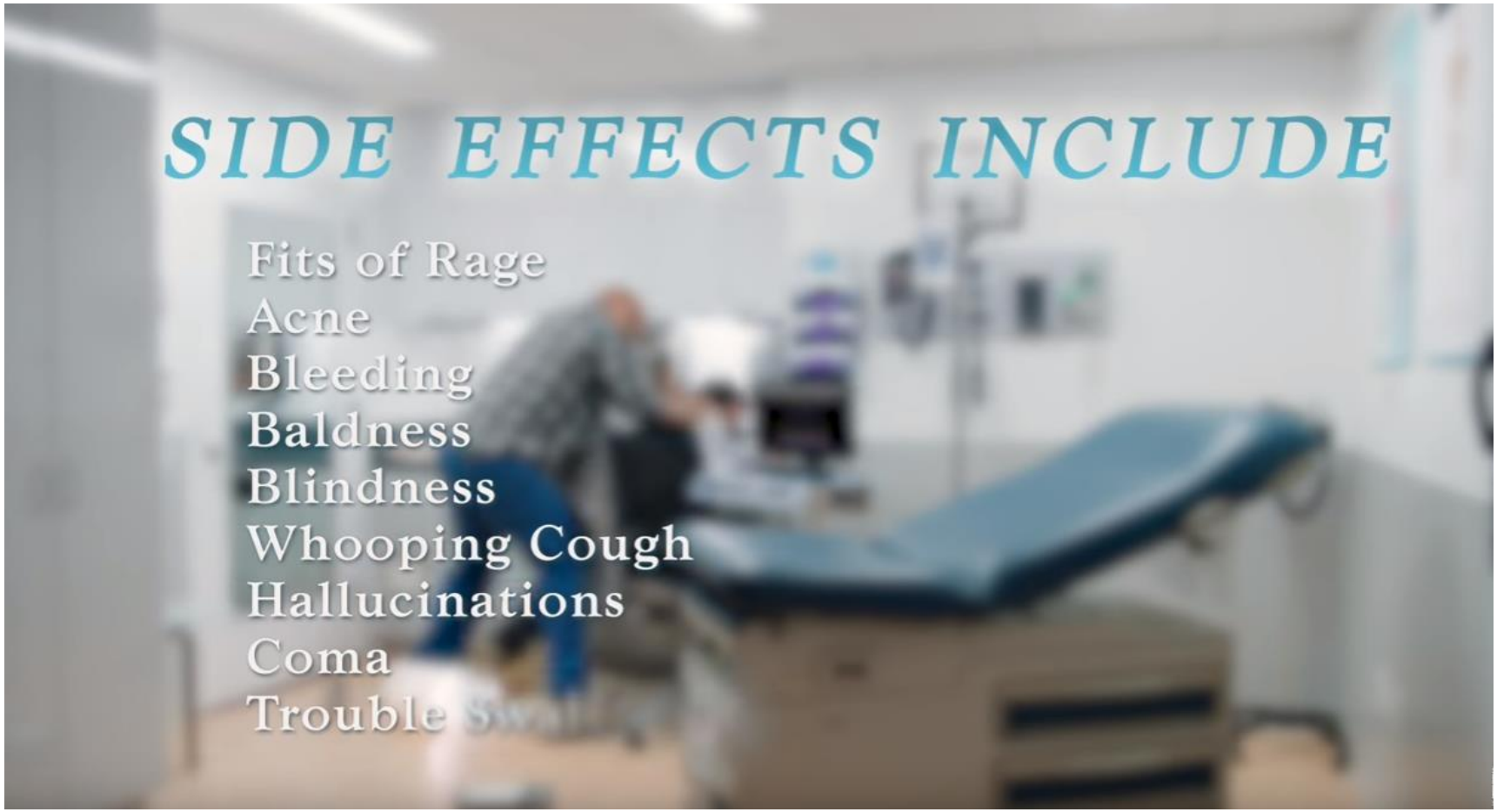
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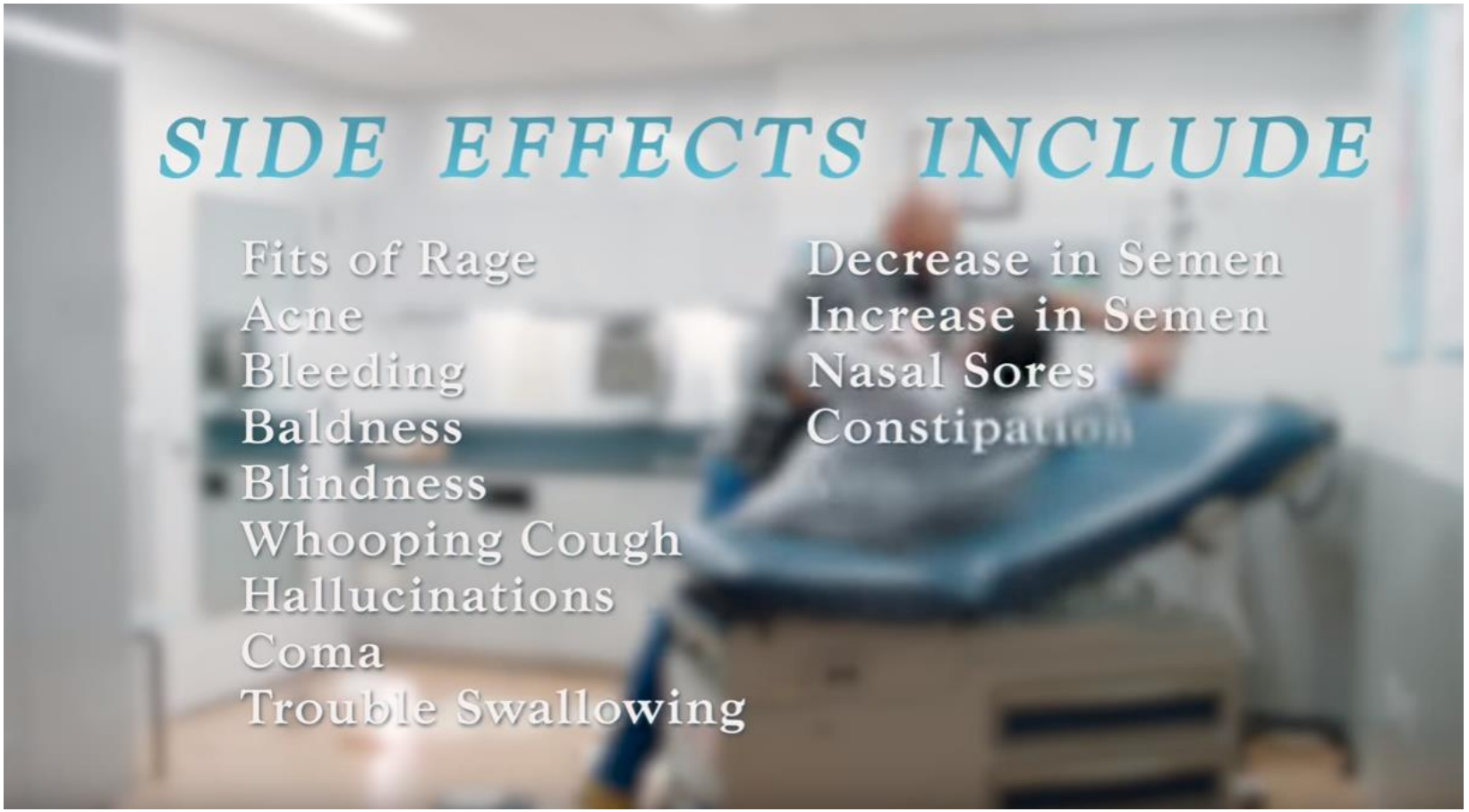
Fits of Rage
Acne
Bleeding
Baldness
Blindness
Whooping Cough
Hallucinations
Coma
Trouble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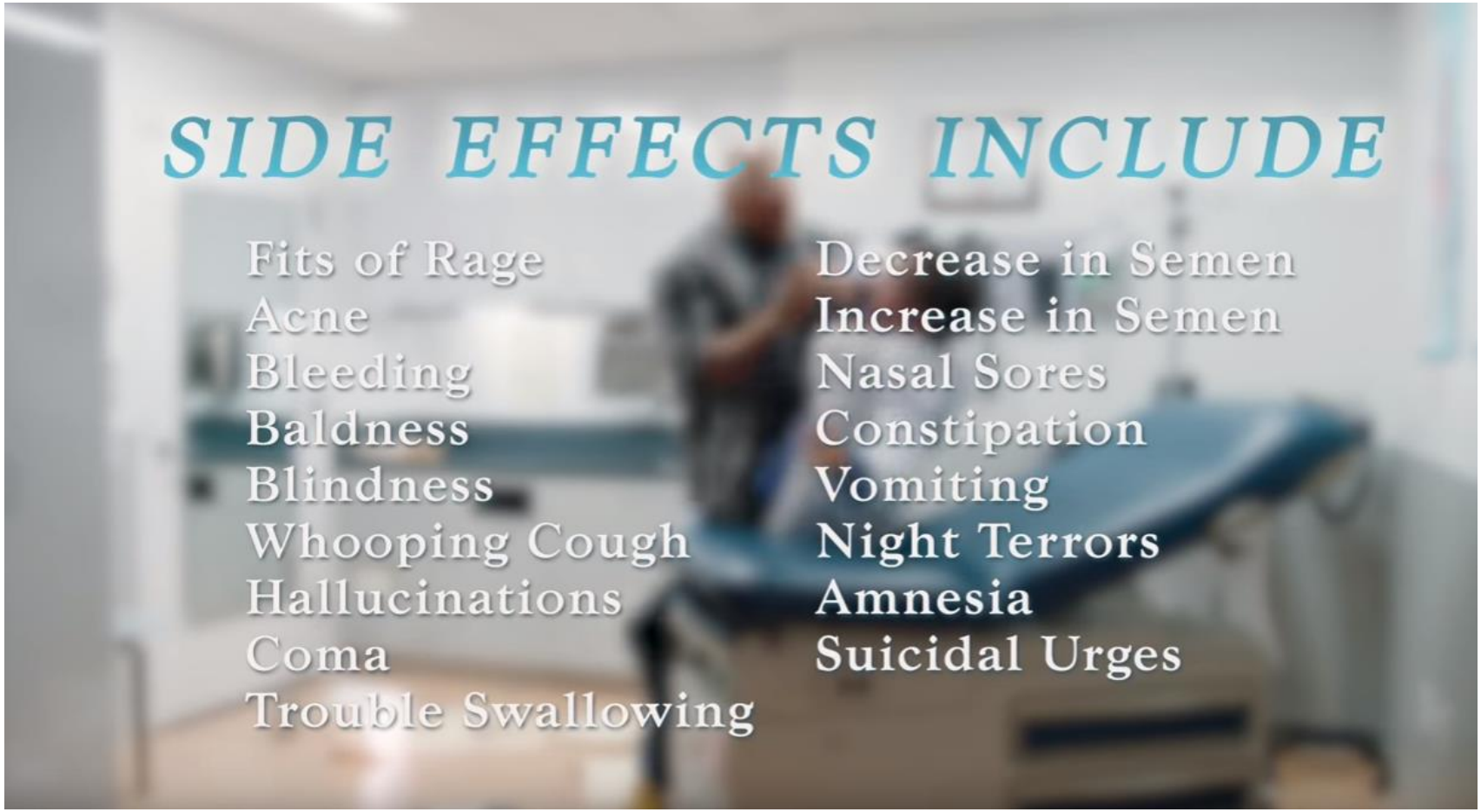
Hallucinations
Coma
Trouble Swallowing
Decrease in Semen
Increase in Semen
Nasal Sores
Constipation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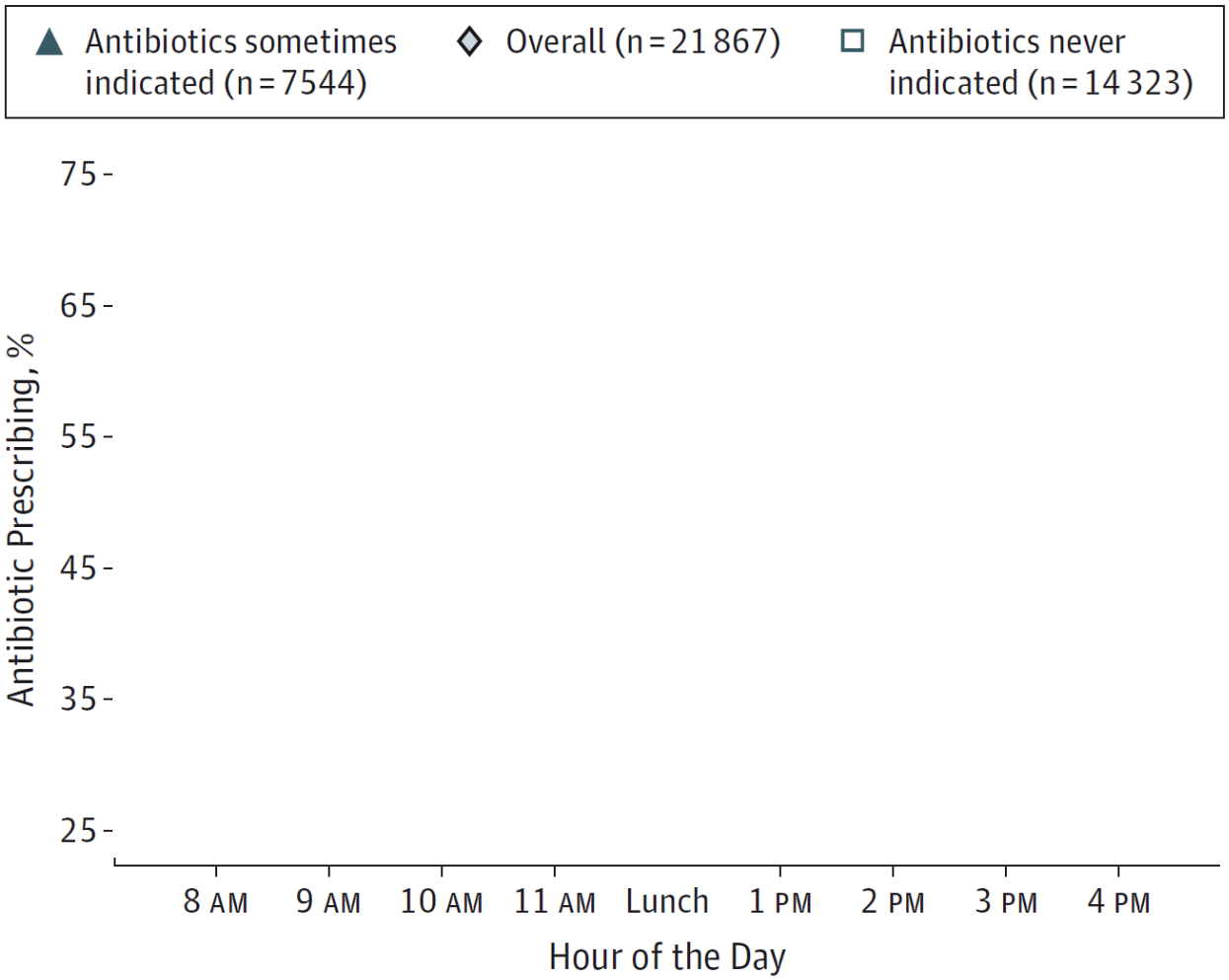
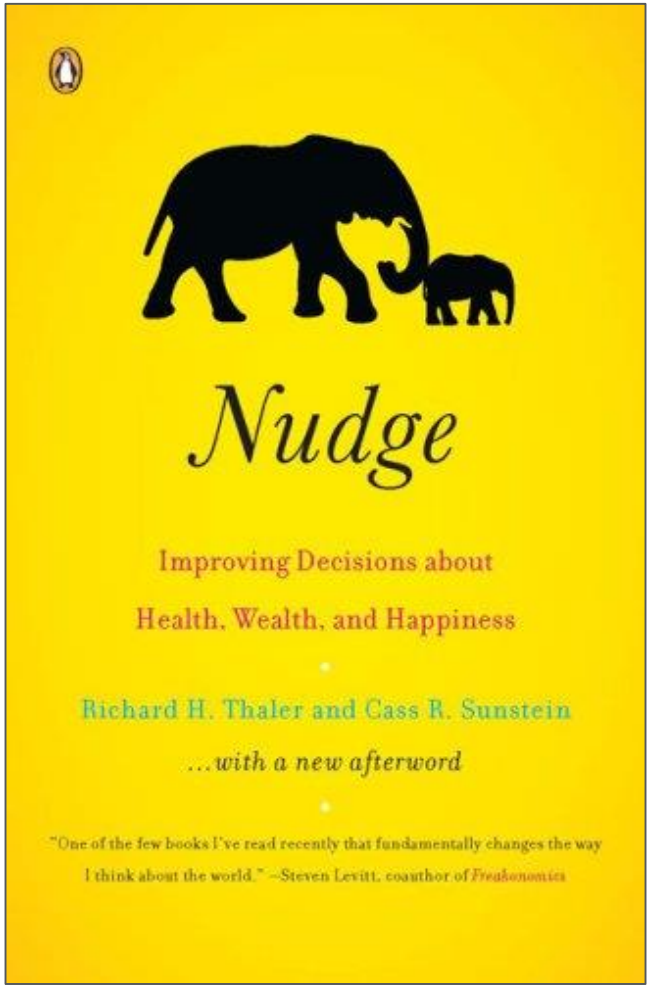
Coma
Trouble Swallowing
Decrease in Semen
Increase in Semen
Nasal Sores
Constipation
Vomiting
Night Terrors
Amnesia
Suicidal Urges

