COMPUTERIZED INTERVENTIONS TO IMPROVE PRESCRIBING PRACTICES

An Example Aimed At Promoting Antibiotics Stewardship

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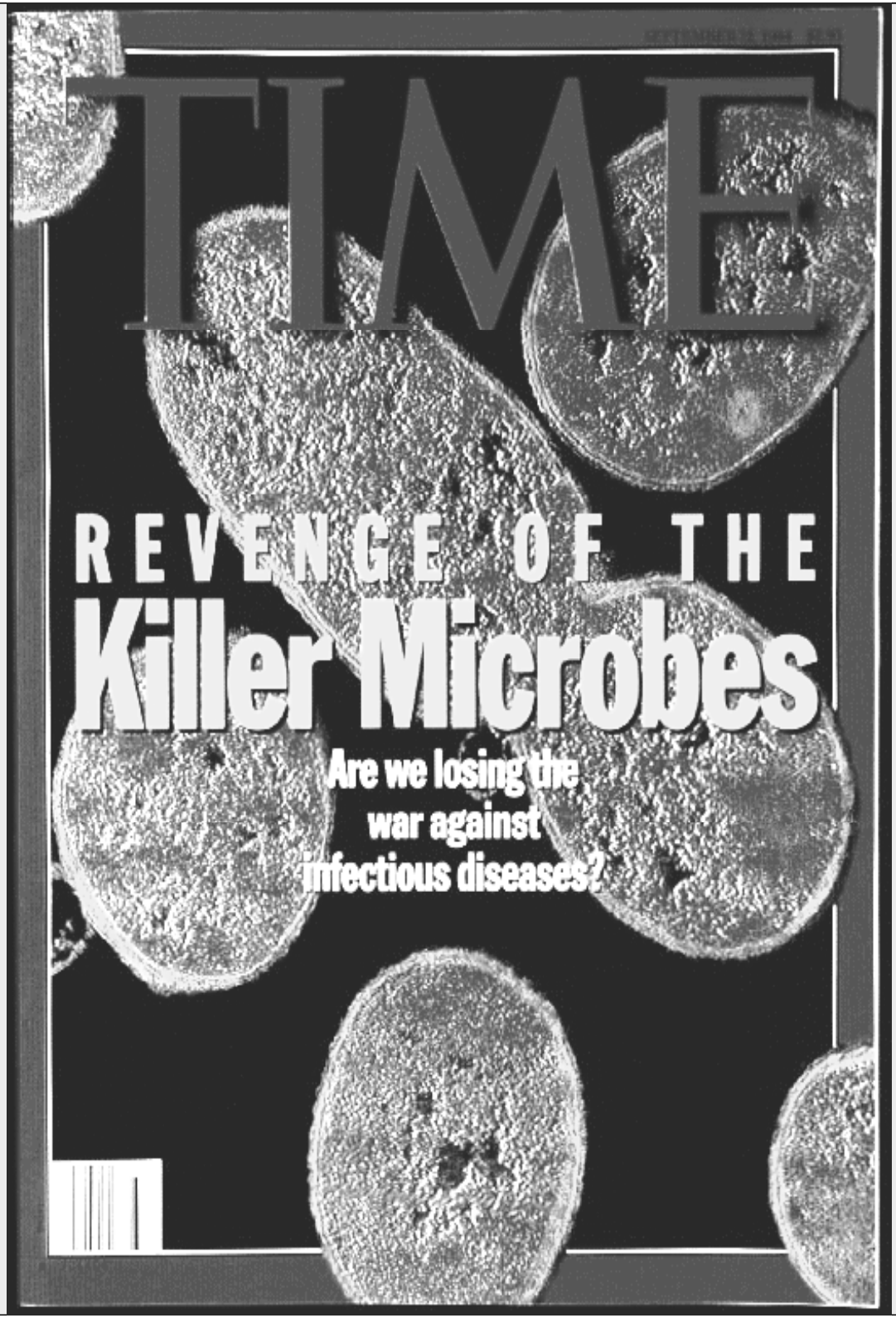
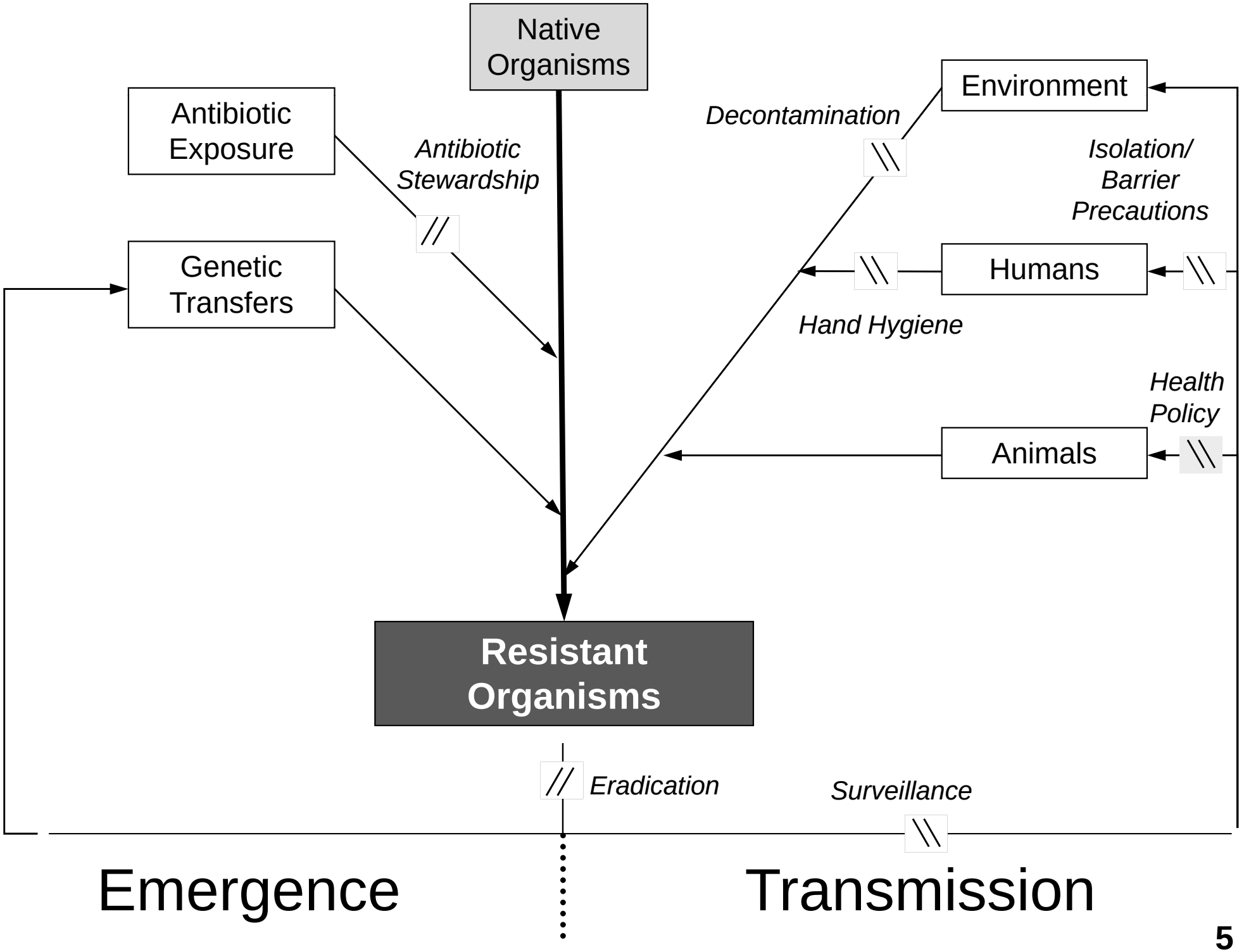
Objectives

- Gain a conceptual framework for the pharmacotherapeutic process
- Gain an approach to deploy informatics interventions in pharmacy
- Understand how to evaluate such an intervention: the example of antibiotics stewardship in the outpatient arena


TIME
REVENGE OF THE
Killer Microbes
Are we losing the
war against
infectious diseases?

Antibiotics Stewardship

- Responsibility to preserve the effectiveness of antibiotics


Native Organisms
Antibiotic Exposure
Antibiotic Stewardship
Environment
Decontamination
Isolation/ Barrier Precautions
Genetic Transfers
Humans
Hand Hygiene
Health Policy
Animals
Resistant Organisms
Eradication
Surveillance
Emergence
Transmission

Associations Between Antimicrobial Use and Resistance.

- Changes in use parallel changes in resistance
- Resistance is more prevalent in healthcare-associated compared with community-acquired infections
- Hospital units with highest rates of antimicrobial use also have the highest rates of resistance
- Patients with infections caused by resistant strains are more likely to have received prior antimicrobials
- Increasing duration of patient exposure to antimicrobials increases colonization with resistant organisms

Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship: Clinical Infectious Diseases 2007;44:159-77

The Target: Outpatient Antibiotics

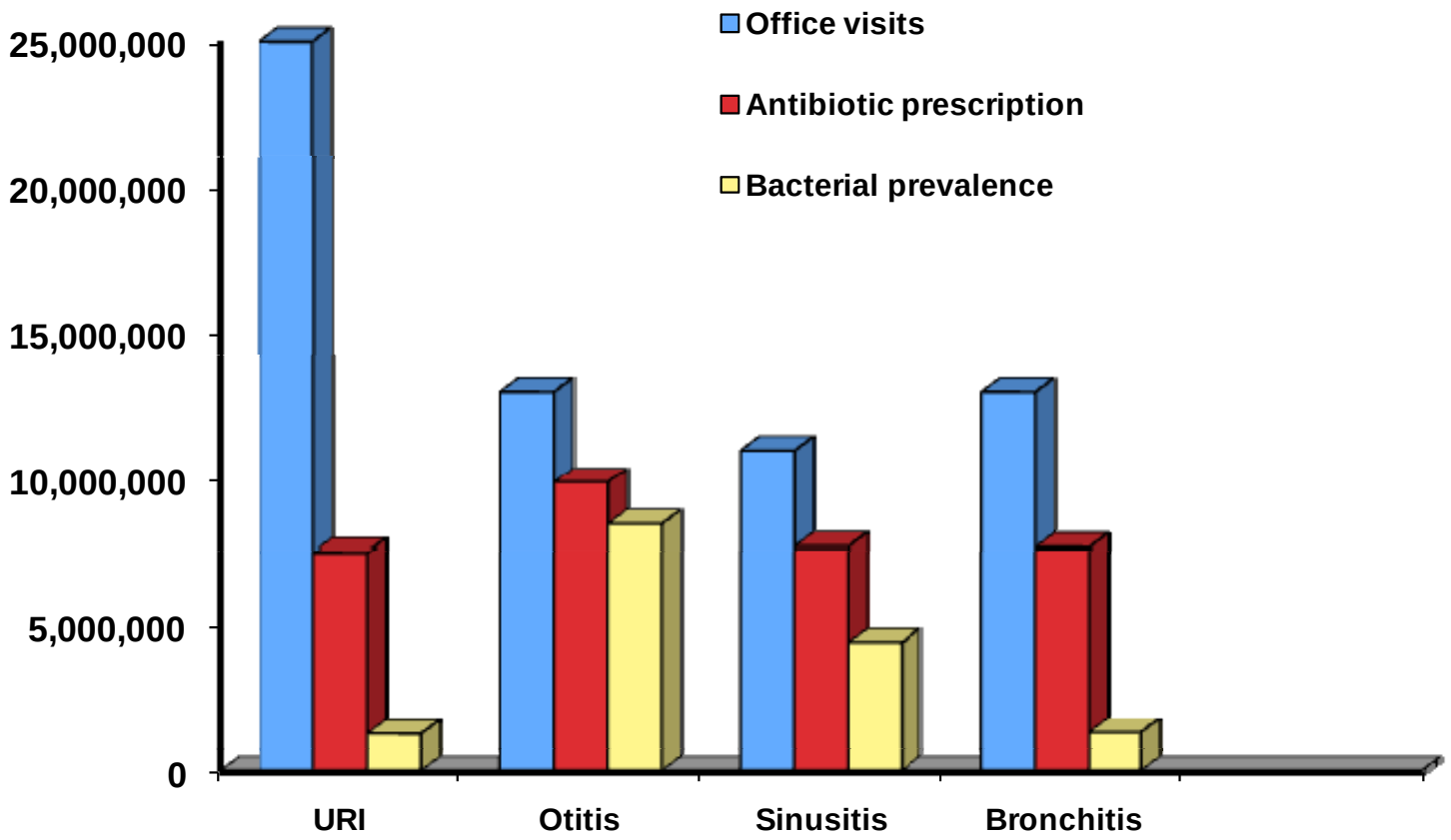
"Don't forget to take a handful of our complimentary antibiotics on your way out."

Outpatient Antibiotics

- Prescribed mostly (75%) for acute respiratory infections…
  - Otitis media
  - Sinusitis
  - Pharyngitis
  - Bronchitis
  - Non-specific URIs

- …illnesses where antibiotic usage is mostly ineffective

Antibiotic Use in Outpatient Respiratory Illnesses



Adapted from Gonzales, CID 2001:33p759-760

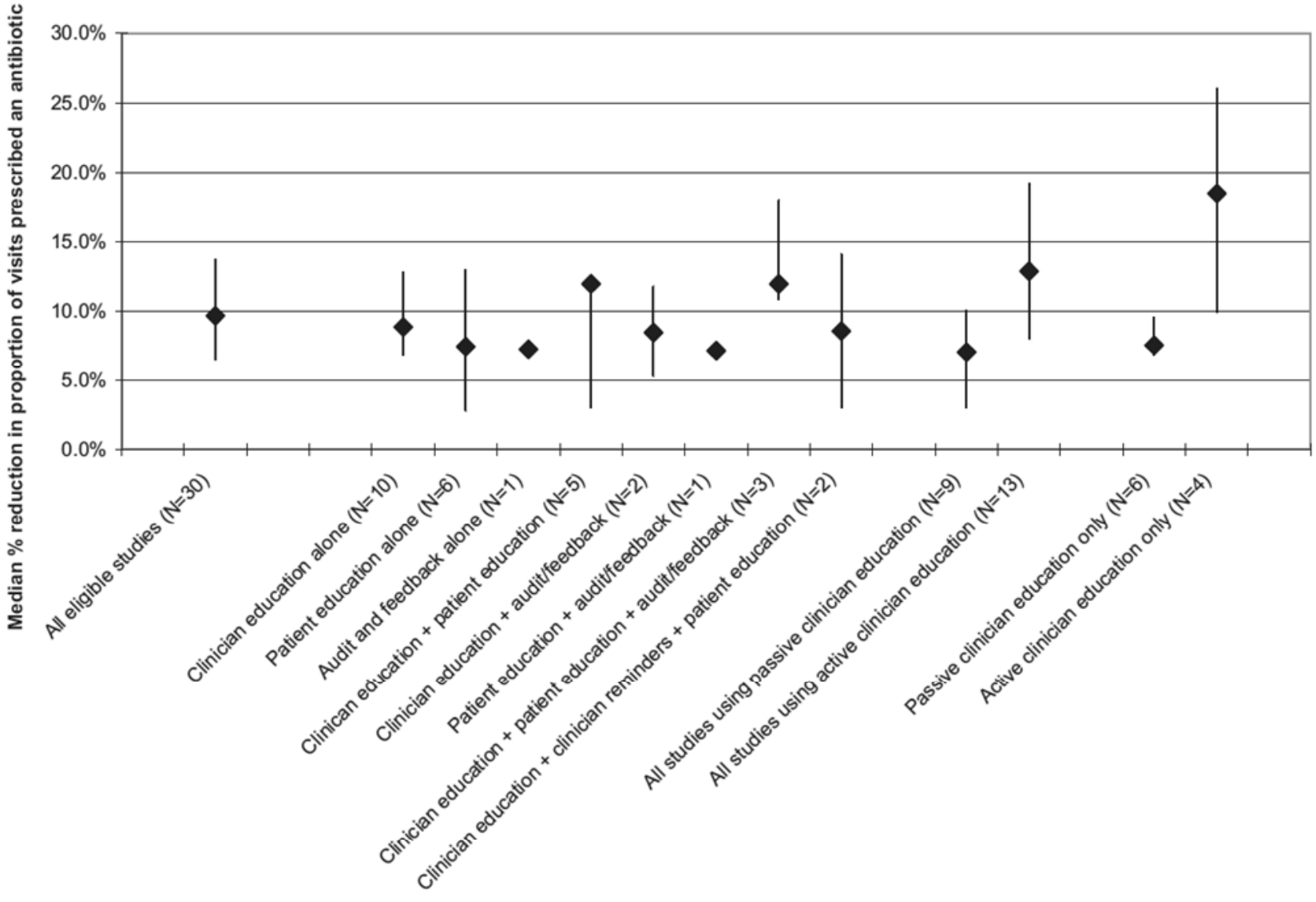
Designing an Effective Intervention

What Has Been Done?