Antibiotic Prescribing by Hour of the Day



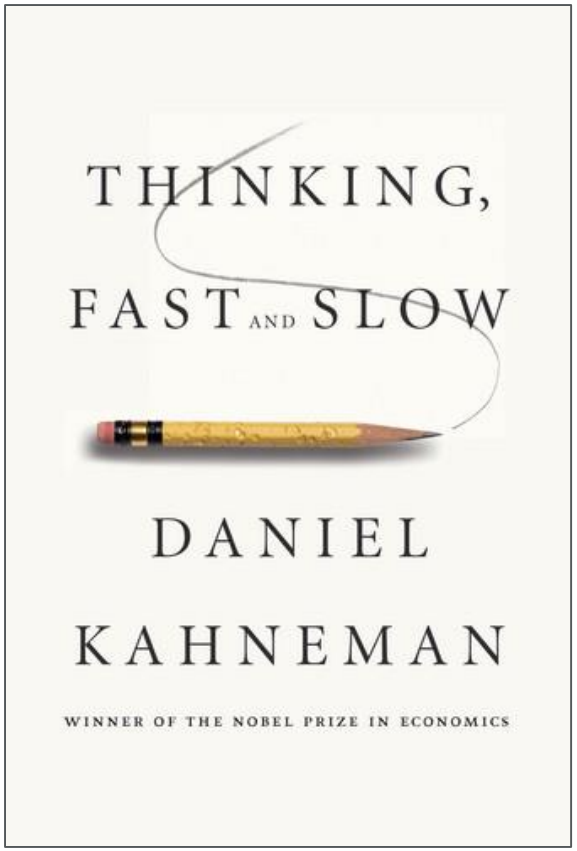
Linder. JAMA Intern Med 2014


Nudge
Improving Decisions about
Health, Wealth, and Happiness
Richard H. Thaler and Cass R. Sunstein
...with a new afterword
"One of the few books I've read recently that fundamentally changes the way I think about the world." —Steven Levitt, coauthor of Freakonomics

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”

Cognitive Systems



1. Automatic

2. Reflective

Behavioral Economics: Food for Thought

- Wine choice
- Supermarket cashier behavior

Partitioning Options

- People tend to be biased towards even allocation across categories (1/n), resulting in *partition dependence*

- Choices can vary dramatically as a function of how those options are organized

Partitioning: Shopping for Wine

Wines partitioned by Region

AUSTRALIAN WINES

(1) Fox Creek
Wine: 2001 Sauvignon Blanc South Australia
Country: Australia
Description: Bright in flavor, refreshing for its lime peel and apple fruit, which echoes on the open-textured finish.

(2) Stonehaven
Wine: 2000 Chardonnay Limestone Coast
Country: Australia
Decription: Bright and tangy, with citrus and melon flavors in the forefront and a peppery note on the finish

CALIFORNIA WINES

(3) Groth
Wine: 2001 Sauvignon Blanc Napa Valley
Country: California
Description: Tangy and intense, with lime rind, green apple, grapefruit and ripe melon tones that weave into a tart, slightly grassy finish.

(4) Luna
Wine: 1999 Pinot Grigio Napa Valley
Country: California
Description: Ripe, with good depth to butter, citrus, apple and anise flavors. Concentration carries through the complex finish.

ITALIAN WINES

(5) Bollini
Wine: 1999 Pinot Grigio Grave del Friuli Reserve Selection
Country: Italy
Description: Aromas of freshly sliced apples and pears, with hints of spice.
Medium- to full-bodied, with good fruit and a medium, fruity finish.

(6) Marchesi di Grésy
Wine: 2000 Chardonnay Langhe
Country: Italy
Description: Crisp and clean Chardonnay, with subtle apple, straw and mineral character. Medium-bodied, with fresh acidity and a long, refreshing finish.

Wines partitioned by Grape

CHARDONAY WINES

(1) Stonehaven
Wine: 2000 Chardonnay Limestone Coast
Country: Australia
Description: Bright and tangy, with citrus and melon flavors in the forefront and a peppery note on the finish

(2) Marchesi di Grésy
Wine: 2000 Chardonnay Langhe
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Description: Crisp and clean Chardonnay, with subtle apple, straw and mineral character. Medium-bodied, with fresh acidity and a long, refreshing finish.

SAUVIGNON BLANC WINES

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Wine: 2001 Sauvignon Blanc Napa Valley
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(4) Fox Creek
Wine: 2001 Sauvignon Blanc South Australia
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Description: Bright in flavor, refreshing for its lime peel and apple fruit, which echoes on the open-textured finish.

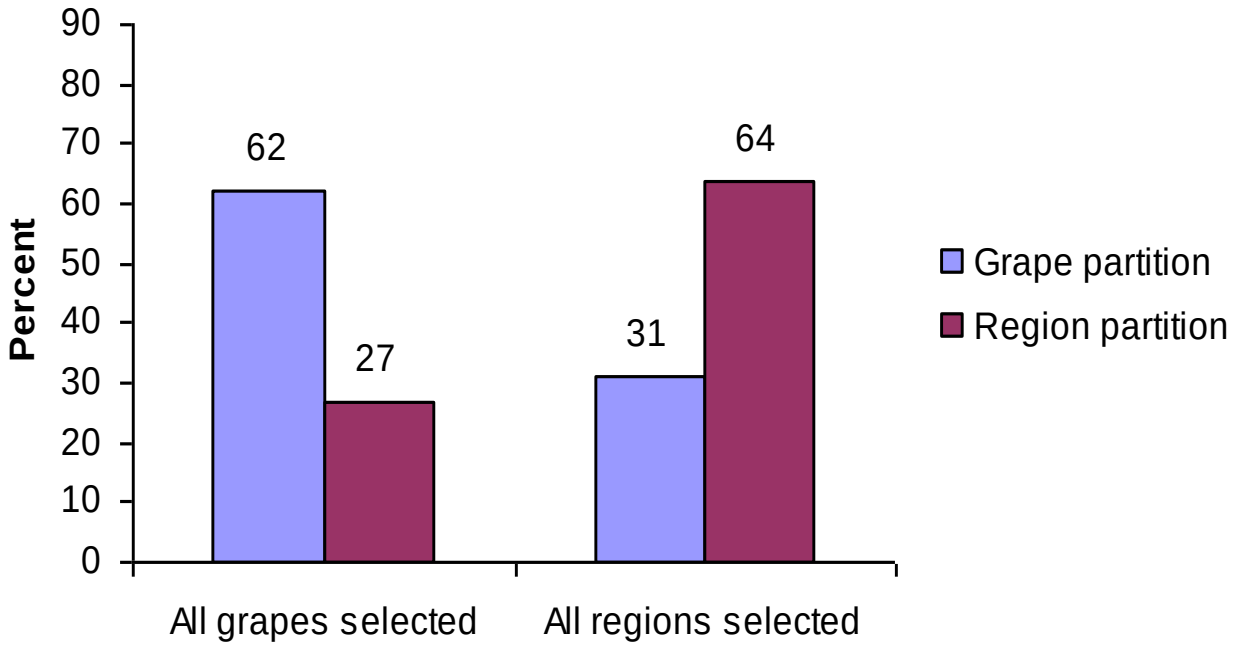
PINOT GRIGIO WINES

(5) Bollini
Wine: 1999 Pinot Grigio Grave del Friuli Reserve Selection
Country: Italy
Description: Aromas of freshly sliced apples and pears, with hints of spice.
Medium- to full-bodied, with good fruit and a medium, fruity finish.

(6) Luna
Wine: 1999 Pinot Grigio Napa Valley
Country: California
Description: Ripe, with good depth to butter, citrus, apple and anise flavors. Concentration carries through the complex finish.

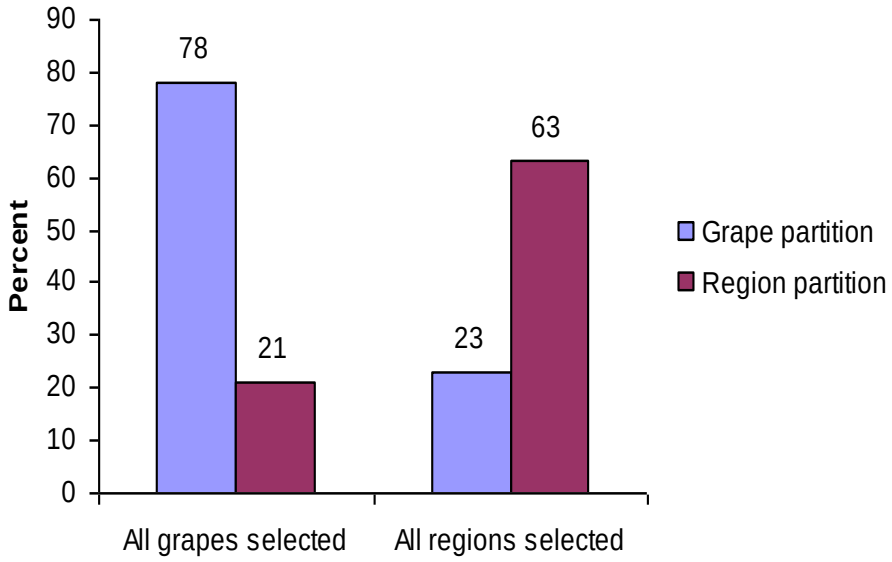
Wine Selection

- Chose 3 white wines from a list of 6 (n = 149)
- Half partitioned by grape, half by region

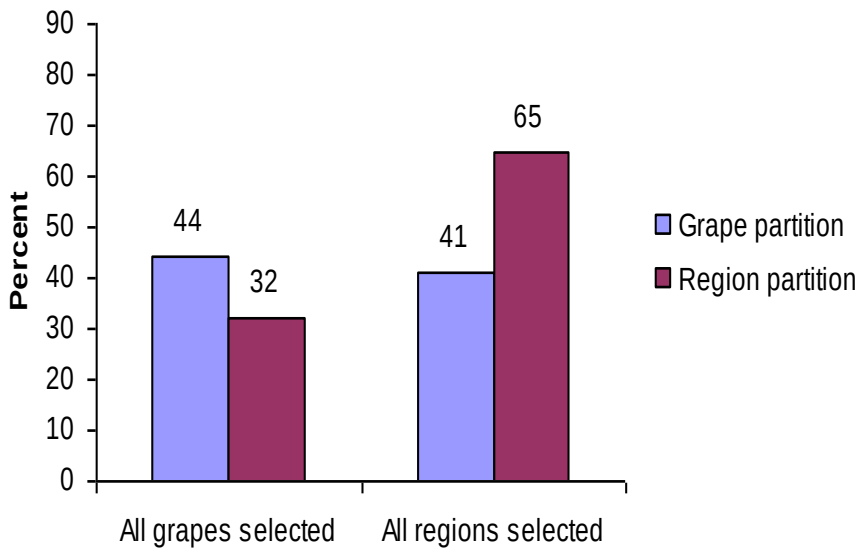


Wine Selection

Novices



Experts



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.