Approaches to Reduce Overuse of Antibiotics for ARI

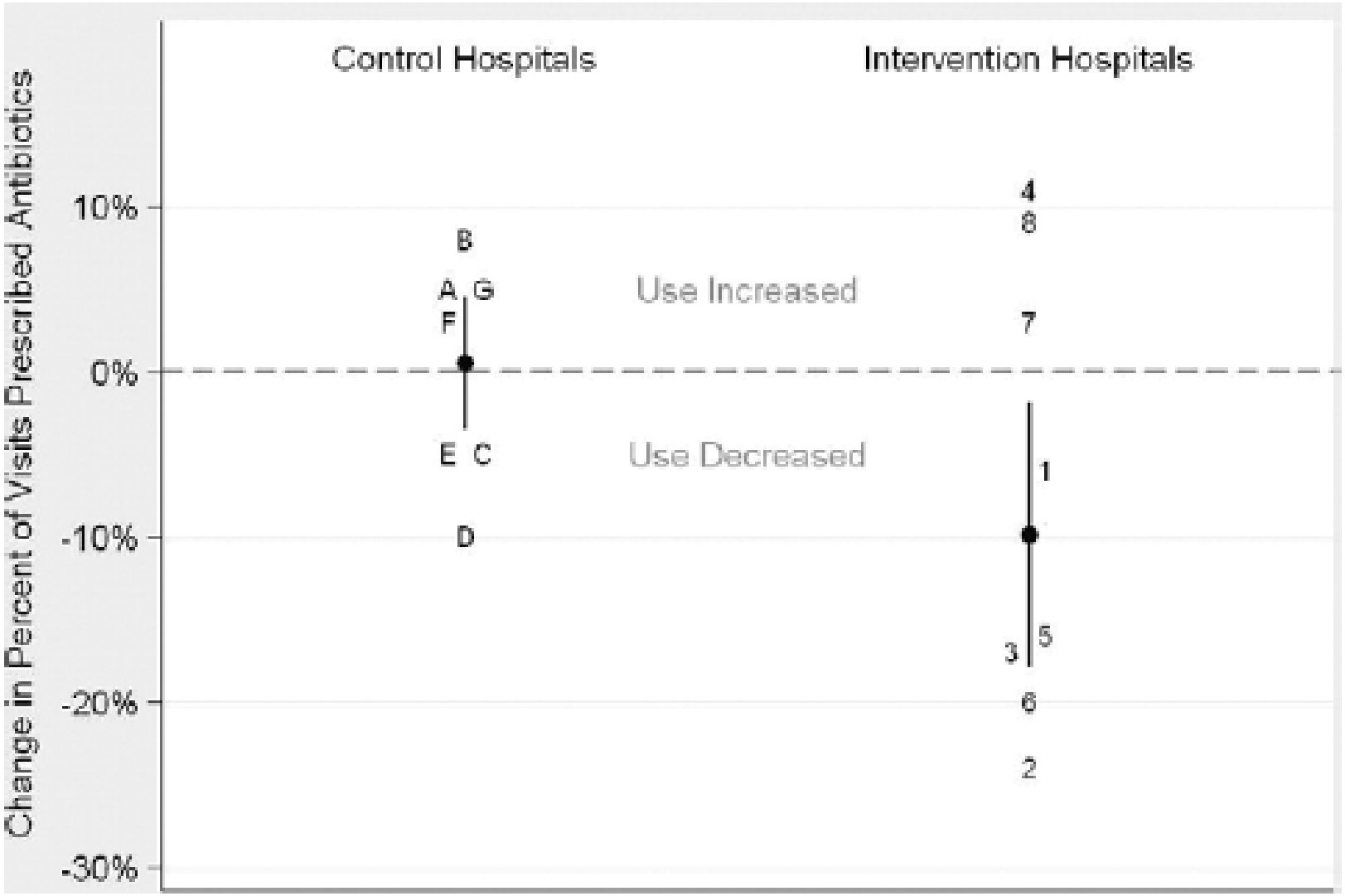
- Education
  - Clinicians
  - Patients
  - Community
- Audit-Feedback
- Combination of above

Approaches to Reduce Overuse of ABX



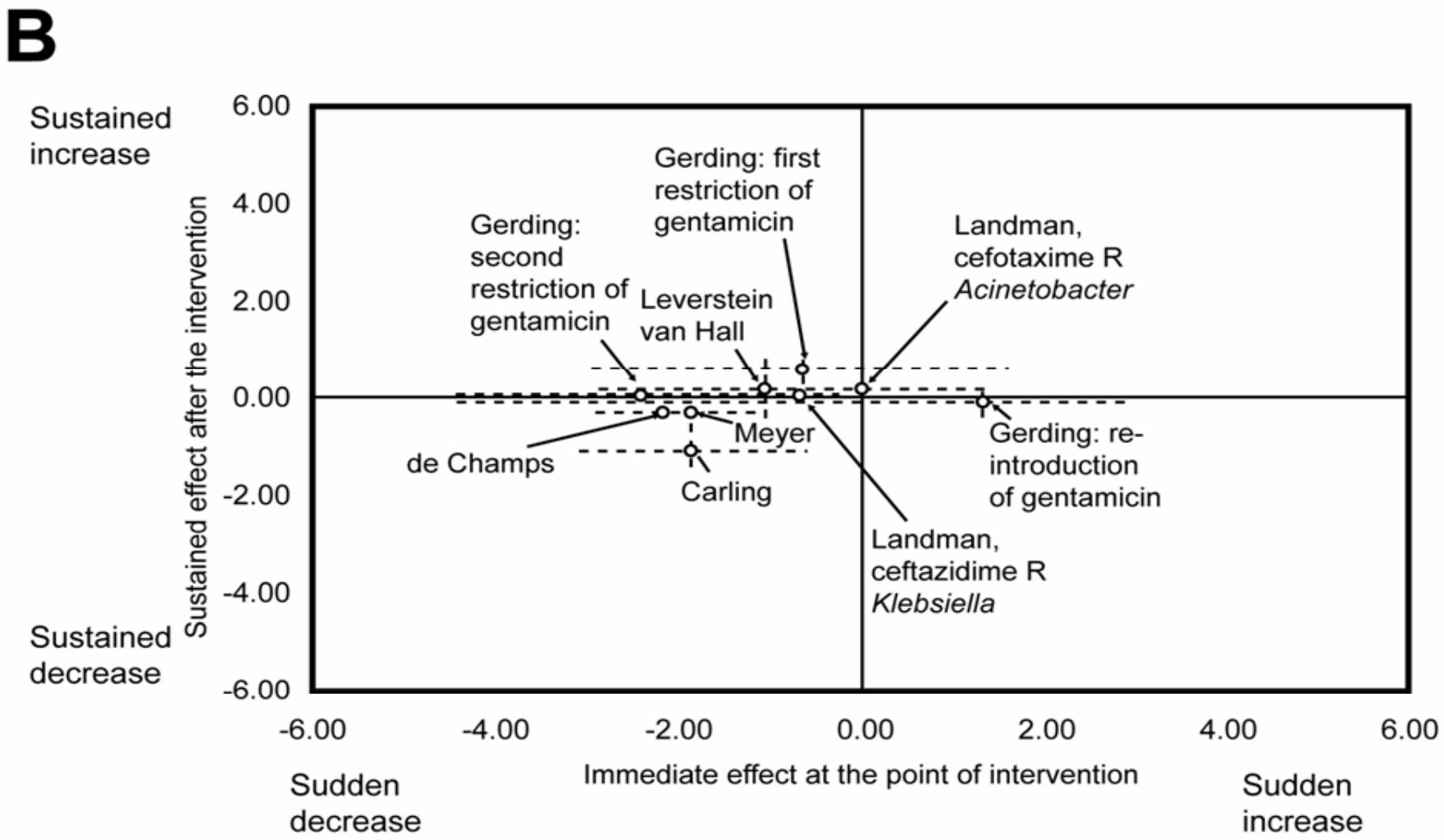
Ranji et al., Medical Care 2008; 46; 847

Effect Size Variation



Metlay JP et al. Ann Emerg Med 2007; 50, 221-230

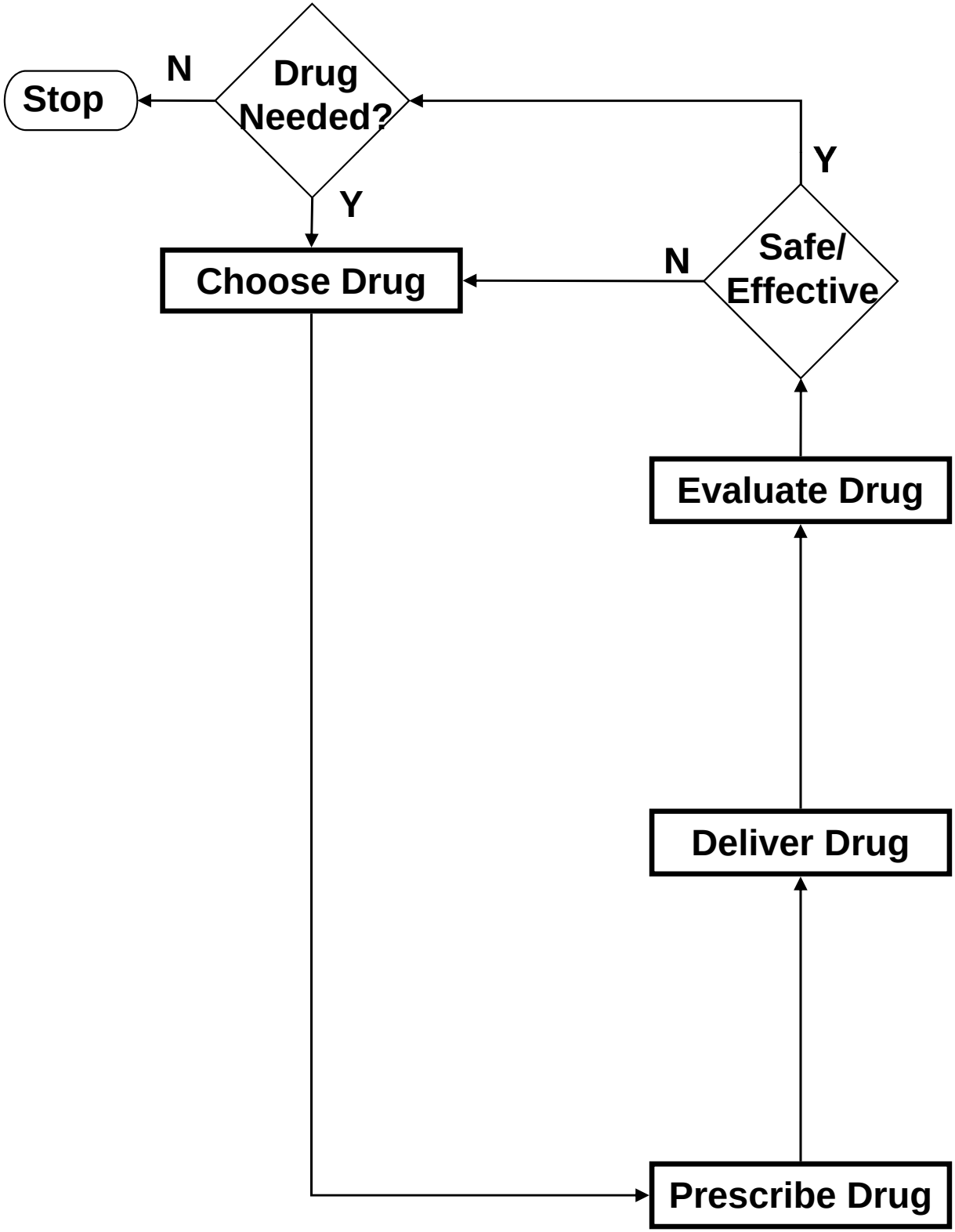
Sustainability of Antibiotics Stewardship Interventions