Partitioning

Acute Bronchitis

OTC medications 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

Partitioning

Acute Bronchitis

Prescription medications grouped

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

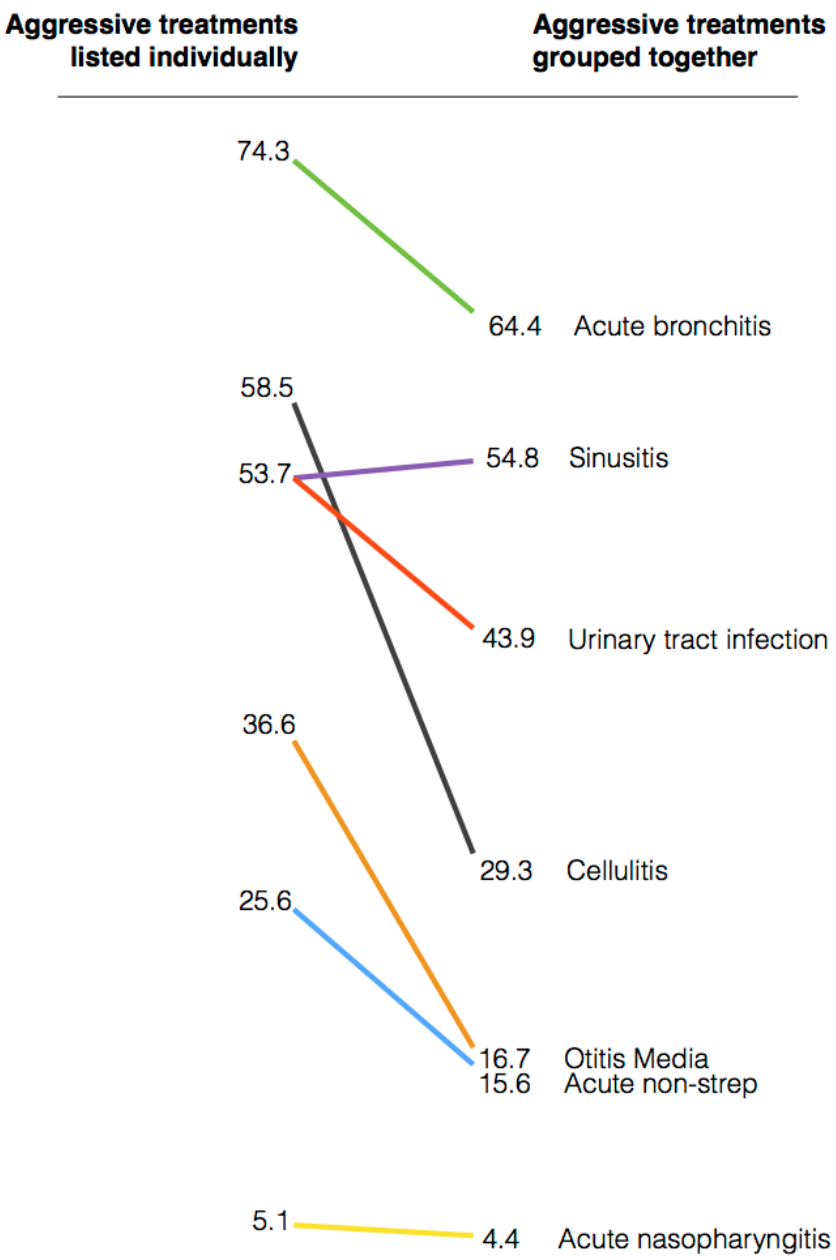
☐ cough lozenge

☐ 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
  - Prescription meds grouped
  - Broader-spectrum grouped
  - Vignette order
  - Positioning of grouped items
- Overall, 12% decrease in choosing aggressive treatment when grouped ($p < .01$)



Supermarket Cashiers

Supermarket Cashiers

- 394 cashiers paid a fixed, hourly wage
- 2-yrs of scanner data in 10-min increments

Supermarket Cashiers: Results

- 10% higher permanent productivity cashier into a shift
  - ↑1.5% of others on the shift
  - ***Line-of-sight only***
    - ↑ 2.7% when 1 or 2 stations behind
    - ↑ 1.3% when 3 or 4 positions behind
    - ↓3% when behind
- More responsive to those often on the same shift

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

Invited Commentary page 432

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).

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
you should or should not take antibiotics.

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

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,

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 esto, es importante que usted sólo use un antibiótico cuando sea necesario para su

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.

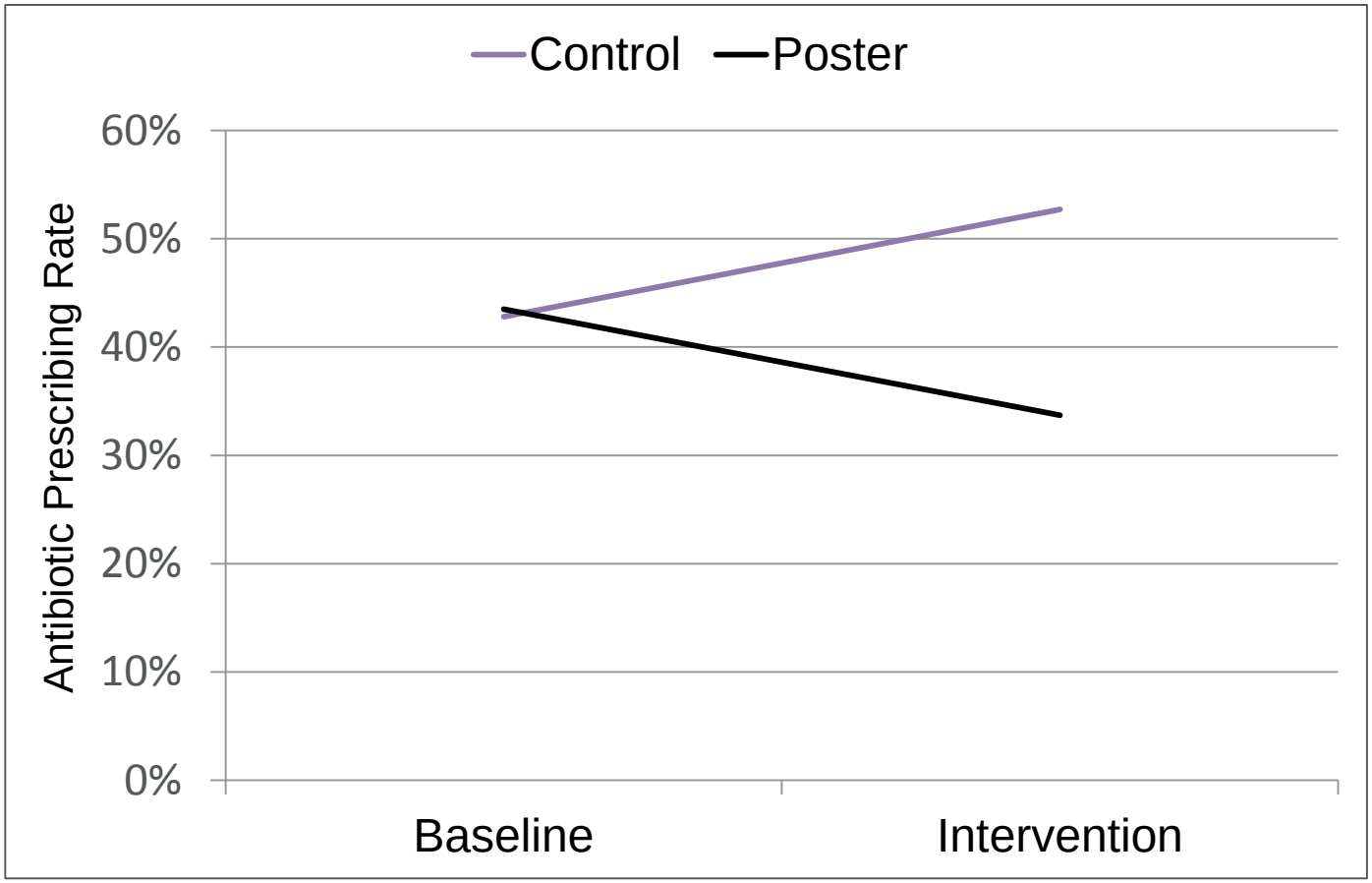
Atentamente,

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.

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

Internal use only.
Do not distribute.

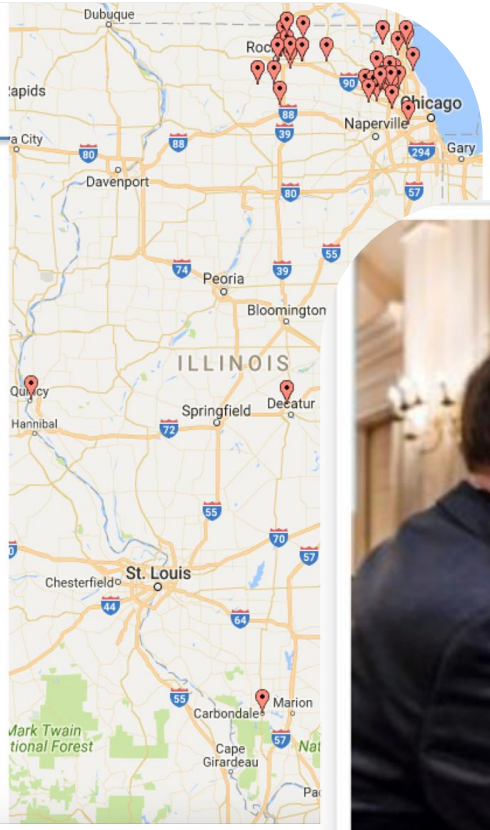
PDSB Campaign Goals

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

Phase I Participation

March 2015 → Present

- 55 practices representing > 385 providers



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.

CDC Core Elements Outpatient Antibiotic Stewardship (2017)

EU Draft Guidelines for Antibiotic Stewardship

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.