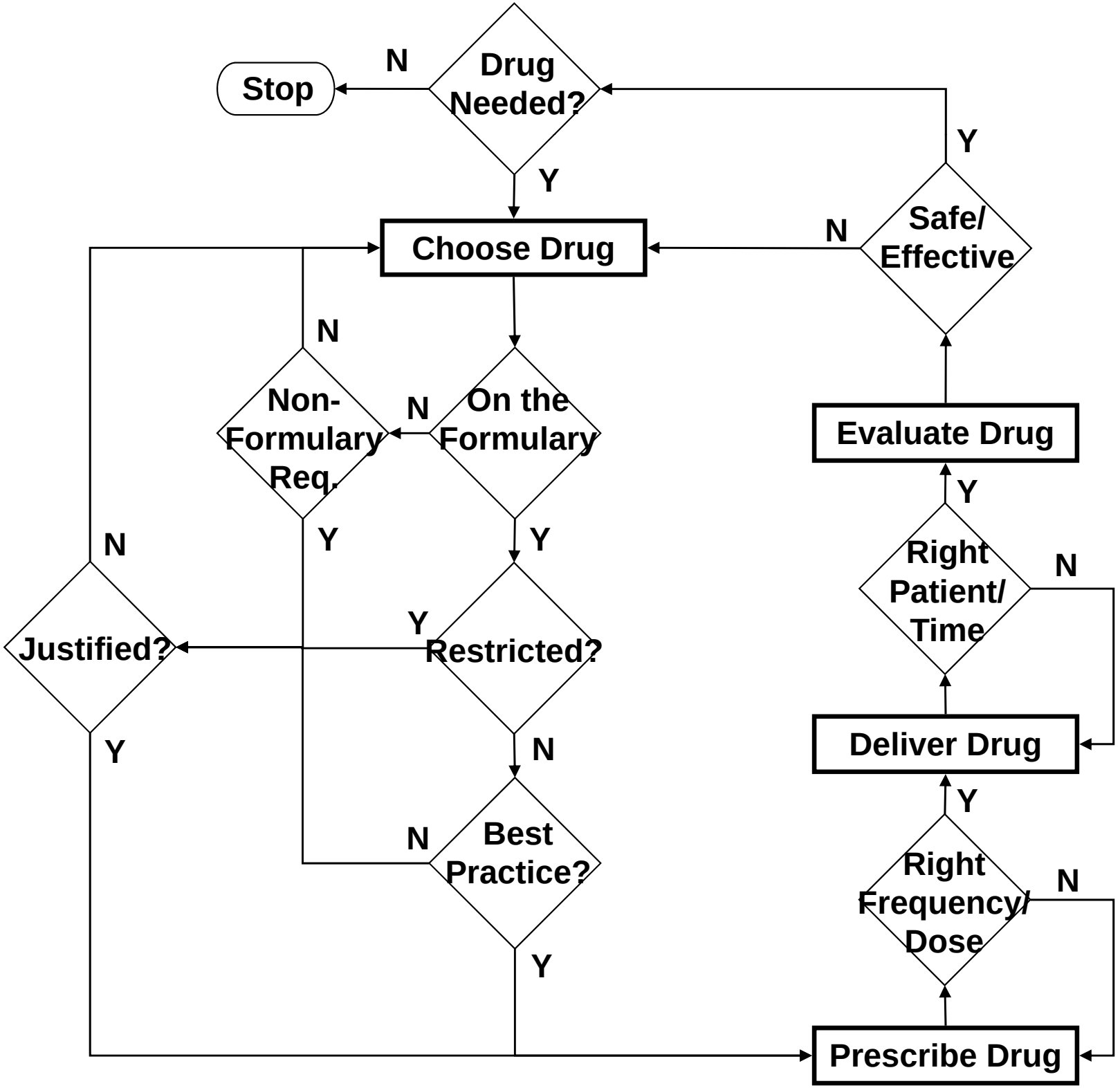


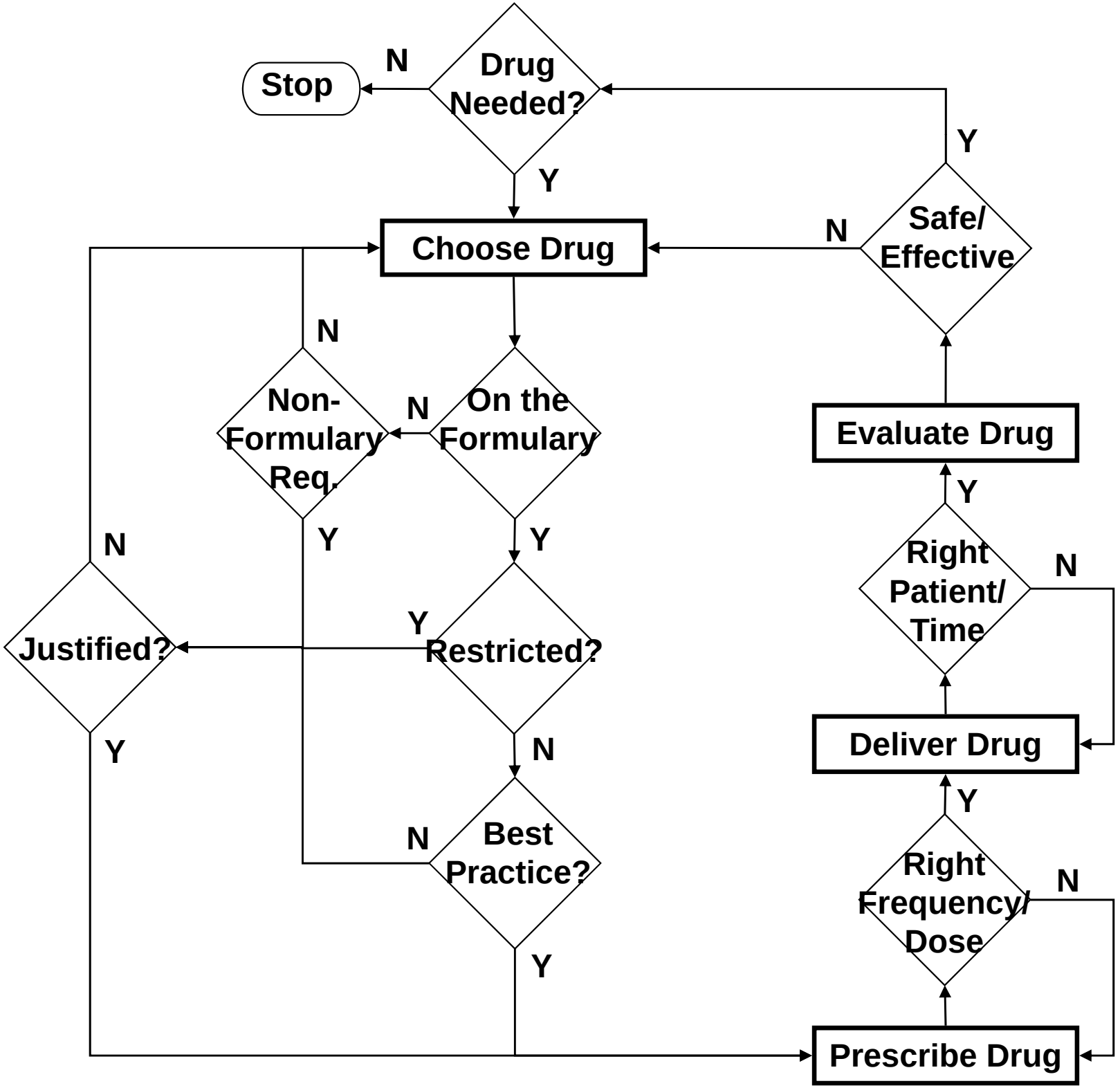
Davey P, et al. Systematic Review of Antimicrobial Drug Prescribing in Hospitals. Emerging Infectious Diseases .2006;12:211-216.

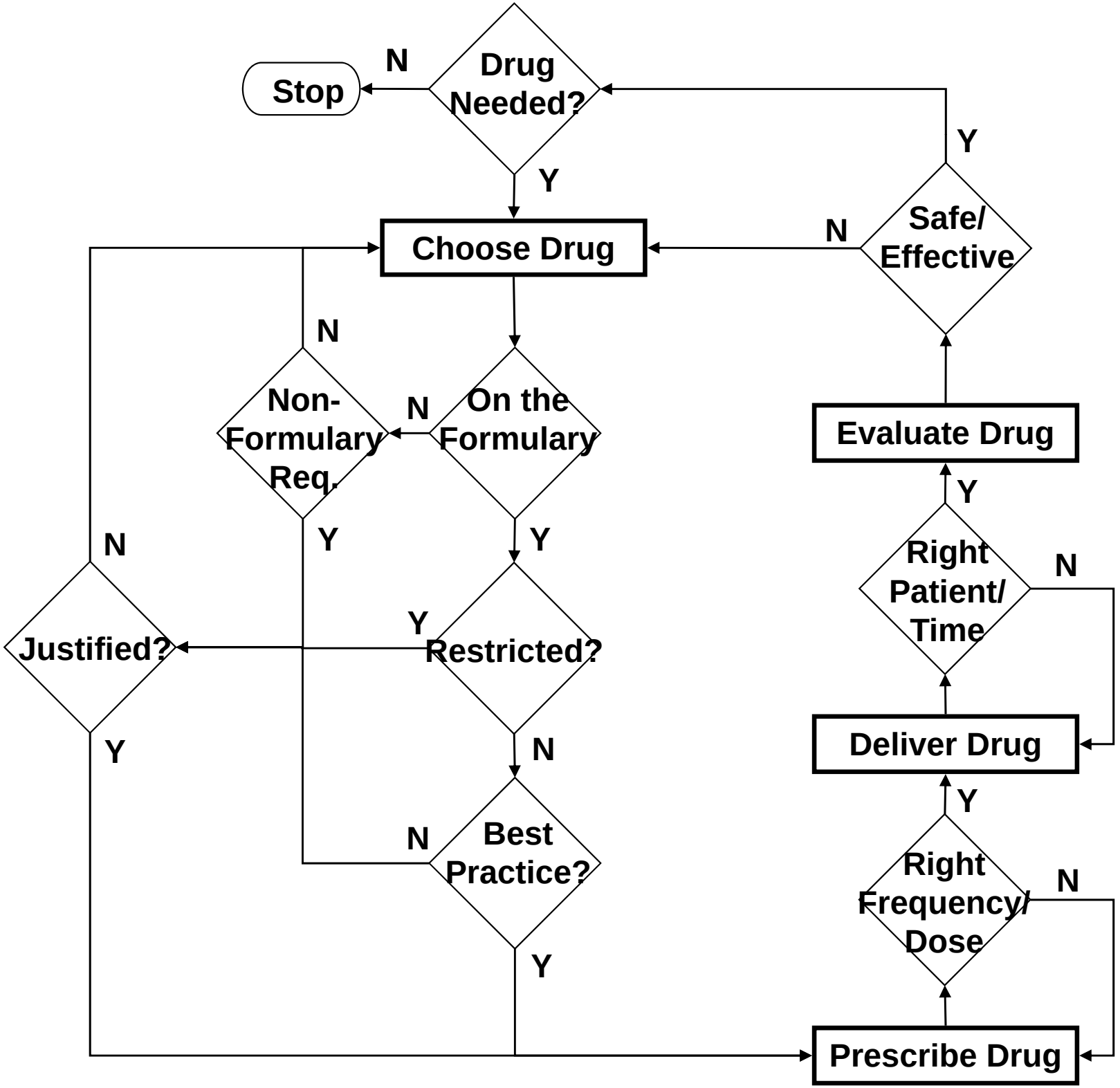
Designing an Effective Intervention

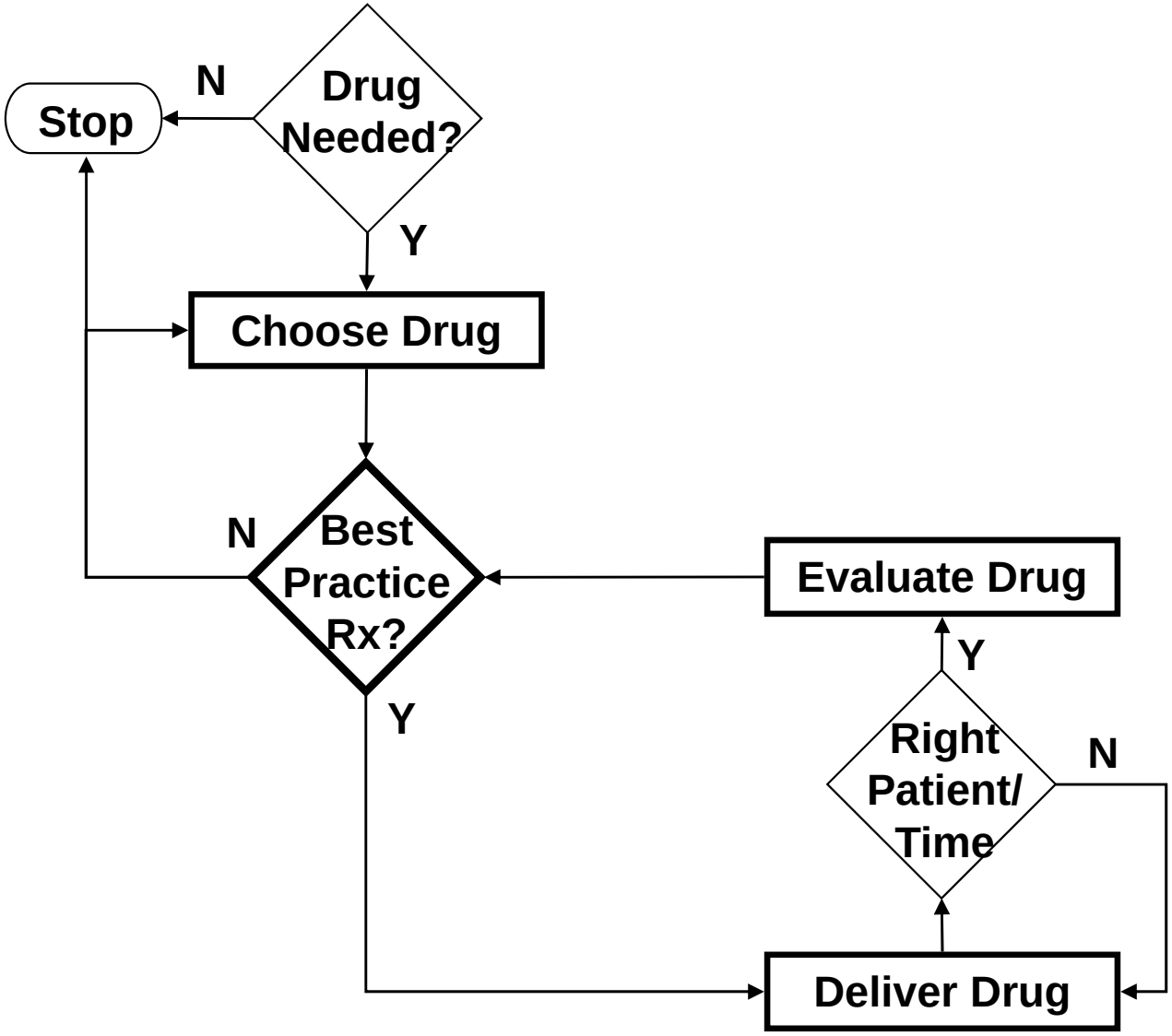
New Approaches Needed


Stop
N
Drug Needed?
Y
Y
Choose Drug
N
Safe/ Effective
Evaluate Drug
Deliver Drug
Prescribe Drug


Drug Needed?
N
Stop
Y
Choose Drug
Safe/ Effective
N
Y
Evaluate Drug
On the Formulary
N
Non-Formulary Req.
N
Y
Y
Right Patient/ Time
N
Y
Restricted?
Y
Justified?
N
Y
N
Deliver Drug
Y
Best Practice?
N
Right Frequency/ Dose
N
Y
Prescribe Drug


Drug Needed?
N
Stop
Y
Choose Drug
Safe/ Effective
N
Y
Evaluate Drug
Y
Right Patient/ Time
N
Deliver Drug
Y
Right Frequency/ Dose
N
Prescribe Drug
On the Formulary
N
Non-Formulary Req.
N
Y
Y
Restricted?
Y
N
Best Practice?
N
Y
Justified?
N
Y


Drug Needed?
N
Stop
Y
Choose Drug
Safe/ Effective
N
Y
Evaluate Drug
Y
Right Patient/ Time
N
Deliver Drug
Y
Right Frequency/ Dose
N
Prescribe Drug
Y
Best Practice?
N
N
Y
Restricted?
Y
N
Justified?
N
Y
On the Formulary
N
Non-Formulary Req.
N
Y


Drug Needed?
N
Stop
Y
Choose Drug
Best Practice Rx?
N
Y
Evaluate Drug
Y
Right Patient/ Time
N
Deliver Drug

The Intervention

The Intervention

- Clinical decision-support software interposed at the time of an electronic prescription

- Deploy therapeutic guidelines for the diagnosis and treatment of ARI

Process Requirements

- GOAL is embraced by all
- RULES are clear and simple
- SIGNS are clear and visible
- Minimizes impedance to healthcare
- Adds value when possible
- Easy to maintain, monitor and share
- Credible
  - **CDS RULES are strong and evidence-based**
  - Safe and effective
  - Compliance is verifiable and enforced

Business Requirements

- Educate providers
- Document rationale
- Allow for feedback
- Imbed monitoring
- Mechanism to build, share and maintain the software

Technical Limitations

Requirements	Capabilities	Rx Order Entry	Order Menu	Note Templ.	Consult/ Note	CNT Templ.	Clinical Remind.
Educate/Feedback	Deploys Logic						
	Hyperlinks						
Document Rationale	**Generates Note**						
Facilitate Workflow	Communicates/Alerts						
	Links to Results						
	Links to Orders						
Human Factors	Intuitive access						
	Interface Control						
	Output Text control						
Process Monitoring	Database Exports						
	Statement Validation						
Process Sharing	Tool Exportability						

Clinical Practice Guidelines for ARI

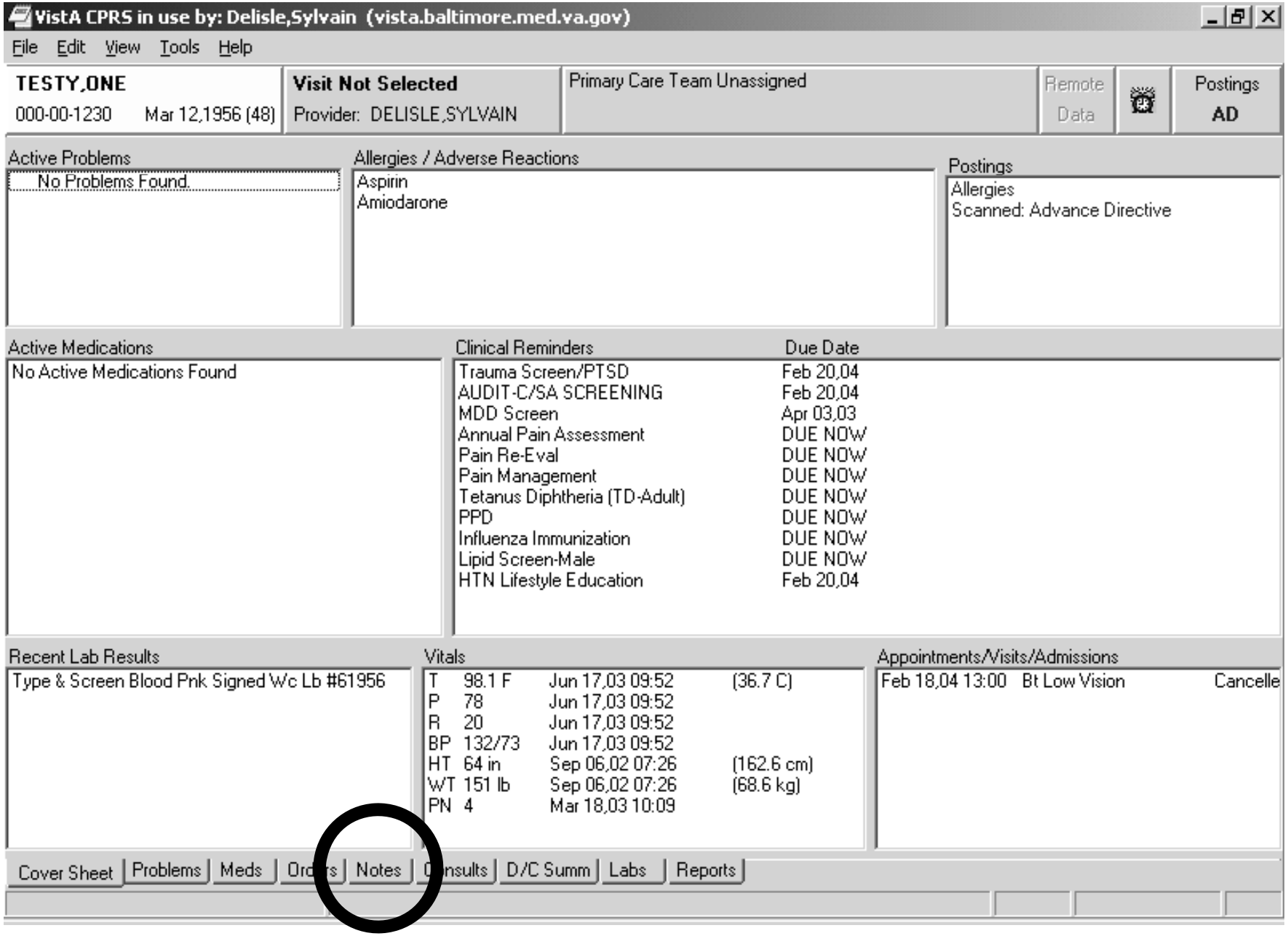
- Published in Annals of Internal Medicine in 2001, these guidelines were developed by a panel of clinicians and endorsed by the CDC, IDSA, ACP-ASIM and AAFP.

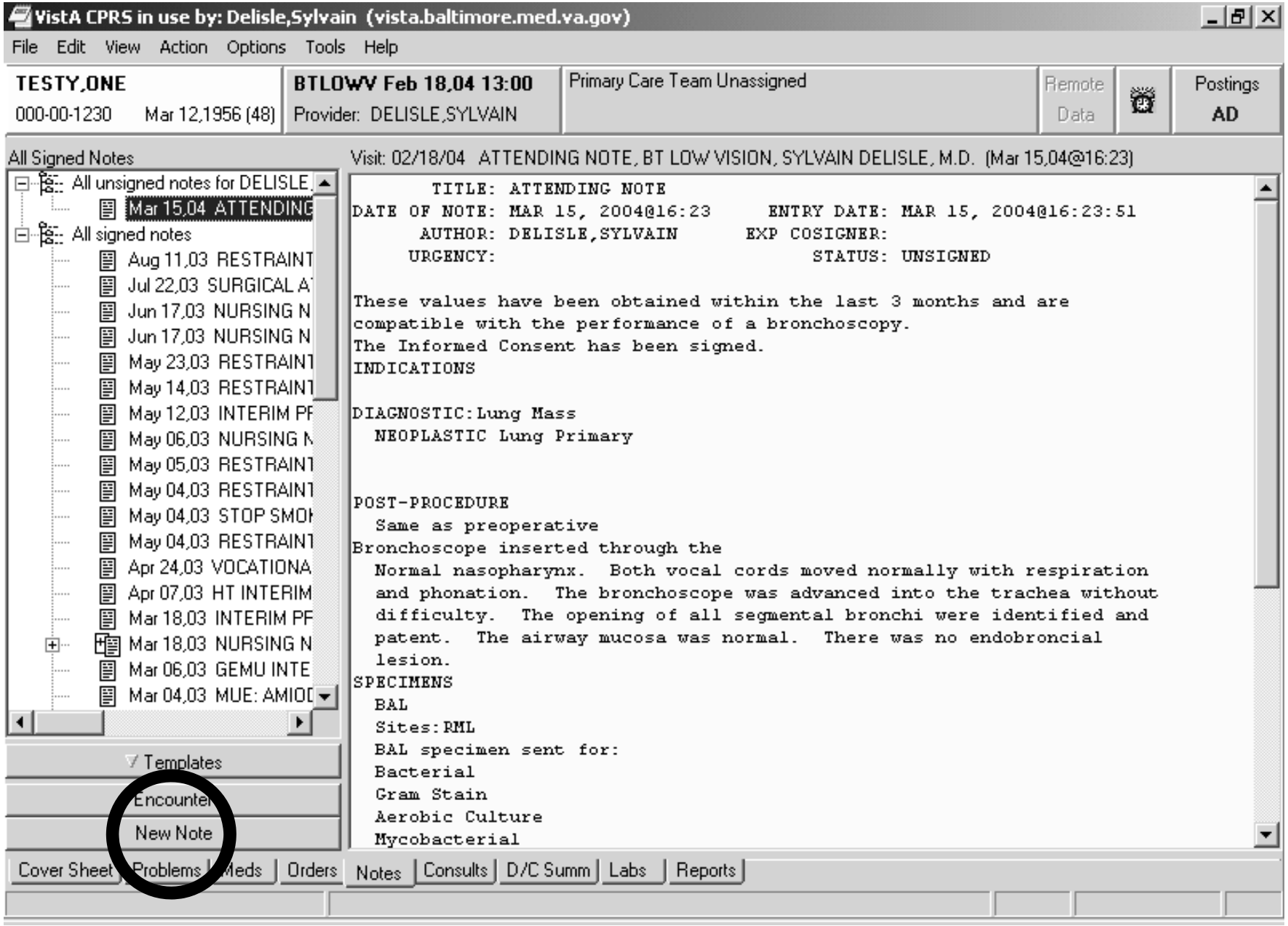
- Each clinical disease within the blanket term “acute respiratory infection” was addressed individually, with focus on establishing diagnosis, determining likelihood of bacterial etiology and predicting benefit of antibiotic use

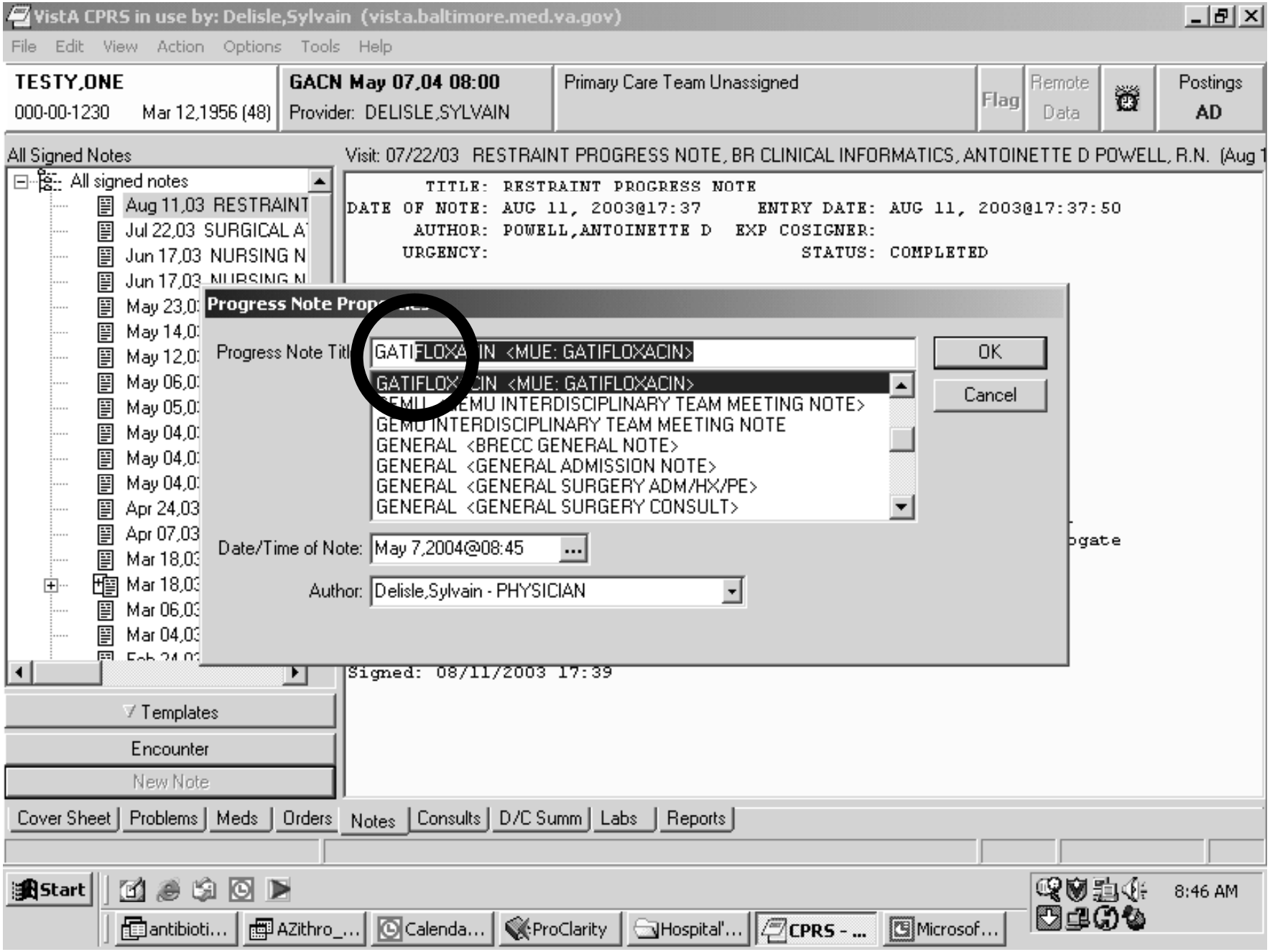
Gonzales, et al. *Ann Intern Med* 2001: 134, 479

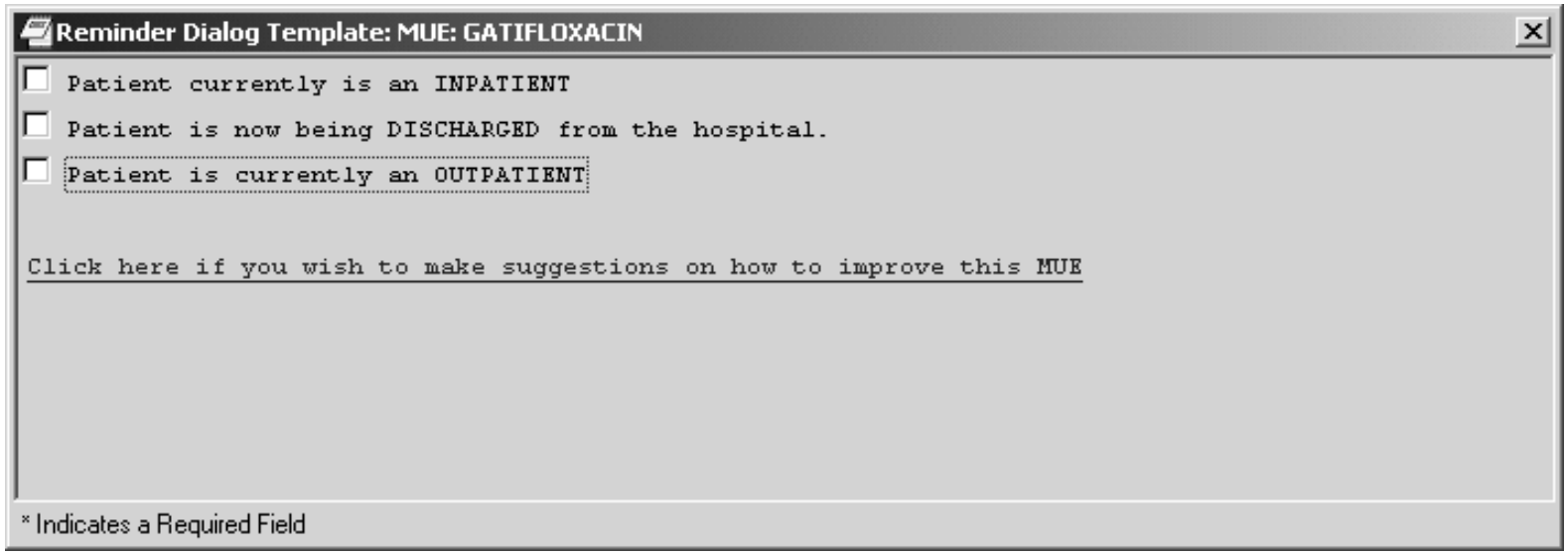
Targeted Antibiotics

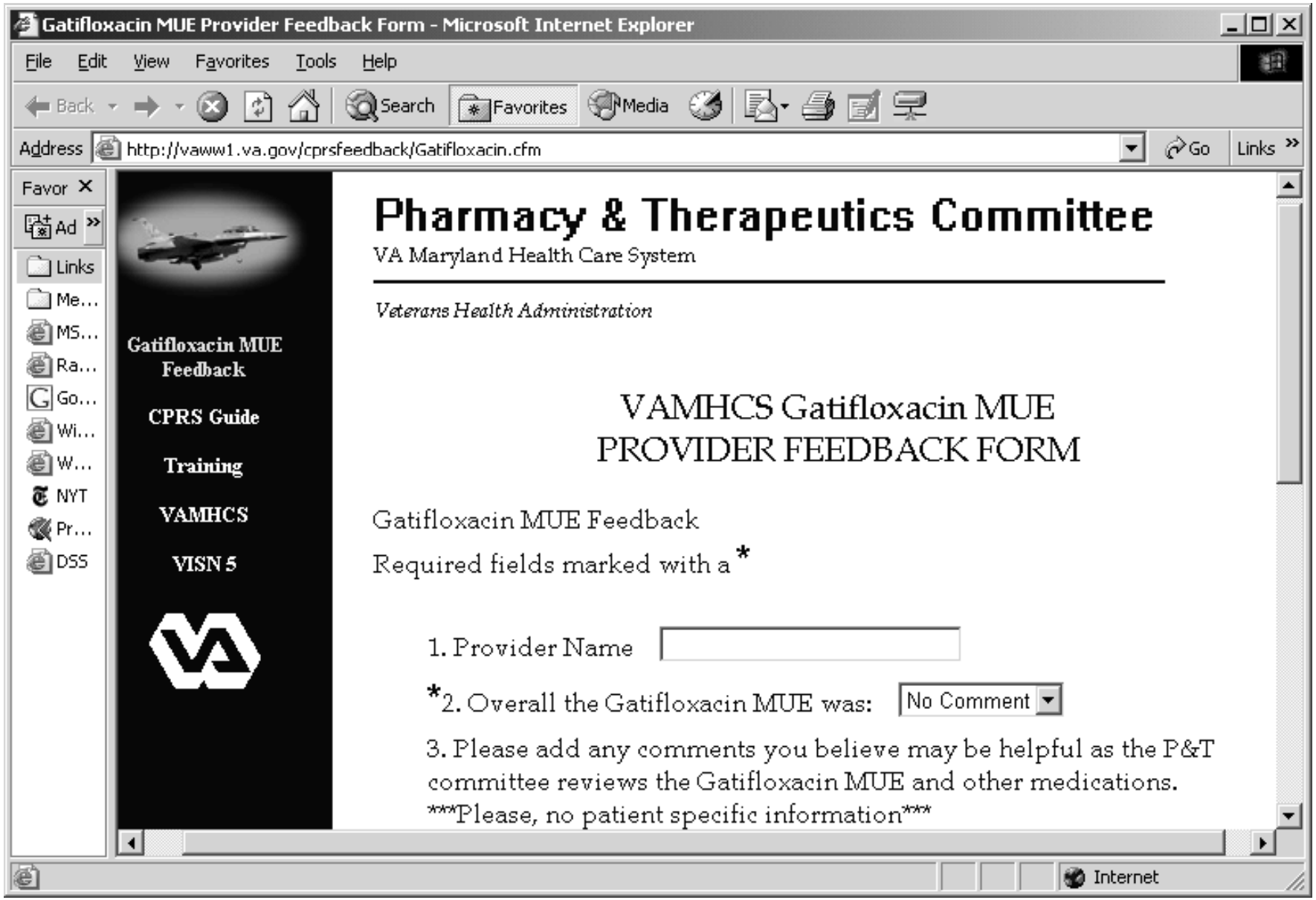
- Targeted the two most popular antibiotics for bronchitis, sinusitis and URI
  - Azithromycin
  - formulary fluoroquinolone (gatifloxacin)
- Other antibiotics were not affected