Editorial page 558

Supplemental content at jama.com

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

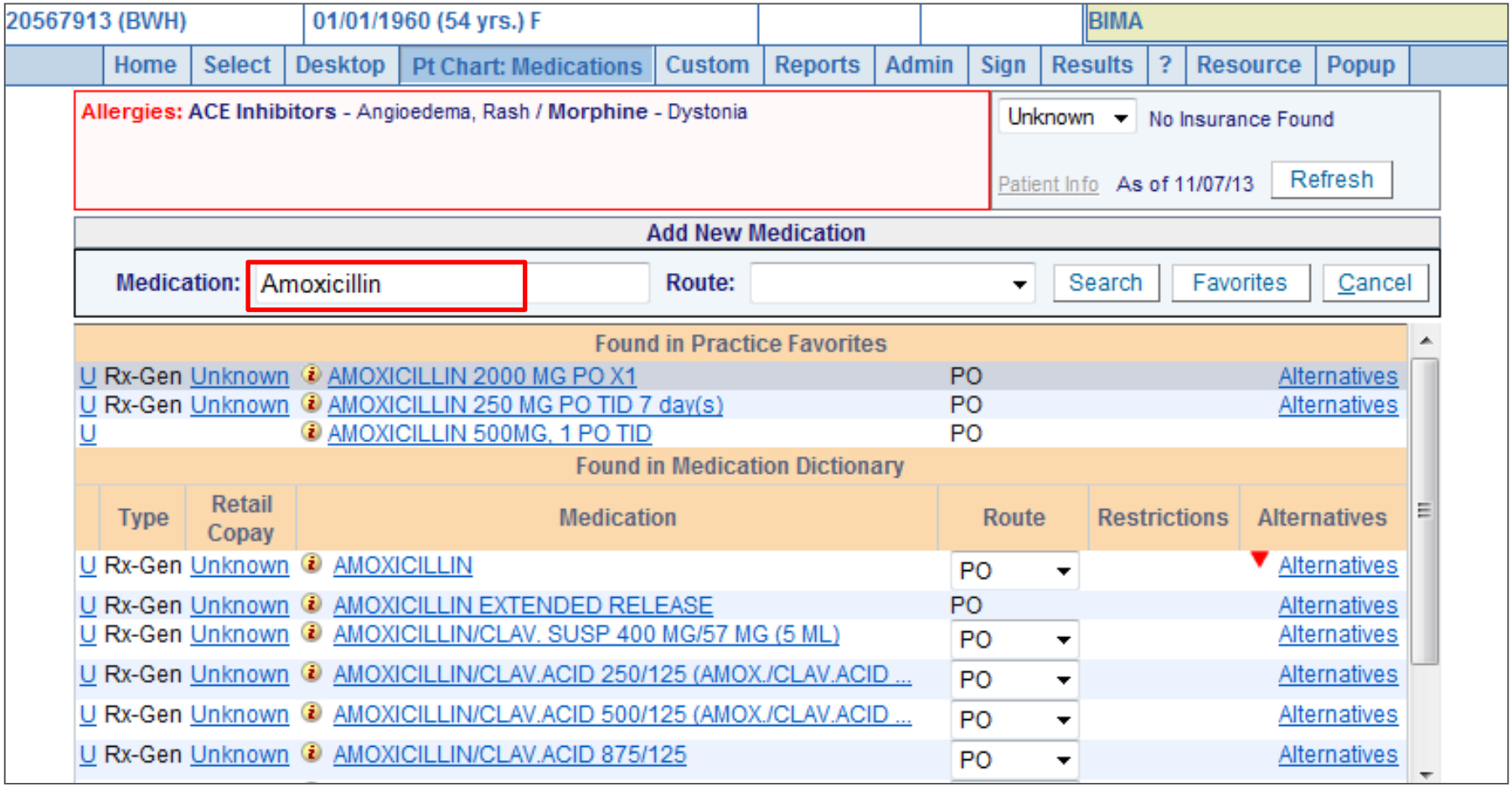
Specific Aim

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

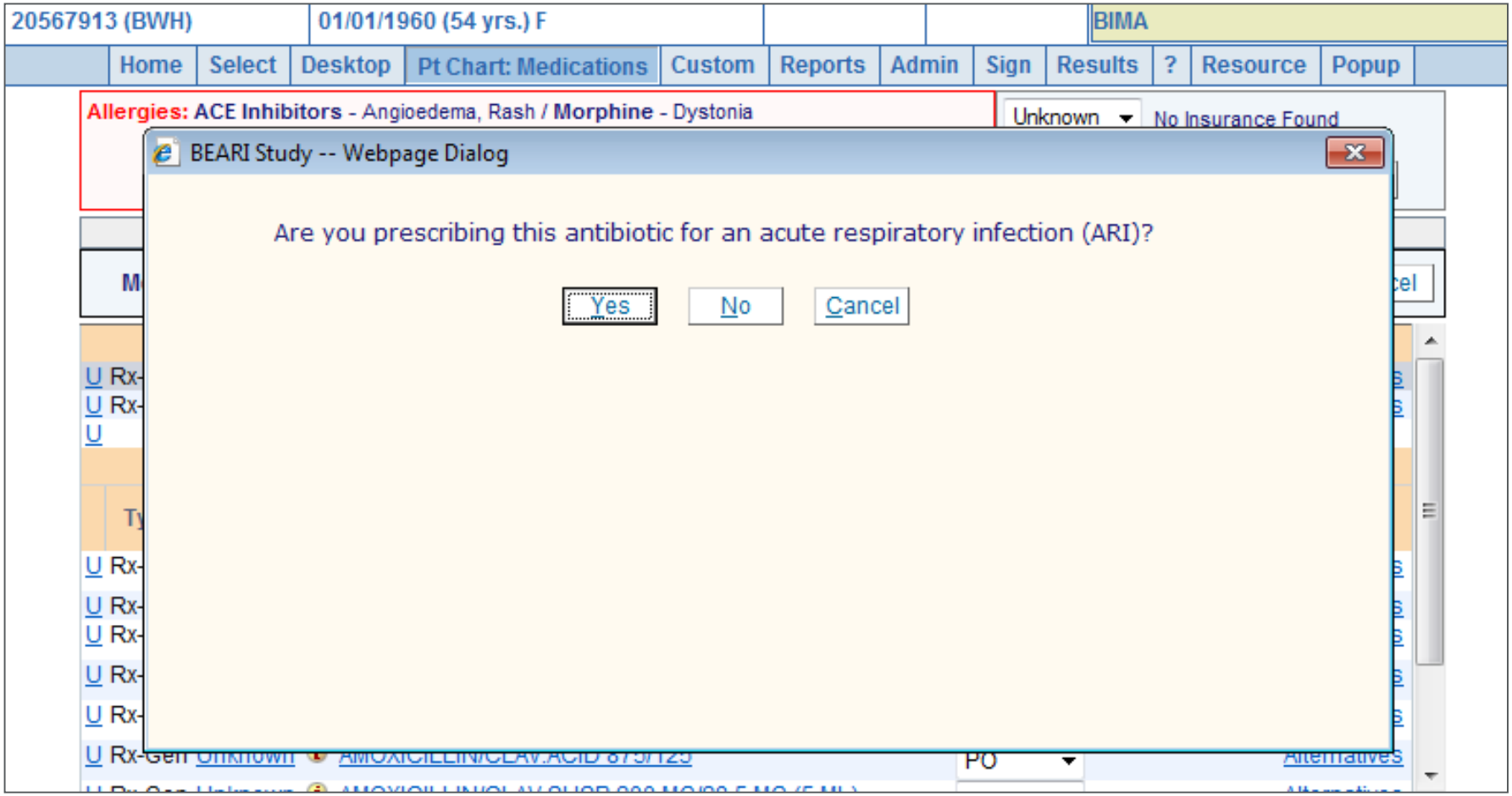
Interventions

1. Suggested Alternatives
2. Accountable Justification
3. Peer Comparison

Intervention 1: Suggested Alternatives



Intervention 1: Suggested Alternatives



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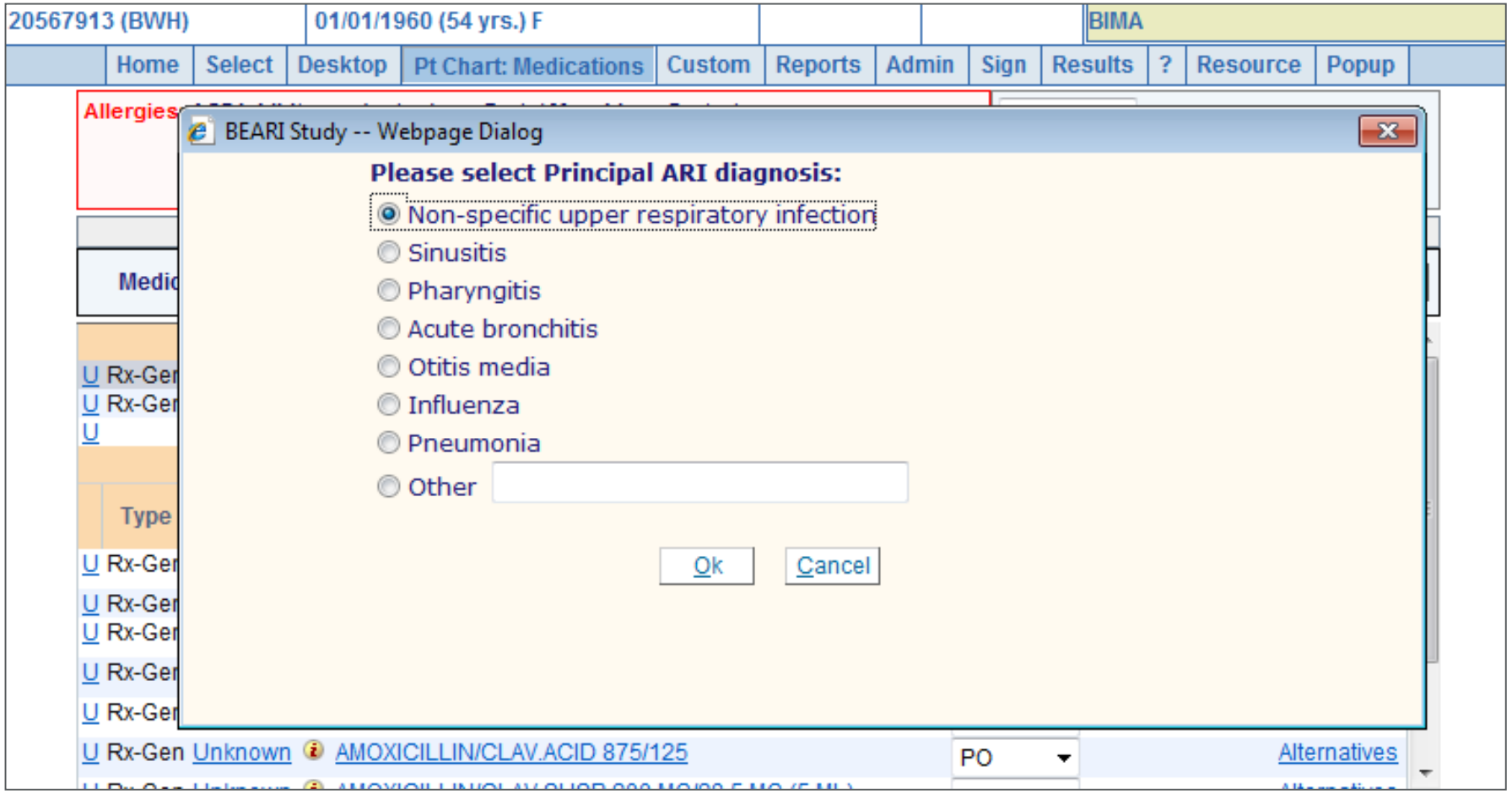