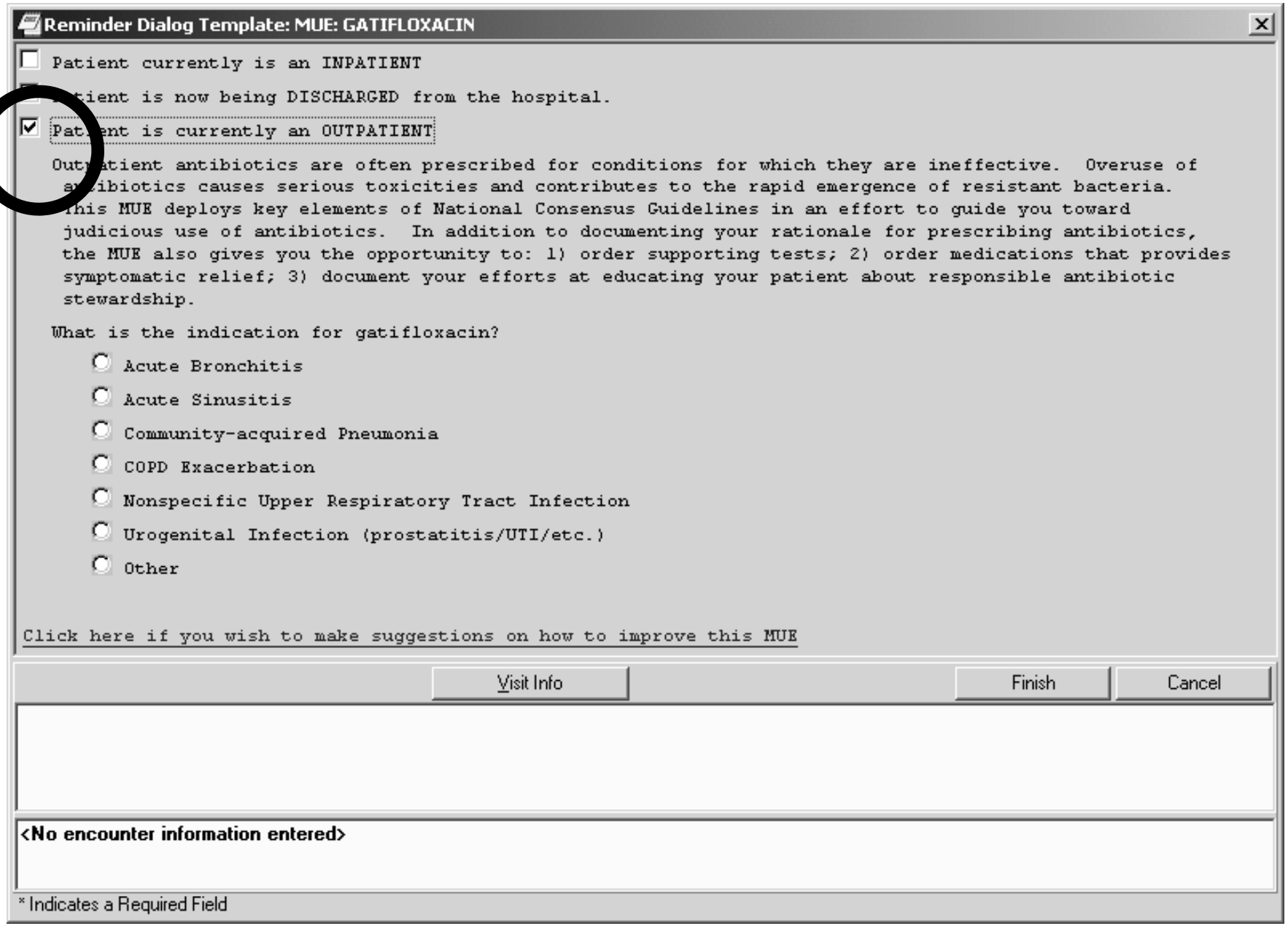

VistA CPRS in use by: Delisle,Sylvain (vista.baltimore.med.va.gov)
File Edit View Tools Help
TESTY,ONE
000-00-1230 Mar 12,1956 (48)
Visit Not Selected
Provider: DELISLE,SYLVAIN
Primary Care Team Unassigned
Remote Data
Postings
AD
Active Problems
No Problems Found.
Allergies / Adverse Reactions
Aspirin
Amiodarone
Postings
Allergies
Scanned: Advance Directive
Active Medications
No Active Medications Found
Clinical Reminders
Due Date
Trauma Screen/PTSD Feb 20,04
AUDIT-C/SA SCREENING Feb 20,04
MDD Screen Apr 03,03
Annual Pain Assessment DUE NOW
Pain Re-Eval DUE NOW
Pain Management DUE NOW
Tetanus Diphtheria (TD-Adult) DUE NOW
PPD DUE NOW
Influenza Immunization DUE NOW
Lipid Screen-Male DUE NOW
HTN Lifestyle Education Feb 20,04
Recent Lab Results
Type & Screen Blood Pnk Signed Wc Lb #61956
Vitals
T 98.1 F Jun 17,03 09:52 (36.7 C)
P 78 Jun 17,03 09:52
R 20 Jun 17,03 09:52
BP 132/73 Jun 17,03 09:52
HT 64 in Sep 06,02 07:26 (162.6 cm)
WT 151 lb Sep 06,02 07:26 (68.6 kg)
PN 4 Mar 18,03 10:09
Appointments/Visits/Admissions
Feb 18,04 13:00 Bt Low Vision Cancelle
Cover Sheet
Problems
Meds
Orders
Notes
Consults
D/C Summ
Labs
Reports

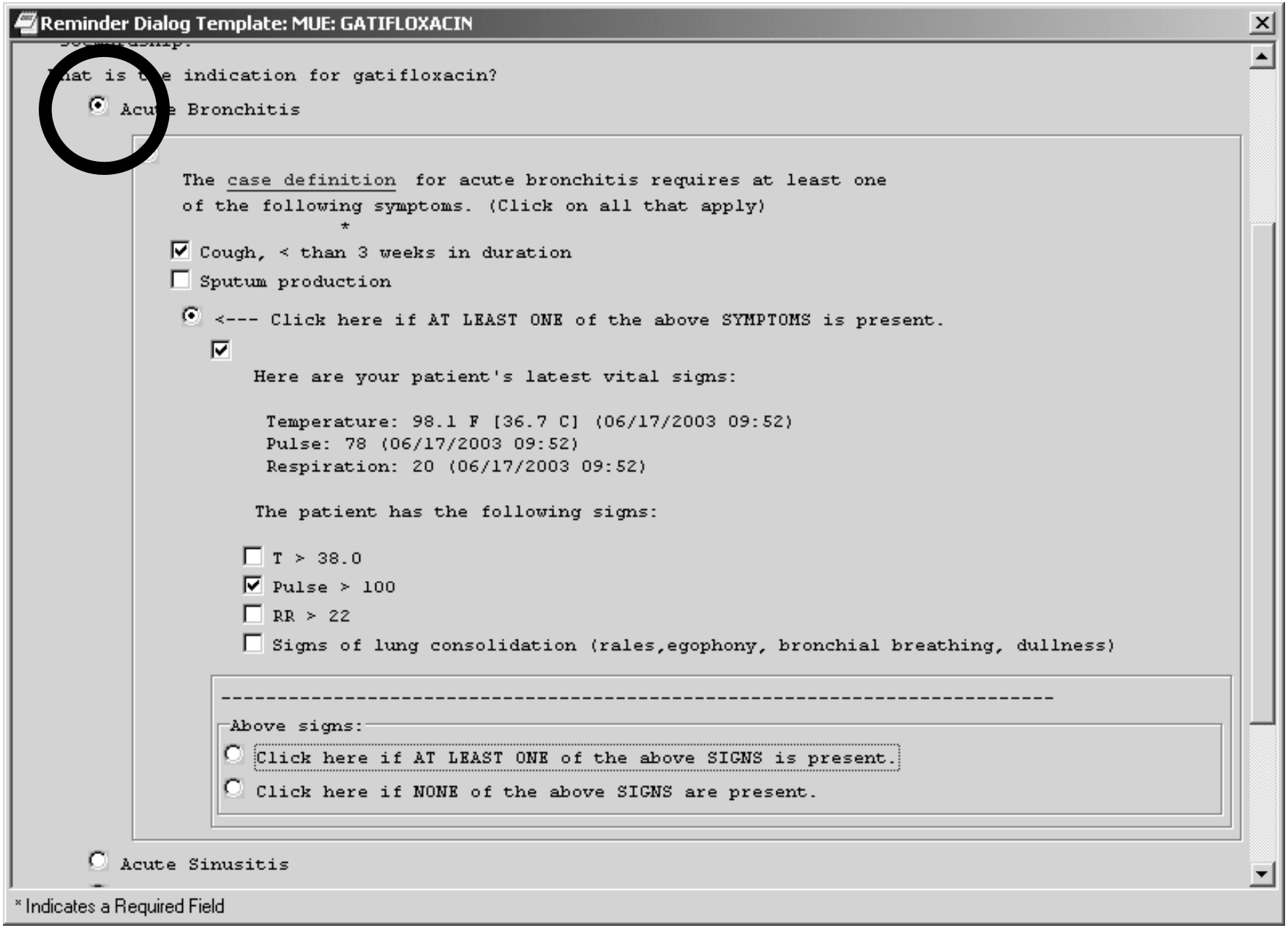

VistA CPRS in use by: Delisle,Sylvain (vista.baltimore.med.va.gov)
File Edit View Action Options Tools Help
TESTY,ONE
000-00-1230 Mar 12,1956 (48)
BTLOWV Feb 18,04 13:00
Provider: DELISLE,SYLVAIN
Primary Care Team Unassigned
Remote Data
Postings AD
All Signed Notes
All unsigned notes for DELISLE,
Mar 15,04 ATTENDING
All signed notes
Aug 11,03 RESTRAINT
Jul 22,03 SURGICAL A
Jun 17,03 NURSING N
Jun 17,03 NURSING N
May 23,03 RESTRAINT
May 14,03 RESTRAINT
May 12,03 INTERIM PF
May 06,03 NURSING N
May 05,03 RESTRAINT
May 04,03 RESTRAINT
May 04,03 STOP SMOK
May 04,03 RESTRAINT
Apr 24,03 VOCATIONA
Apr 07,03 HT INTERIM
Mar 18,03 INTERIM PF
Mar 18,03 NURSING N
Mar 06,03 GEMU INTE
Mar 04,03 MUE: AMIOD
Visit: 02/18/04 ATTENDING NOTE, BT LOW VISION, SYLVAIN DELISLE, M.D. (Mar 15,04@16:23)
TITLE: ATTENDING NOTE
DATE OF NOTE: MAR 15, 2004@16:23 ENTRY DATE: MAR 15, 2004@16:23:51
AUTHOR: DELISLE,SYLVAIN EXP COSIGNER:
URGENCY: STATUS: UNSIGNED
These values have been obtained within the last 3 months and are
compatible with the performance of a bronchoscopy.
The Informed Consent has been signed.
INDICATIONS
DIAGNOSTIC:Lung Mass
NEOPLASTIC Lung Primary
POST-PROCEDURE
Same as preoperative
Bronchoscope inserted through the
Normal nasopharynx. Both vocal cords moved normally with respiration
and phonation. The bronchoscope was advanced into the trachea without
difficulty. The opening of all segmental bronchi were identified and
patent. The airway mucosa was normal. There was no endobroncial
lesion.
SPECIMENS
BAL
Sites:RML
BAL specimen sent for:
Bacterial
Gram Stain
Aerobic Culture
Mycobacterial
Templates
Encounter
New Note
Cover Sheet
Problems
Meds
Orders
Notes
Consults
D/C Summ
Labs
Reports

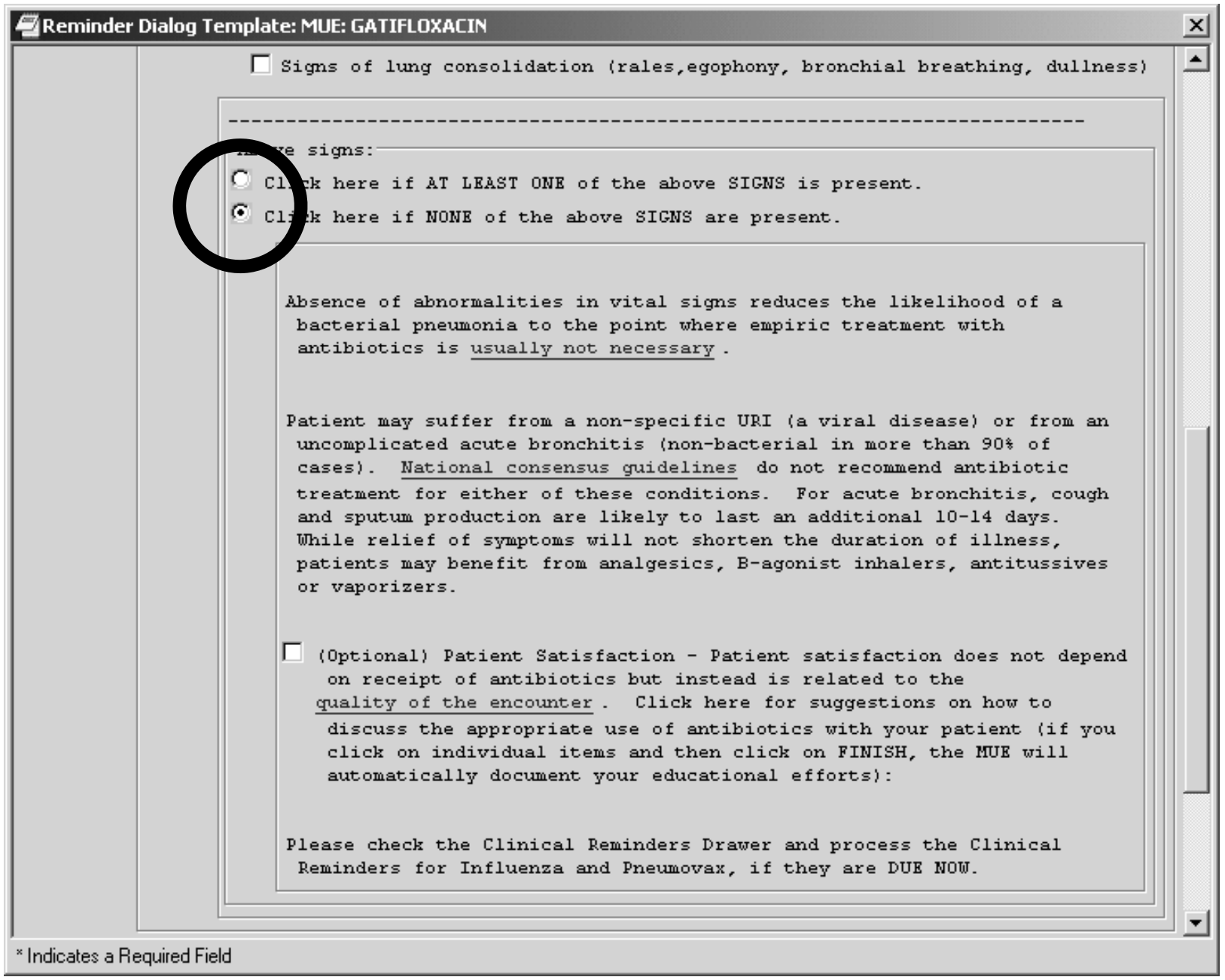

VistA CPRS in use by: Delisle,Sylvain (vista.baltimore.med.va.gov)
File Edit View Action Options Tools Help
TESTY,ONE
000-00-1230 Mar 12,1956 (48)
GACN May 07,04 08:00
Provider: DELISLE,SYLVAIN
Primary Care Team Unassigned
Flag
Remote Data
Postings AD
All Signed Notes
All signed notes
Aug 11,03 RESTRAINT
Jul 22,03 SURGICAL A
Jun 17,03 NURSING N
Visit: 07/22/03 RESTRAINT PROGRESS NOTE, BR CLINICAL INFORMATICS, ANTOINETTE D POWELL, R.N. (Aug 1
TITLE: RESTRAINT PROGRESS NOTE
DATE OF NOTE: AUG 11, 2003@17:37 ENTRY DATE: AUG 11, 2003@17:37:50
AUTHOR: POWELL,ANTOINETTE D EXP COSIGNER:
URGENCY: STATUS: COMPLETED
Progress Note Prop
Progress Note Titl
GATIFLOXACIN <MUE: GATIFLOXACIN>
GEMU INTERDISCIPLINARY TEAM MEETING NOTE
GENERAL <BRECC GENERAL NOTE>
GENERAL <GENERAL ADMISSION NOTE>
GENERAL <GENERAL SURGERY ADM/HX/PE>
GENERAL <GENERAL SURGERY CONSULT>
OK
Cancel
Date/Time of Note: May 7,2004@08:45
Author: Delisle,Sylvain - PHYSICIAN
Signed: 08/11/2003 17:39
Templates
Encounter
New Note
Cover Sheet Problems Meds Orders Notes Consults D/C Summ Labs Reports
Start
antibioti...
AZithro_...
Calenda...
ProClarity
Hospital'...
CPRS - ...
Microsof...
8:46 AM