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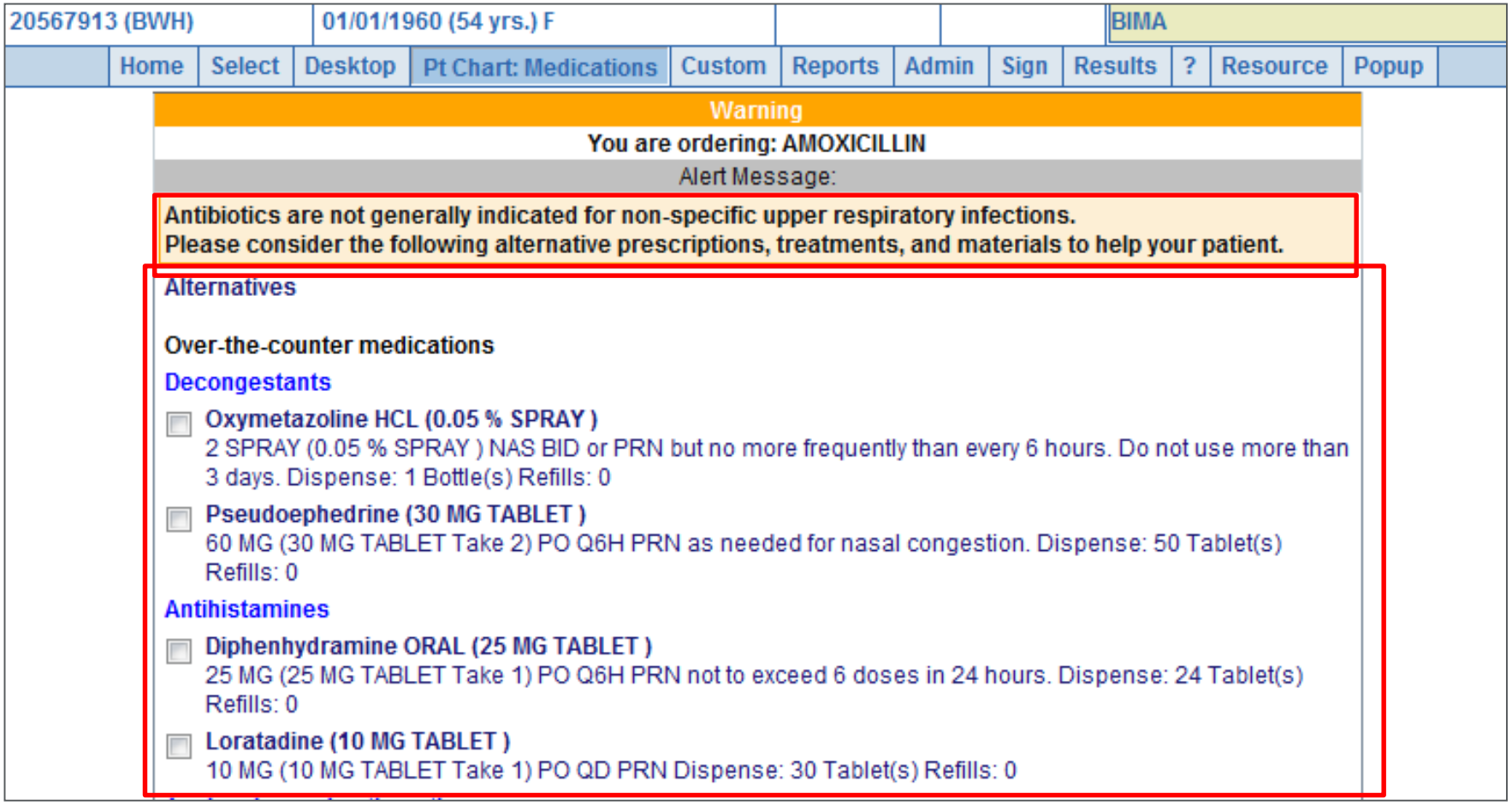
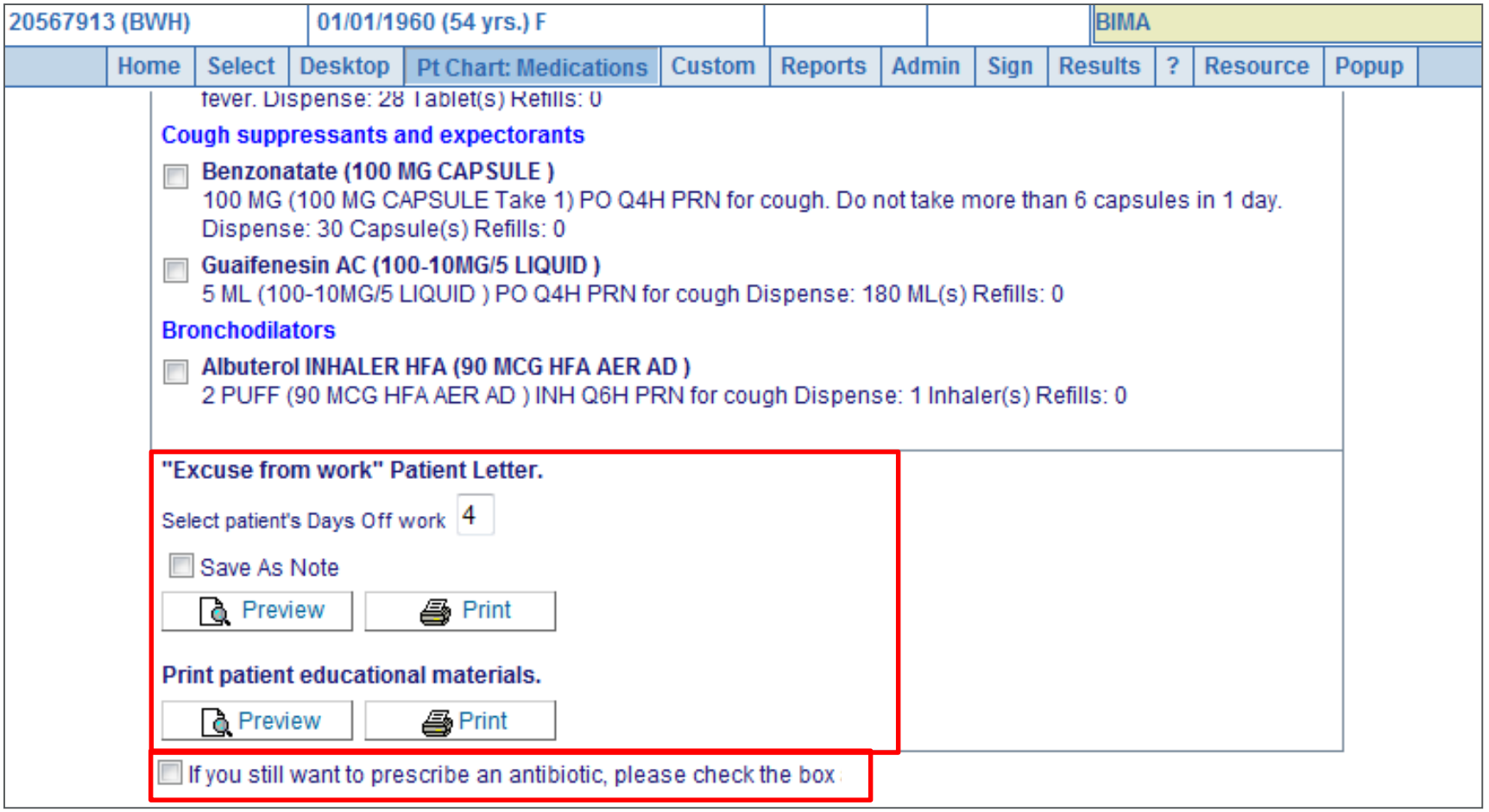
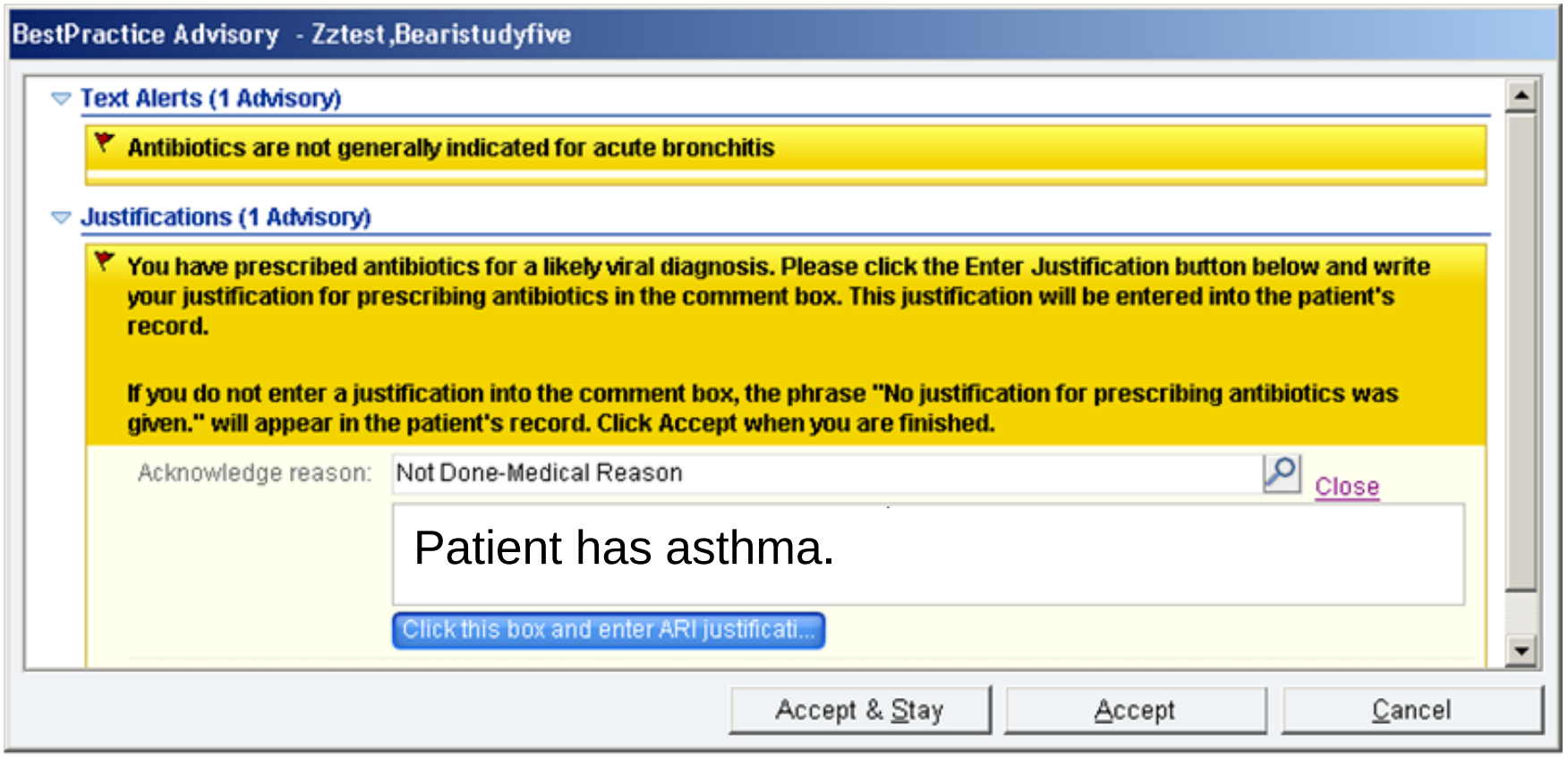