Reminder Dialog Template: MUE: GATIFLOXACIN
Patient currently is an INPATIENT
Patient is now being DISCHARGED from the hospital.
Patient is currently an OUTPATIENT
Click here if you wish to make suggestions on how to improve this MUE
* Indicates a Required Field


Gatifloxacin MUE Provider Feedback Form - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://vaww1.va.gov/cprsfeedback/Gatifloxacin.cfm
Go Links
Favor
Ad
Links
Me...
MS...
Ra...
Go...
Wi...
W...
NYT
Pr...
DSS
Gatifloxacin MUE Feedback
CPRS Guide
Training
VAMHCS
VISN 5
Pharmacy & Therapeutics Committee
VA Maryland Health Care System
Veterans Health Administration
VAMHCS Gatifloxacin MUE
PROVIDER FEEDBACK FORM
Gatifloxacin MUE Feedback
Required fields marked with a *
1. Provider Name
*2. Overall the Gatifloxacin MUE was:
No Comment
3. Please add any comments you believe may be helpful as the P&T committee reviews the Gatifloxacin MUE and other medications.
Please, no patient specific information
Internet


Reminder Dialog Template: MUE: GATIFLOXACIN
Patient currently is an INPATIENT
Patient is now being DISCHARGED from the hospital.
Patient is currently an OUTPATIENT
Outpatient antibiotics are often prescribed for conditions for which they are ineffective. Overuse of antibiotics causes serious toxicities and contributes to the rapid emergence of resistant bacteria. This MUE deploys key elements of National Consensus Guidelines in an effort to guide you toward judicious use of antibiotics. In addition to documenting your rationale for prescribing antibiotics, the MUE also gives you the opportunity to: 1) order supporting tests; 2) order medications that provides symptomatic relief; 3) document your efforts at educating your patient about responsible antibiotic stewardship.
What is the indication for gatifloxacin?
Acute Bronchitis
Acute Sinusitis
Community-acquired Pneumonia
COPD Exacerbation
Nonspecific Upper Respiratory Tract Infection
Urogenital Infection (prostatitis/UTI/etc.)
Other
Click here if you wish to make suggestions on how to improve this MUE
Visit Info
Finish
Cancel
<No encounter information entered>
* Indicates a Required Field

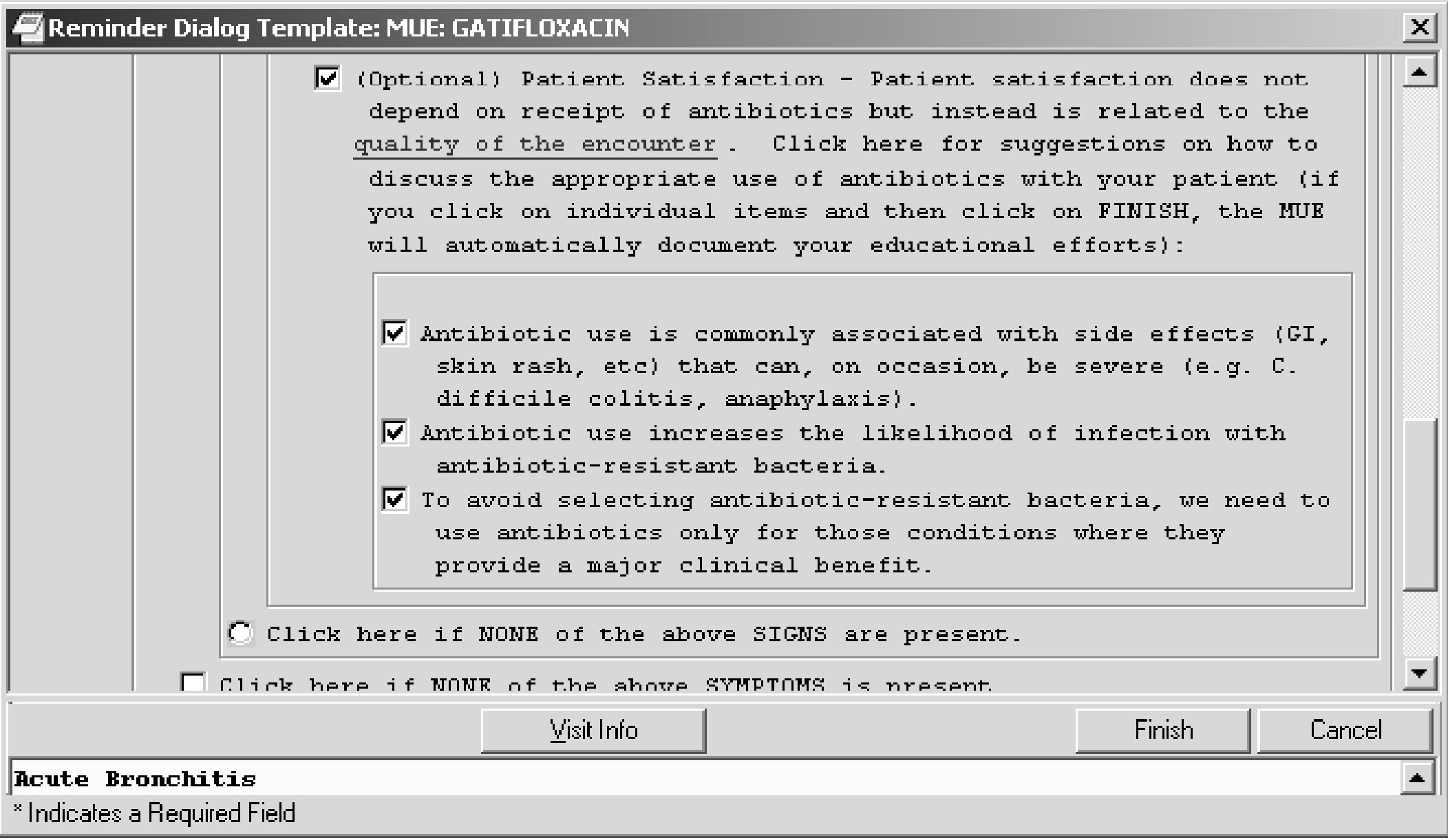

Reminder Dialog Template: MUE: GATIFLOXACIN
What is the indication for gatifloxacin?
Acute Bronchitis
The case definition for acute bronchitis requires at least one of the following symptoms. (Click on all that apply)
*
Cough, < than 3 weeks in duration
Sputum production
<--- Click here if AT LEAST ONE of the above SYMPTOMS is present.
Here are your patient's latest vital signs:
Temperature: 98.1 F [36.7 C] (06/17/2003 09:52)
Pulse: 78 (06/17/2003 09:52)
Respiration: 20 (06/17/2003 09:52)
The patient has the following signs:
T > 38.0
Pulse > 100
RR > 22
Signs of lung consolidation (rales,egophony, bronchial breathing, dullness)
Above signs:
Click here if AT LEAST ONE of the above SIGNS is present.
Click here if NONE of the above SIGNS are present.
Acute Sinusitis
* Indicates a Required Field

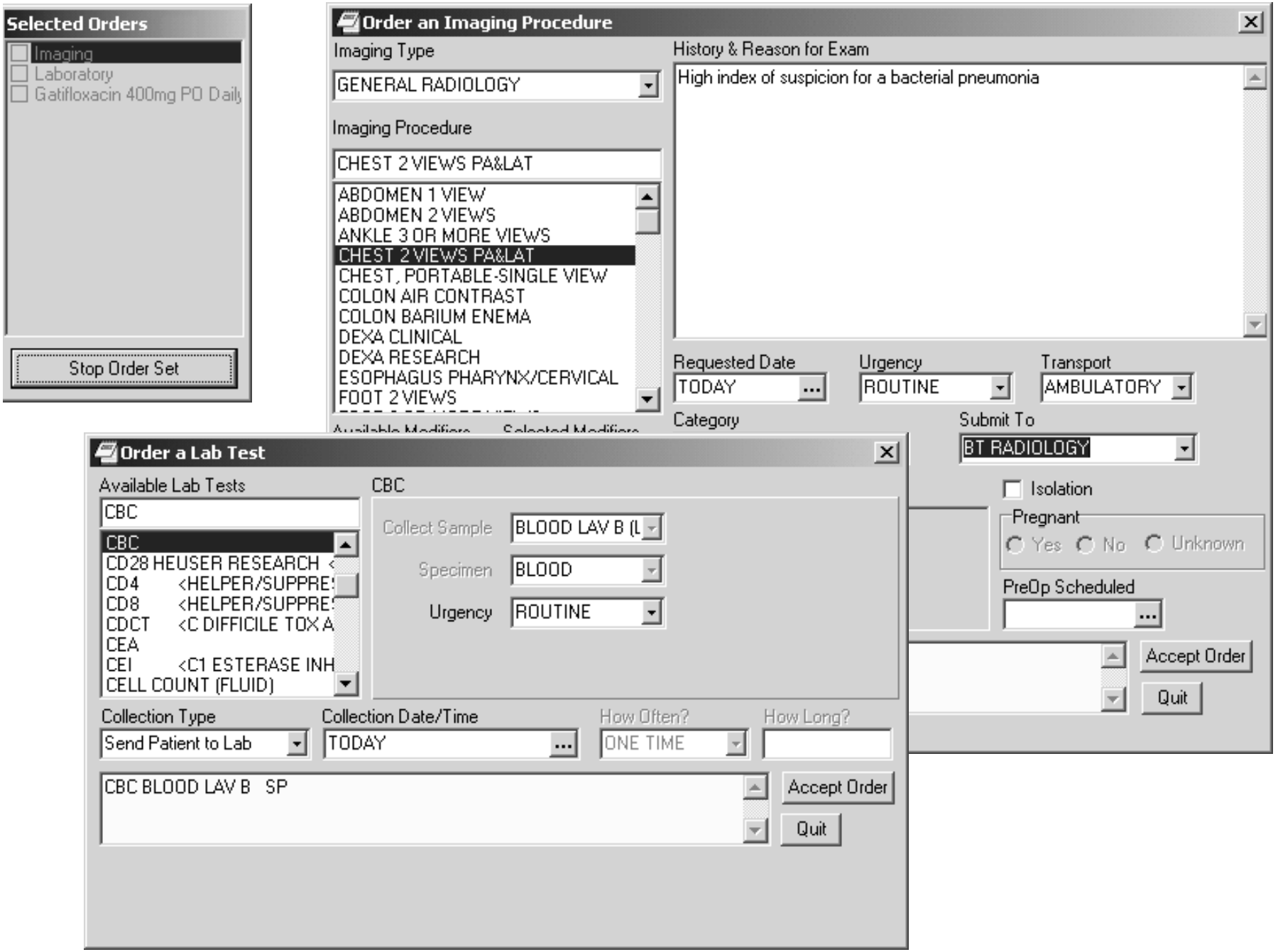

Reminder Dialog Template: MUE: GATIFLOXACIN
Signs of lung consolidation (rales,egophony, bronchial breathing, dullness)
---
e signs:
Click here if AT LEAST ONE of the above SIGNS is present.
Click here if NONE of the above SIGNS are present.
Absence of abnormalities in vital signs reduces the likelihood of a bacterial pneumonia to the point where empiric treatment with antibiotics is usually not necessary .
Patient may suffer from a non-specific URI (a viral disease) or from an uncomplicated acute bronchitis (non-bacterial in more than 90% of cases). National consensus guidelines do not recommend antibiotic treatment for either of these conditions. For acute bronchitis, cough and sputum production are likely to last an additional 10-14 days. While relief of symptoms will not shorten the duration of illness, patients may benefit from analgesics, B-agonist inhalers, antitussives or vaporizers.
(Optional) Patient Satisfaction - Patient satisfaction does not depend on receipt of antibiotics but instead is related to the quality of the encounter . Click here for suggestions on how to discuss the appropriate use of antibiotics with your patient (if you click on individual items and then click on FINISH, the MUE will automatically document your educational efforts):
Please check the Clinical Reminders Drawer and process the Clinical Reminders for Influenza and Pneumovax, if they are DUE NOW.
* Indicates a Required Field

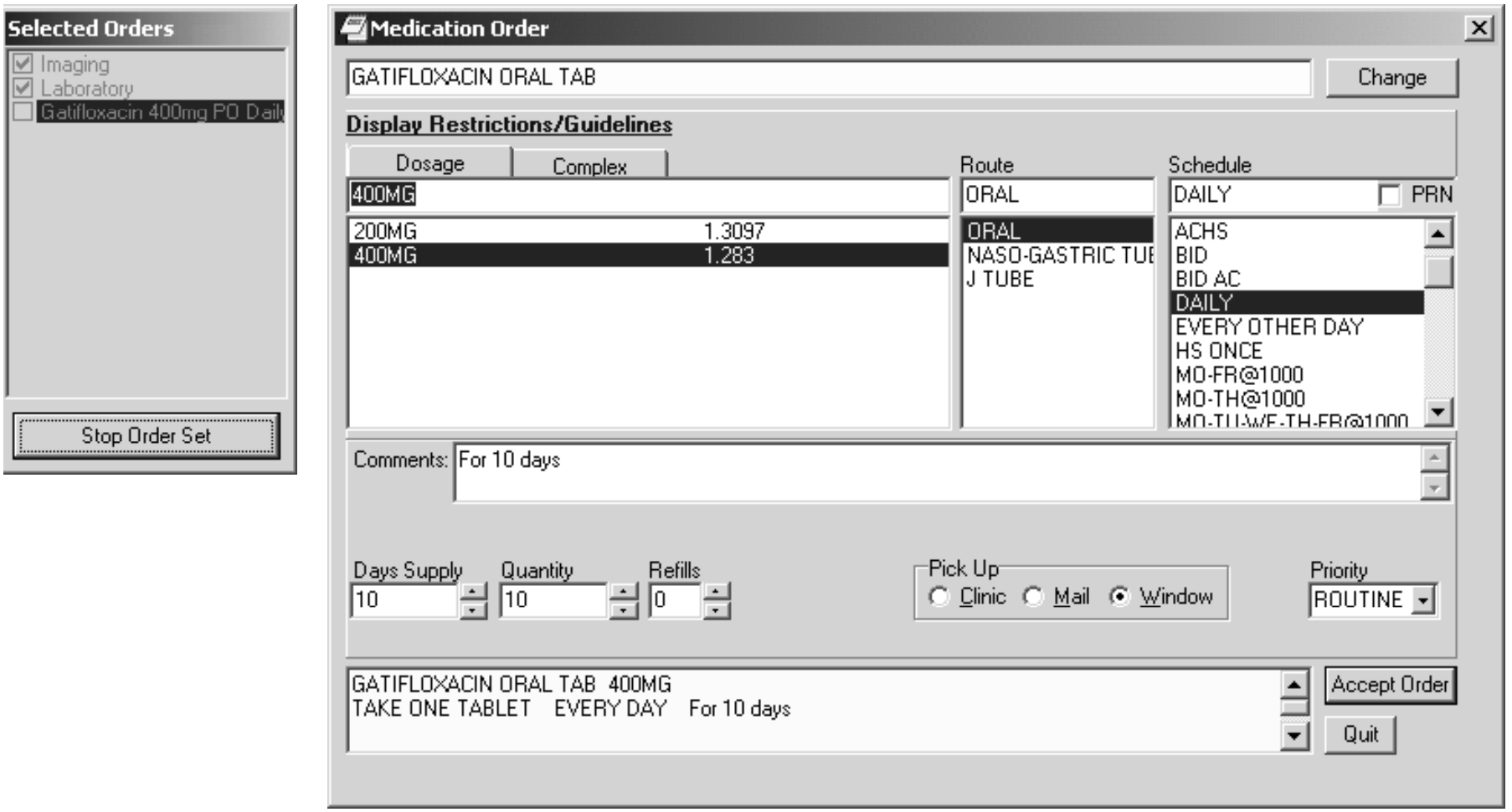
Antibiotic Use for Emergency Department Patients With Upper Respiratory Infections: Prescribing Practices, Patient Expectations, and Patient Satisfaction

Samuel Ong, MD
Janet Nakase, MPH
Gregory J. Moran, MD
David J. Karras, MD
Matthew J. Kuehnert, MD
David A. Talan, MD
EMERGEncy ID NET Study Group

From Olive View–University of California Los Angeles Medical Center, Sylmar, CA (Ong, Nakase, Moran, Talan); Temple University School of Medicine, Philadelphia, PA (Karras); and the Centers for Disease Control and Prevention (Kuenhert).

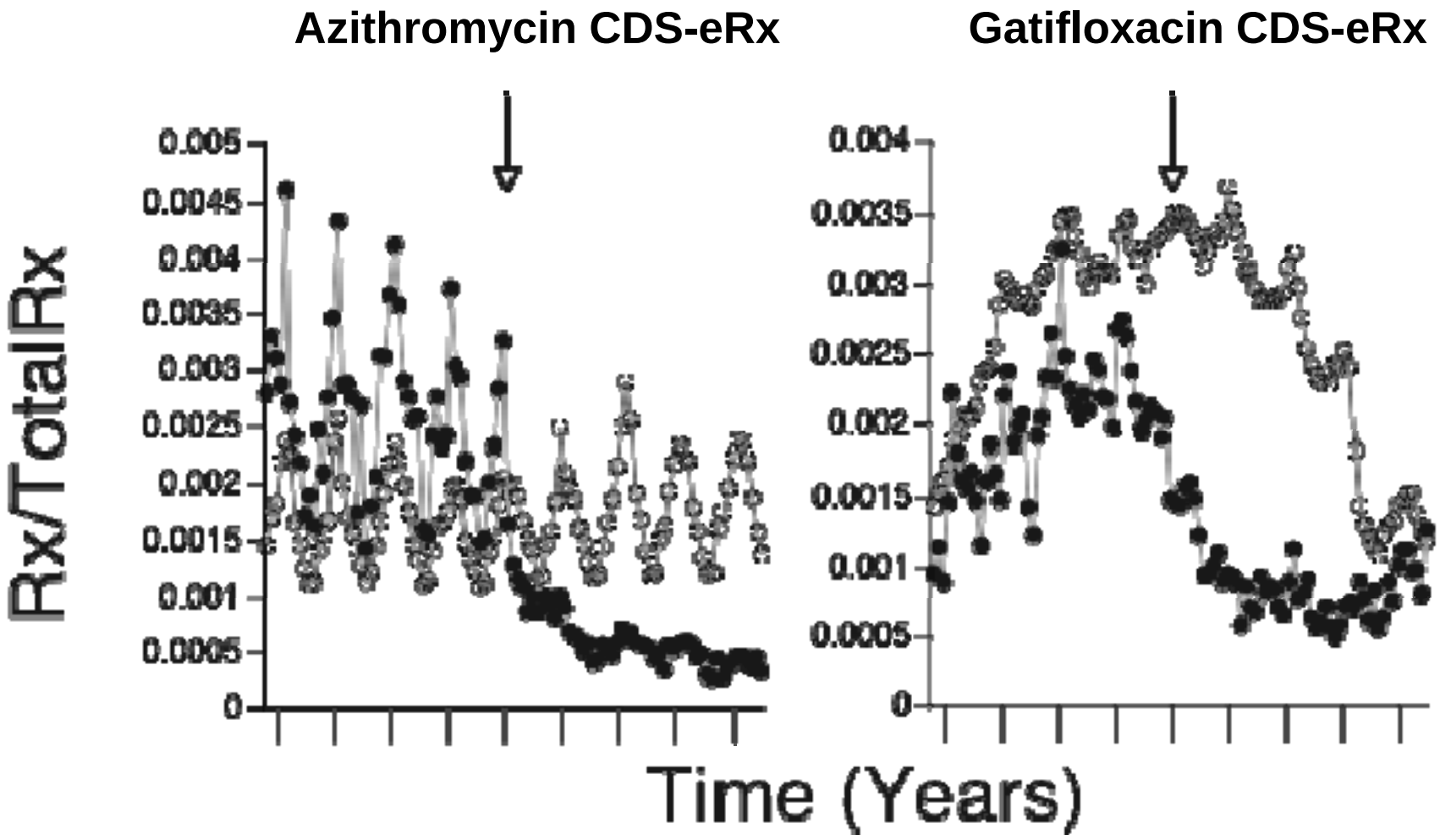

Reminder Dialog Template: MUE: GATIFLOXACIN
(Optional) Patient Satisfaction - Patient satisfaction does not depend on receipt of antibiotics but instead is related to the quality of the encounter . Click here for suggestions on how to discuss the appropriate use of antibiotics with your patient (if you click on individual items and then click on FINISH, the MUE will automatically document your educational efforts):
Antibiotic use is commonly associated with side effects (GI, skin rash, etc) that can, on occasion, be severe (e.g. C. difficile colitis, anaphylaxis).
Antibiotic use increases the likelihood of infection with antibiotic-resistant bacteria.
To avoid selecting antibiotic-resistant bacteria, we need to use antibiotics only for those conditions where they provide a major clinical benefit.
Click here if NONE of the above SIGNS are present.
Visit Info
Finish
Cancel
Acute Bronchitis
* Indicates a Required Field


Selected Orders
Imaging
Laboratory
Gatifloxacin 400mg PO Daily
Stop Order Set
Order an Imaging Procedure
Imaging Type
GENERAL RADIOLOGY
Imaging Procedure
CHEST 2 VIEWS PA&LAT
ABDOMEN 1 VIEW
ABDOMEN 2 VIEWS
ANKLE 3 OR MORE VIEWS
CHEST 2 VIEWS PA&LAT
CHEST, PORTABLE-SINGLE VIEW
COLON AIR CONTRAST
COLON BARIUM ENEMA
DEXA CLINICAL
DEXA RESEARCH
ESOPHAGUS PHARYNX/CERVICAL
FOOT 2 VIEWS
History & Reason for Exam
High index of suspicion for a bacterial pneumonia
Requested Date
TODAY
Urgency
ROUTINE
Transport
AMBULATORY
Category
Submit To
BT RADIOLOGY
Isolation
Pregnant
Yes
No
Unknown
PreOp Scheduled
Accept Order
Quit
Order a Lab Test
Available Lab Tests
CBC
CBC
CD28 HEUSER RESEARCH
CD4 <HELPER/SUPPRE
CD8 <HELPER/SUPPRE
CDCT <C DIFFICILE TOX A
CEA
CEI <C1 ESTERASE INH
CELL COUNT (FLUID)
CBC
Collect Sample
BLOOD LAV B (L
Specimen
BLOOD
Urgency
ROUTINE
Collection Type
Send Patient to Lab
Collection Date/Time
TODAY
How Often?
ONE TIME
How Long?
CBC BLOOD LAV B SP
Accept Order
Quit


Selected Orders
Imaging
Laboratory
Gatifloxacin 400mg PO Daily
Stop Order Set
Medication Order
GATIFLOXACIN ORAL TAB
Change
Display Restrictions/Guidelines
Dosage
Complex
Route
Schedule
400MG
ORAL
DAILY
PRN
200MG 1.3097
400MG 1.283
ORAL
NASO-GASTRIC TUE
J TUBE
ACHS
BID
BID AC
DAILY
EVERY OTHER DAY
HS ONCE
MO-FR@1000
MO-TH@1000
Comments:
For 10 days
Days Supply
Quantity
Refills
10
10
0
Pick Up
Clinic
Mail
Window
Priority
ROUTINE
GATIFLOXACIN ORAL TAB 400MG
TAKE ONE TABLET EVERY DAY For 10 days
Accept Order
Quit

Outcomes

Utilization of Targeted ABX



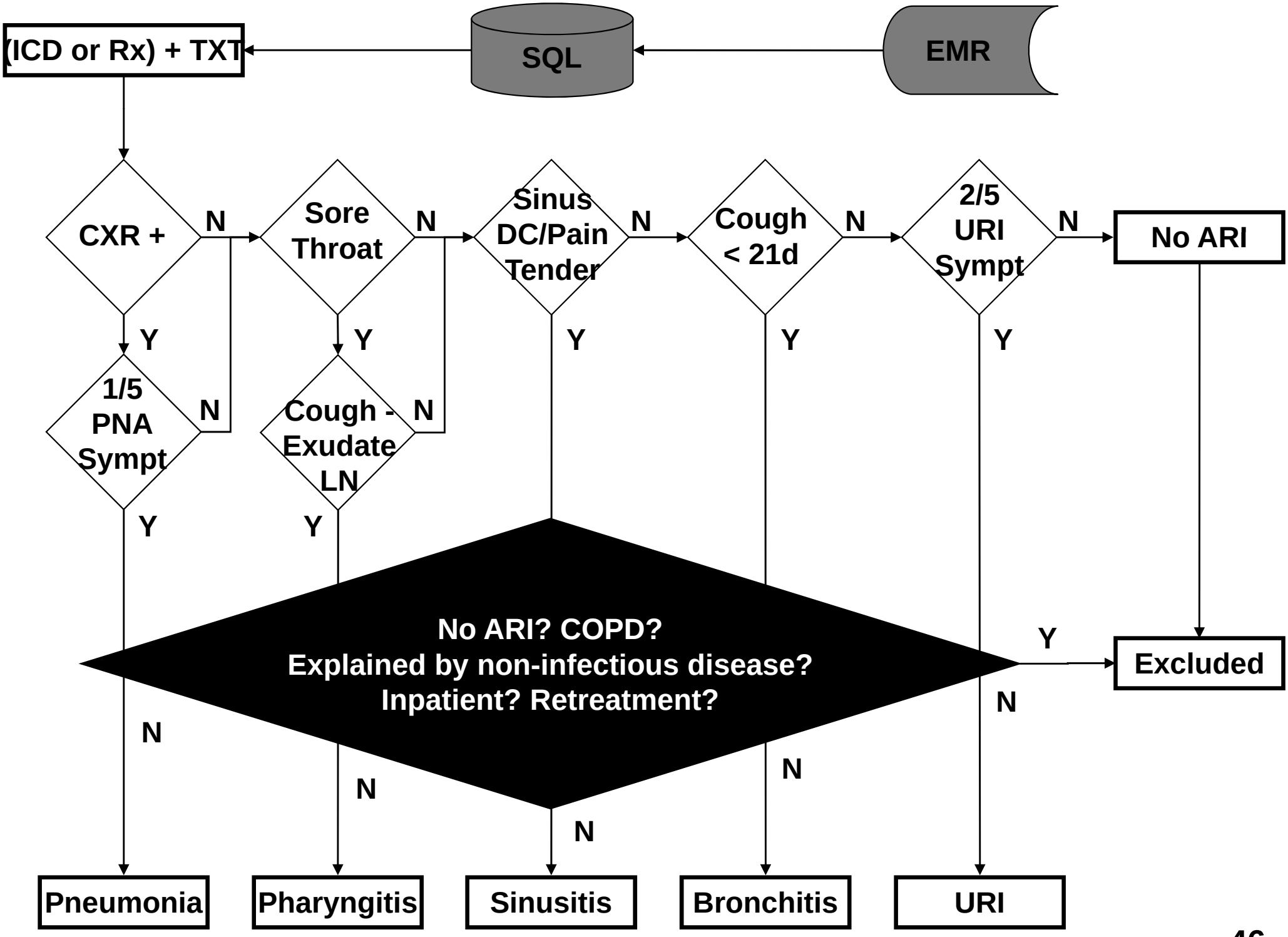
Desirable Outcomes

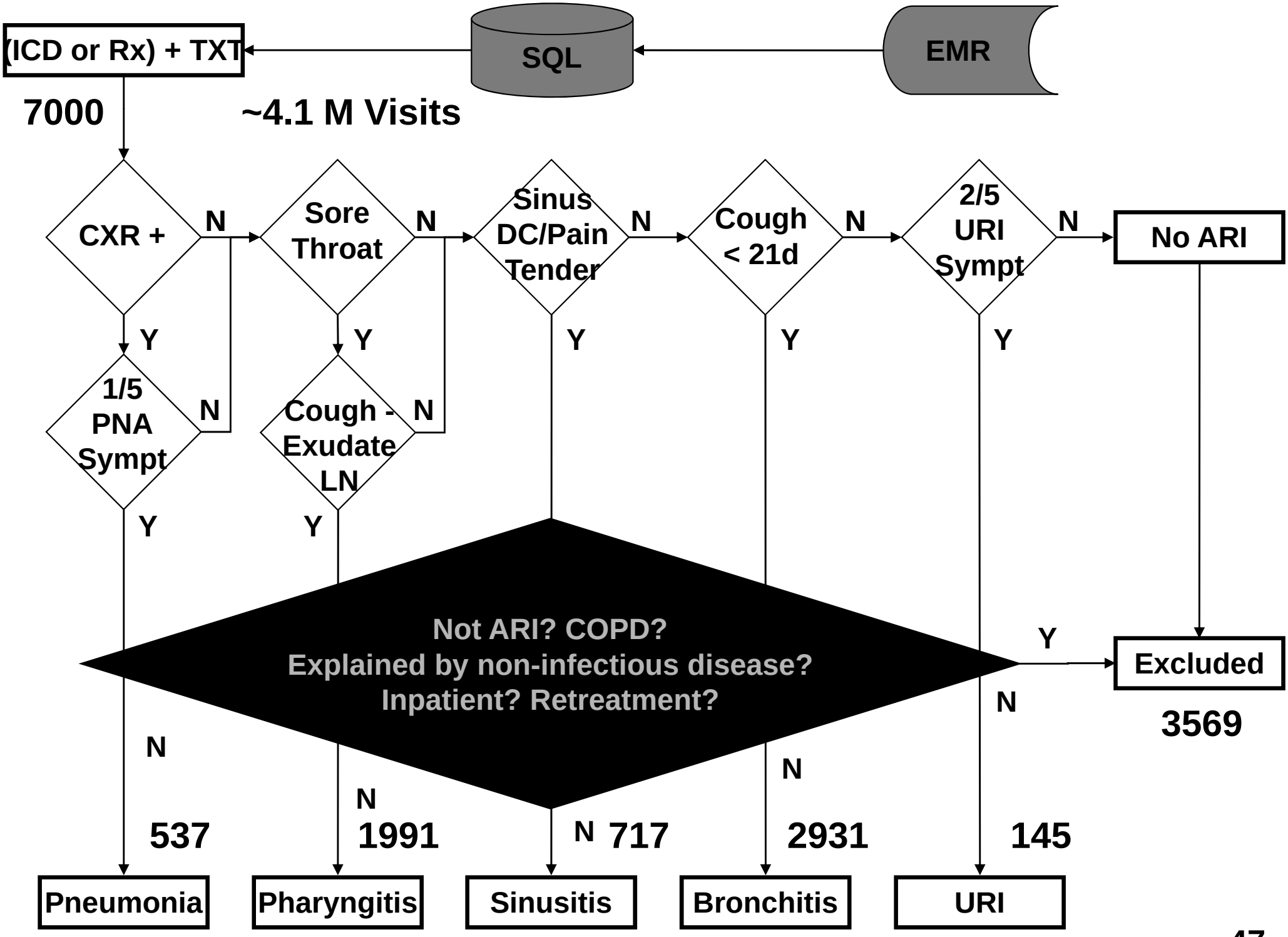
- Warranted utilization was unaffected
- Unwarranted utilization was reduced