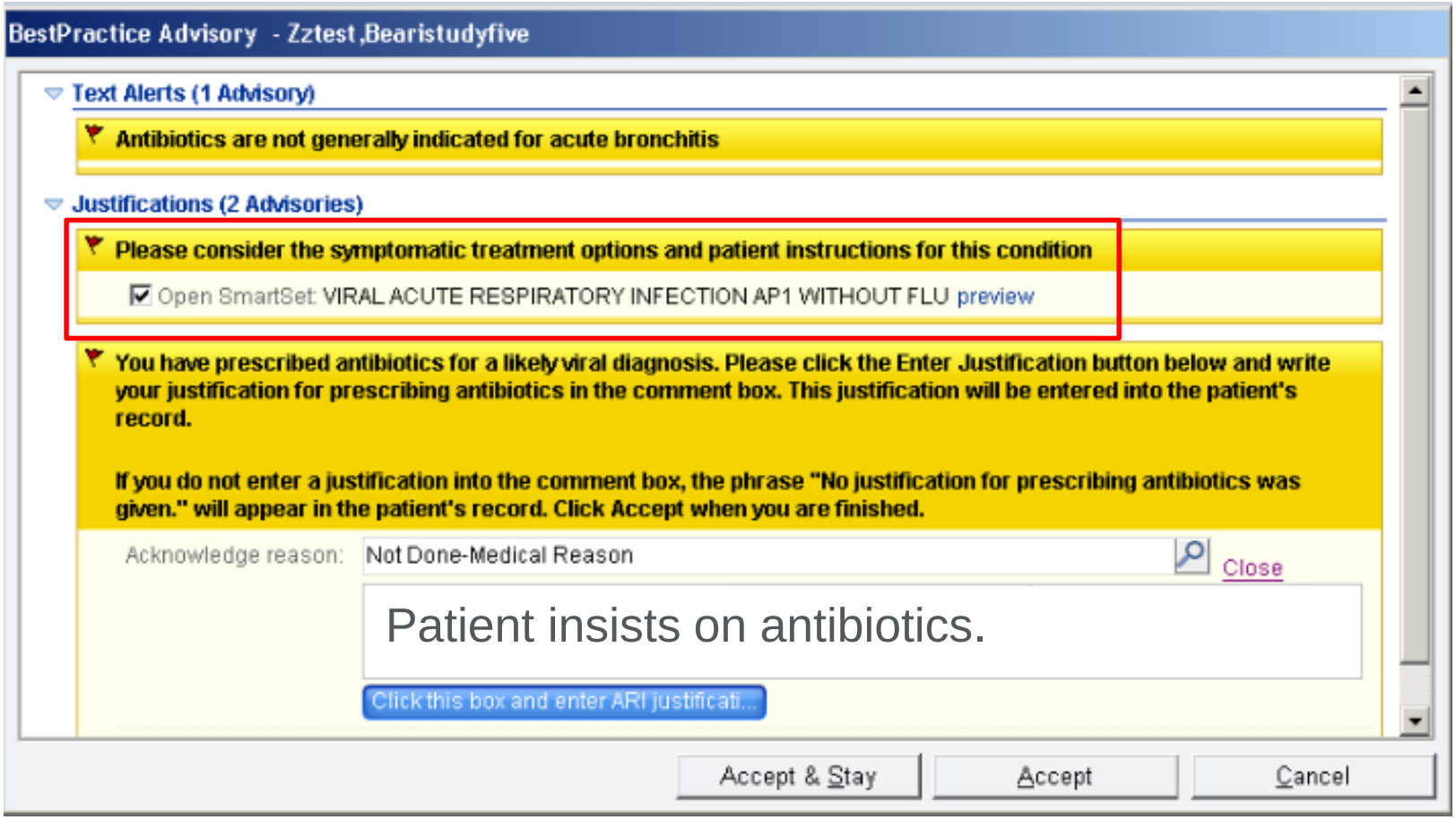
Intervention 1: Suggested Alternatives



Intervention 2: Accountable Justification



Interventions 1 and 2: Combined



Intervention 3: Peer Comparison

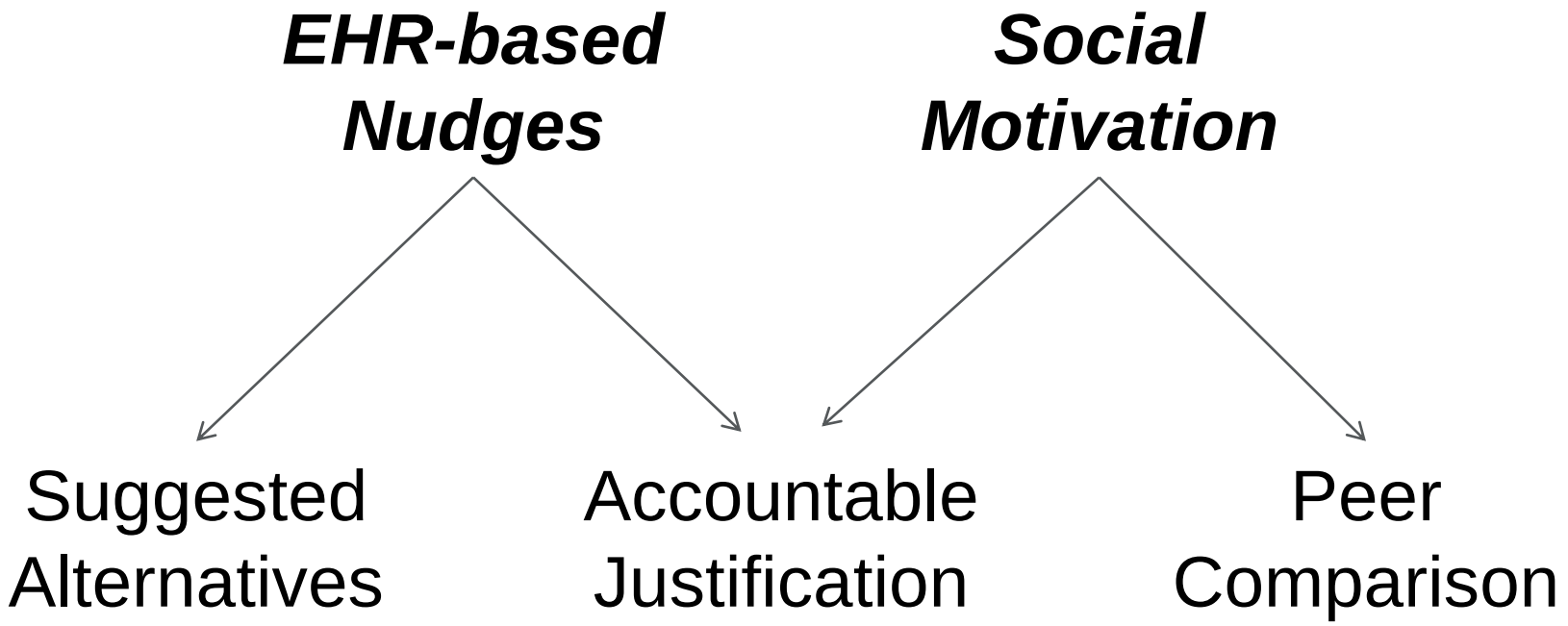
"You are a Top Performer"

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



Methods: Practices and Randomization

47 Primary Care Practices

3 Health Systems, 3 EHRs

Los Angeles: 25

Boston: 22

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
  - Modeled differences in the trajectory of antibiotic prescribing starting at month zero
  - Evaluated interactions

- ***Timing:*** pre-intervention, intervention, post-intervention

Persistence of Effects

Letters

RESEARCH LETTER

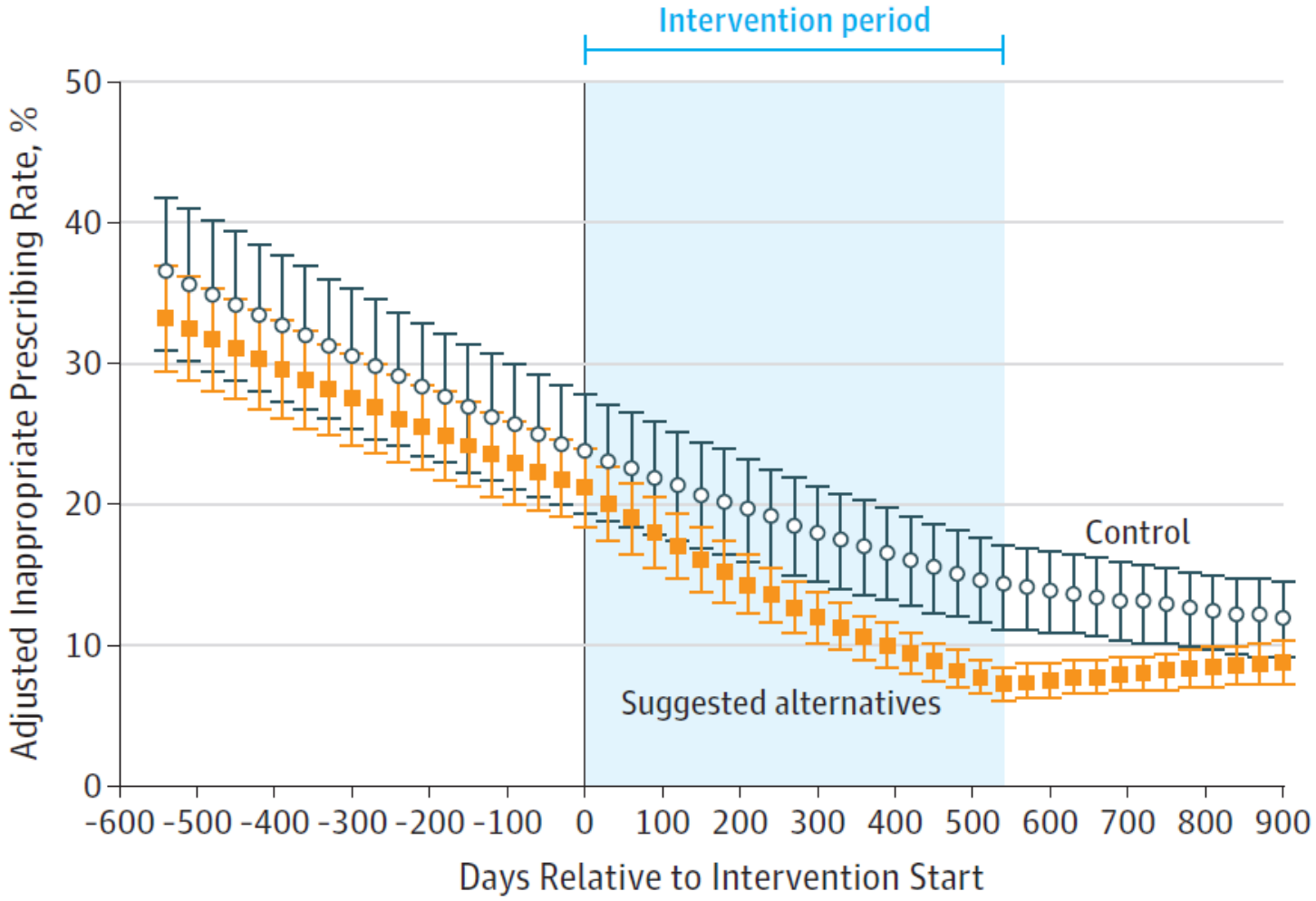
Effects of Behavioral Interventions on Inappropriate Antibiotic Prescribing in Primary Care 12 Months After Stopping Interventions

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

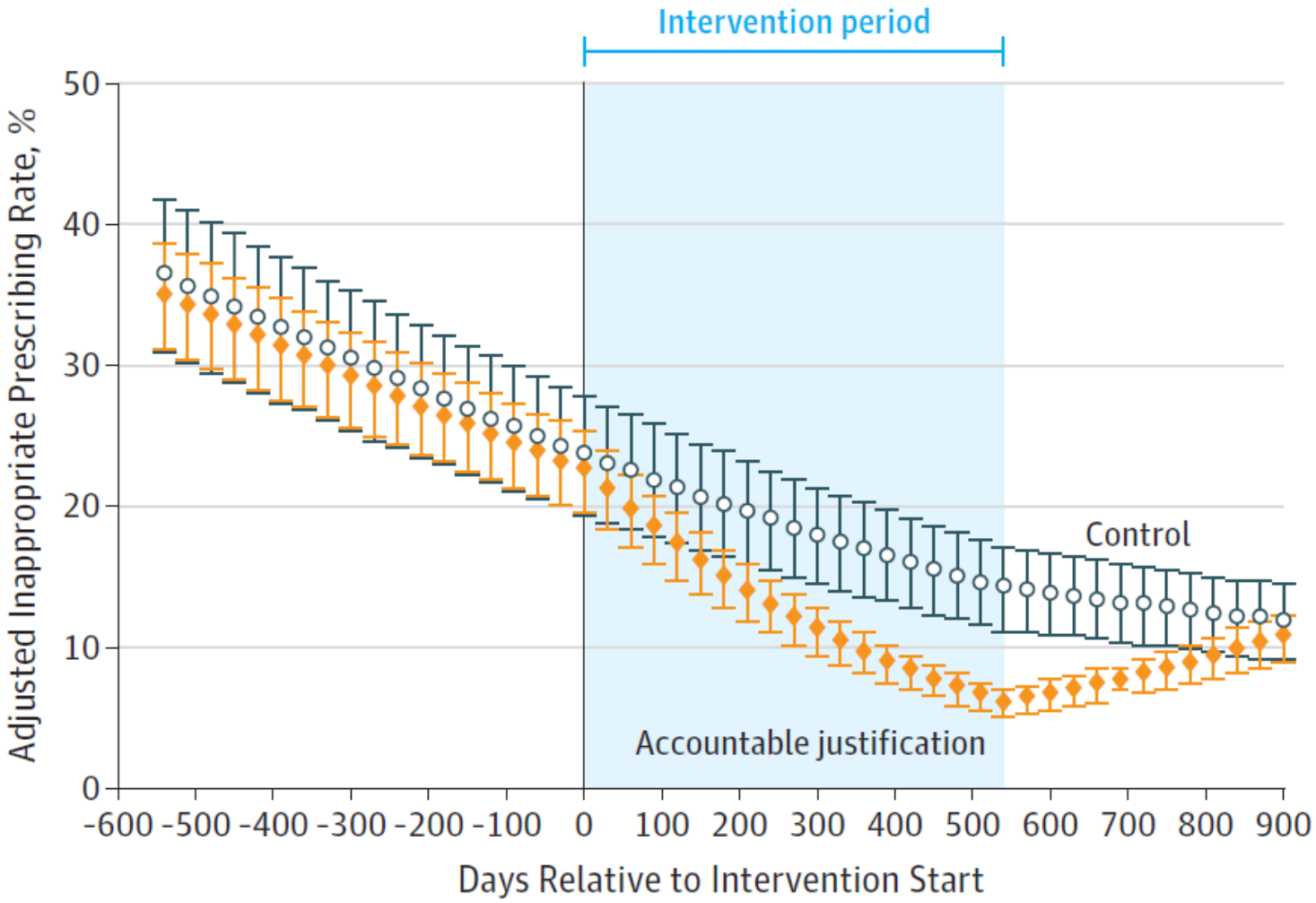
Results | There were 14 753 visits for antibiotic-inappropriate ARIs during the baseline period, 16 959 during the intervention period, and 7489 during the postintervention period. During the postintervention period, the rate of inappropriate antibiotic prescribing decreased in control clinics from 14.2% 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: Suggested Alternatives



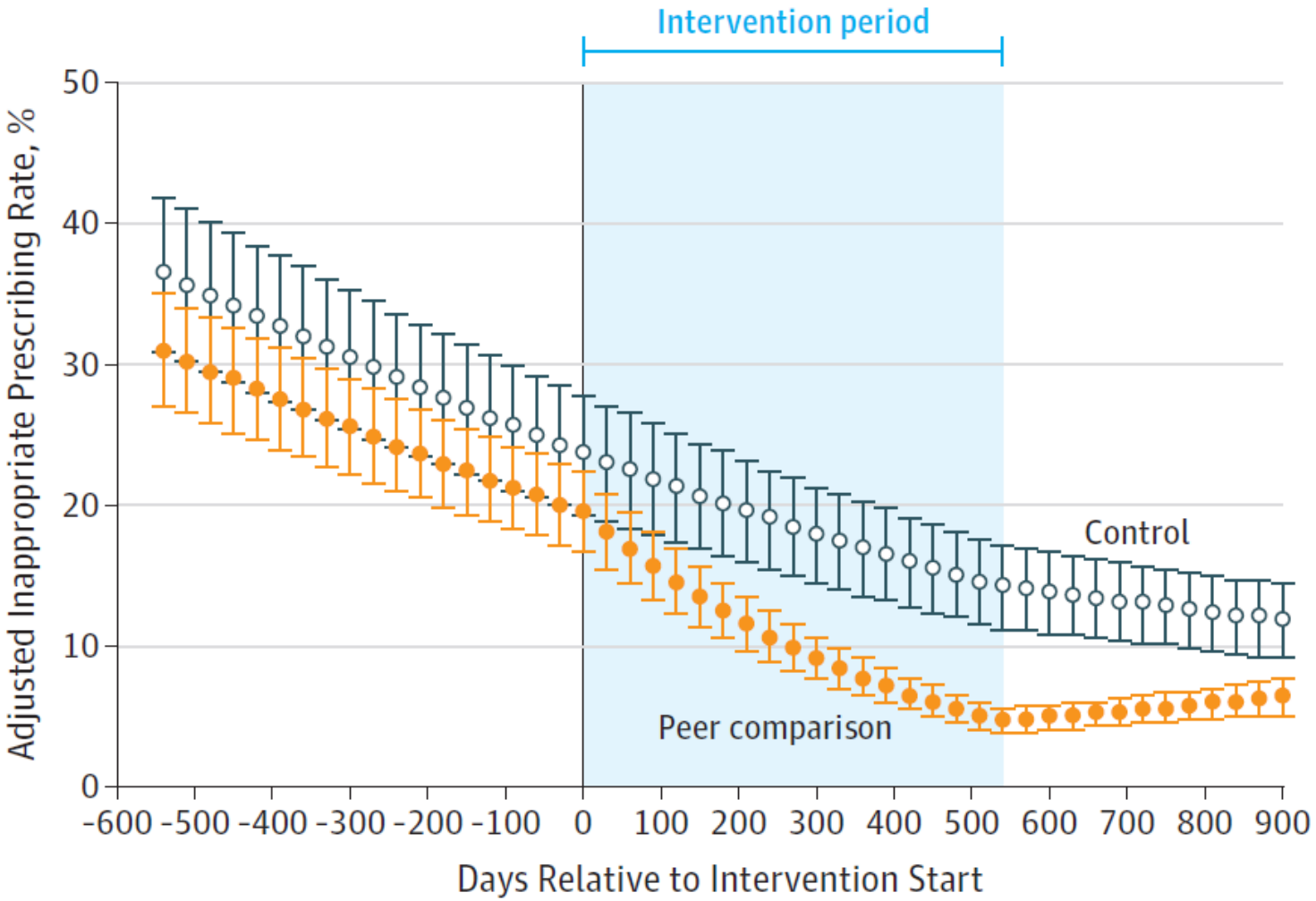
Linder. JAMA 2017

Persistence: Accountable Justification



Linder. JAMA 2017

Persistence: Peer Comparison



Linder. JAMA 2017

Limitations

- Limited to enrollees
- Dependent on EHR and billing data

Strengths

- Randomized controlled trial
- Large size
- 3 different EHRs

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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

Mehrotra and Linder. JAMA Intern Med 2016

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?

jlinder@northwestern.edu @jeffreylinder