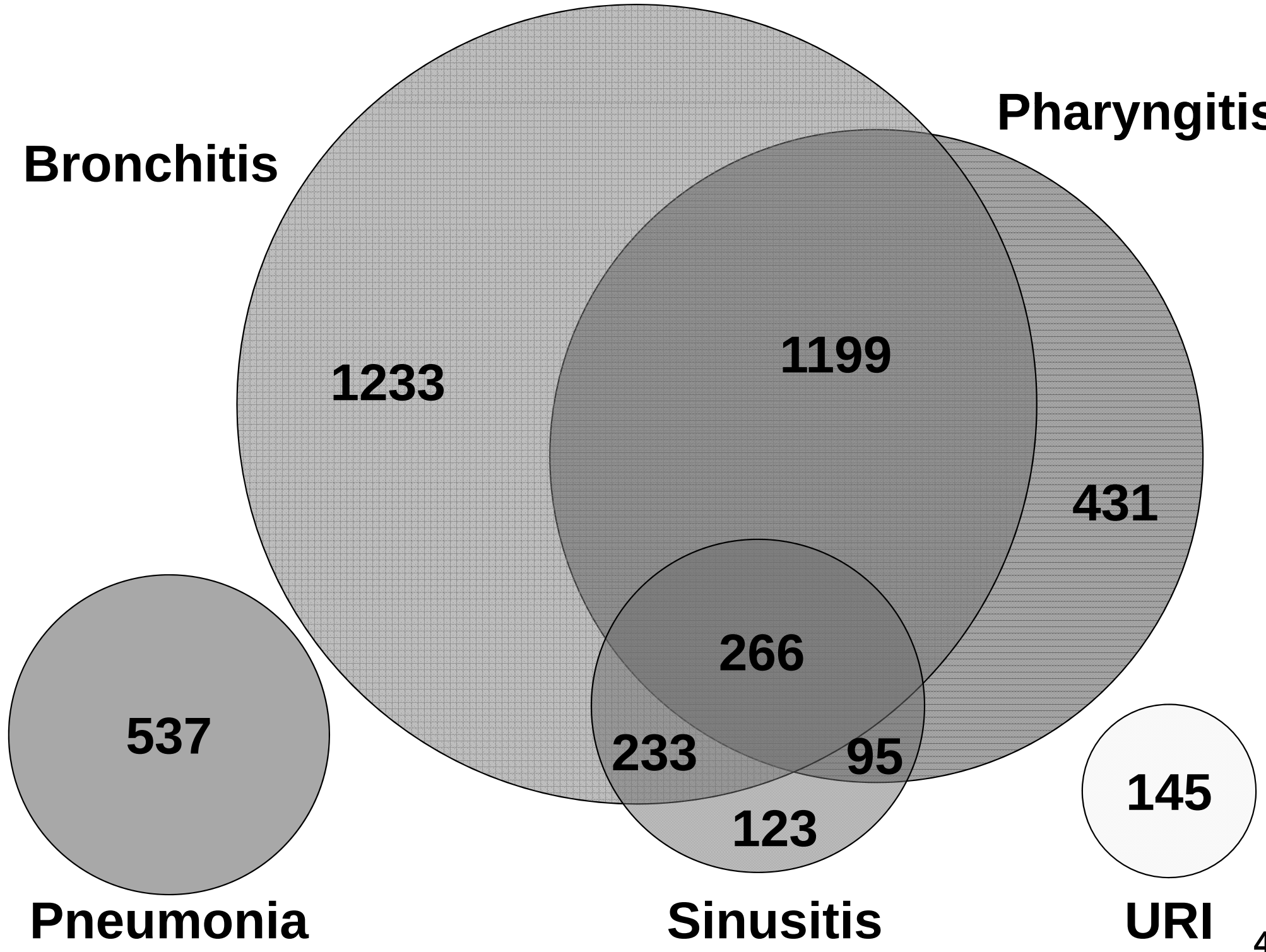
Undesirable Outcomes

- Warranted utilization was impeded
- Unwarranted utilization was transferred to alternative antibiotics

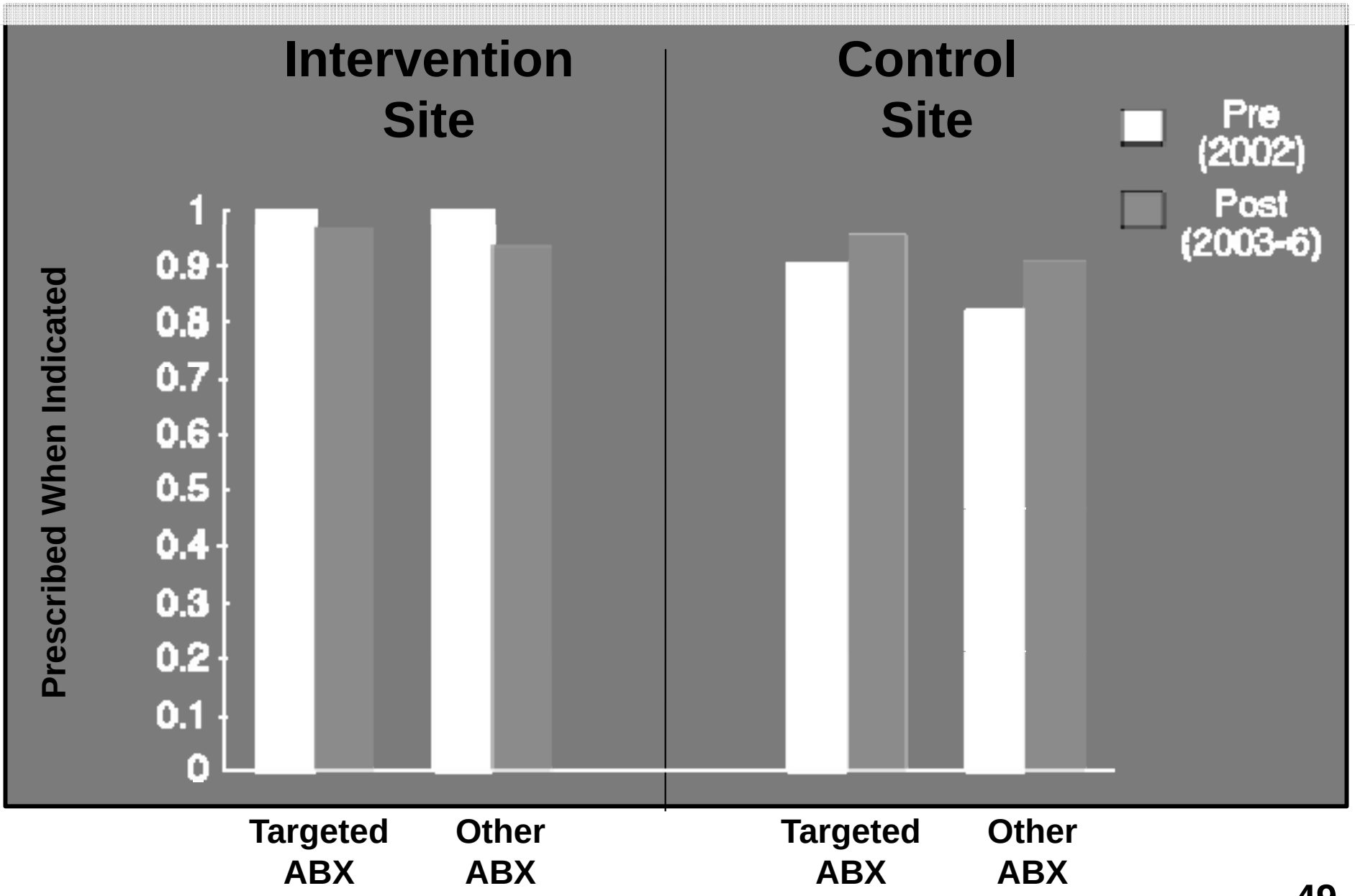
Was Utilization Adjusted Toward the Guideline-Defined Desirable Outcomes?


(ICD or Rx) + TXT
SQL
EMR
CXR +
Sore Throat
Sinus DC/Pain Tender
Cough < 21d
2/5 URI Sympt
No ARI
1/5 PNA Sympt
Cough - Exudate LN
No ARI? COPD?
Explained by non-infectious disease?
Inpatient? Retreatment?
Excluded
Pneumonia
Pharyngitis
Sinusitis
Bronchitis
URI
Y
N

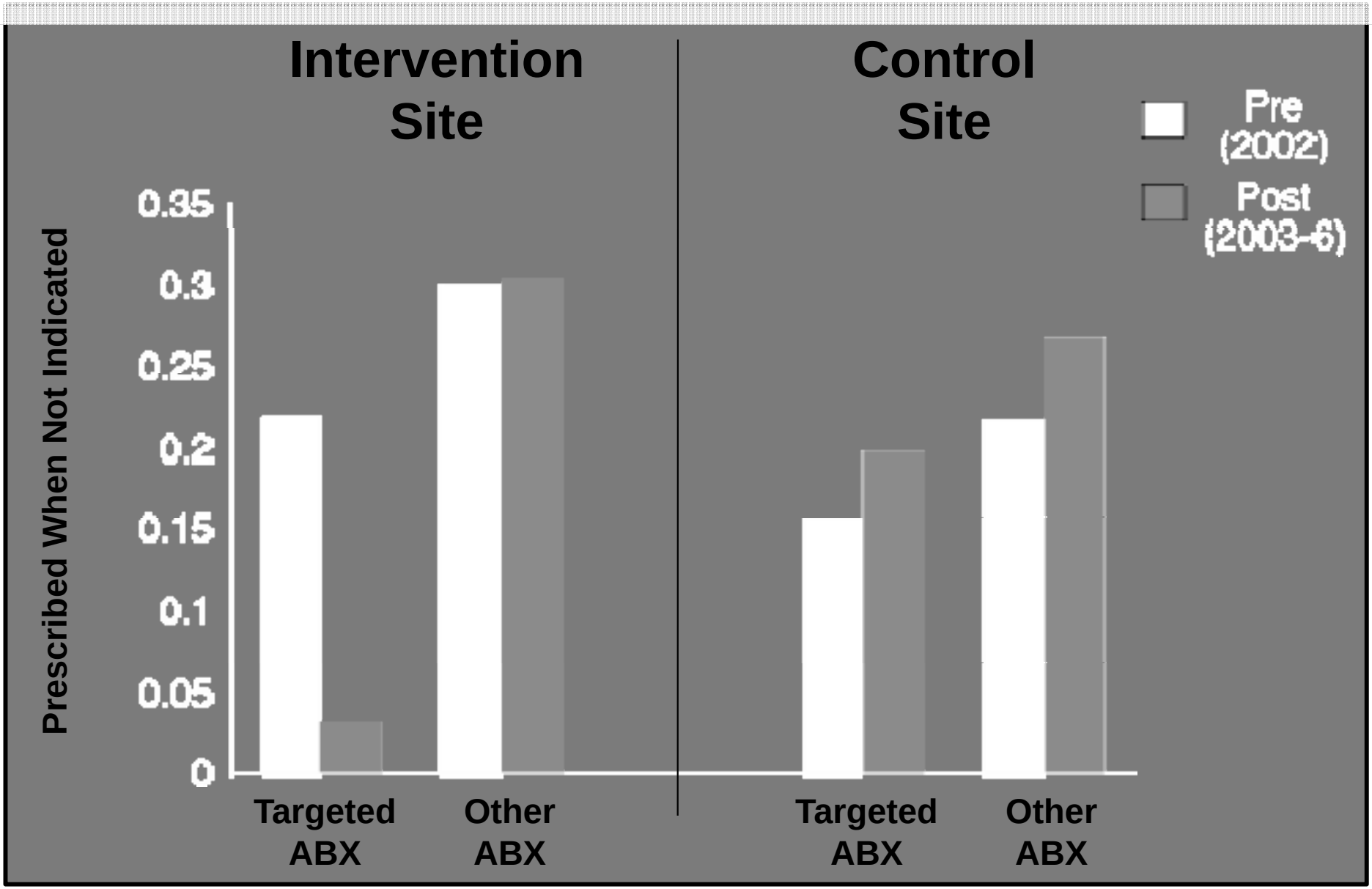

(ICD or Rx) + TXT
SQL
EMR
7000
~4.1 M Visits
CXR +
Sore Throat
Sinus DC/Pain Tender
Cough < 21d
2/5 URI Sympt
No ARI
1/5 PNA Sympt
Cough - Exudate LN
Y
N
Not ARI? COPD?
Explained by non-infectious disease?
Inpatient? Retreatment?
Excluded
3569
537
1991
717
2931
145
Pneumonia
Pharyngitis
Sinusitis
Bronchitis
URI


Bronchitis
Pharyngitis
1233
1199
431
266
537
233
95
123
145
Pneumonia
Sinusitis
URI

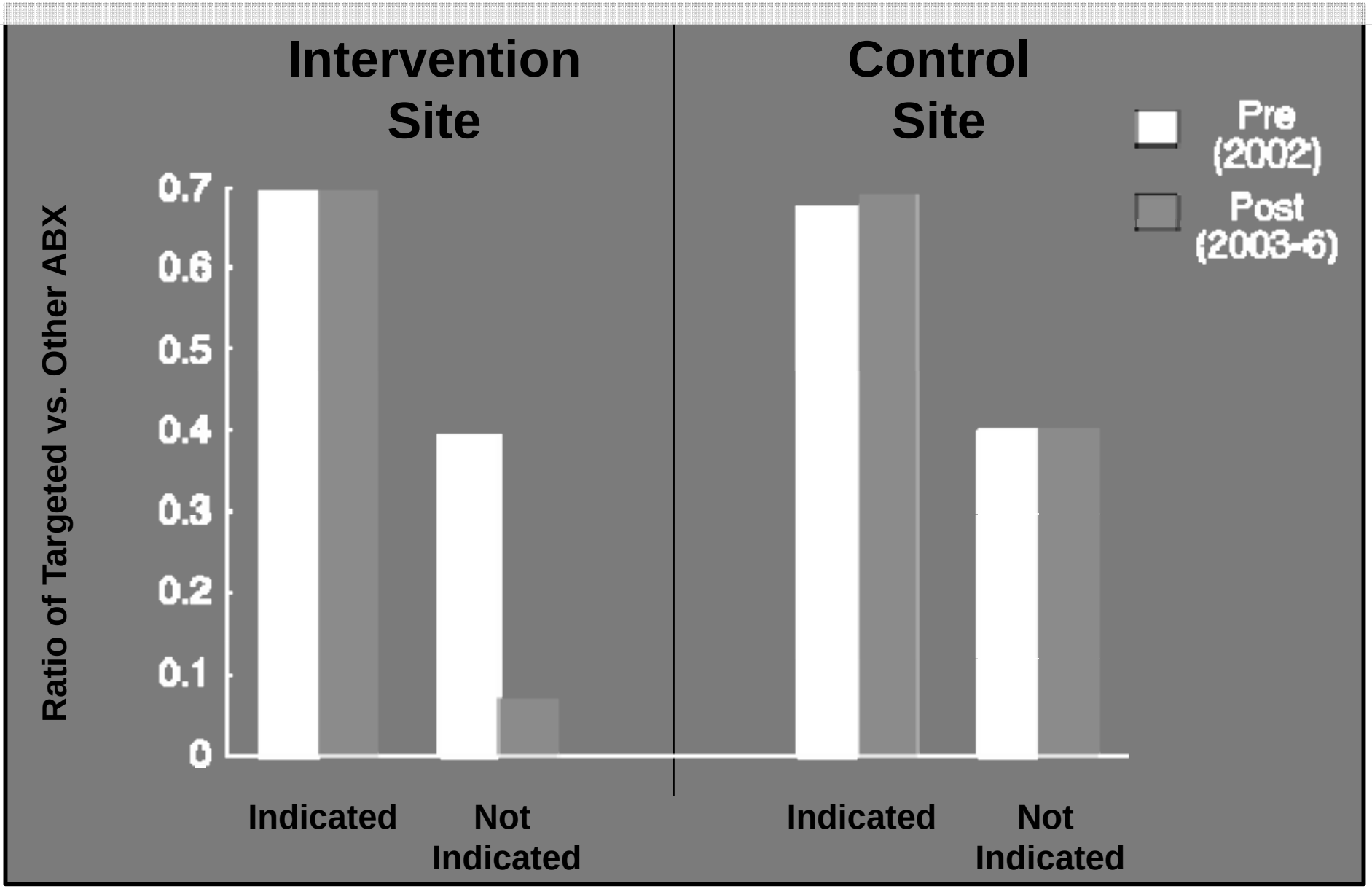
Prescribed When Indicated for ARI



Prescribed When Not Indicated for ARI



Targeted vs. All ABX for ARI



More Outcomes

- All cases of pneumonia received antibiotics
- Overall improvement in guideline congruence entirely attributable to antibiotics targeted by the intervention

Summary (1)

- Antibiotics pressure is a key promoter of antimicrobial resistance
- Most unwarranted use of antibiotics targets outpatients with uncomplicated acute respiratory infections (ARI)

Summary (2)

- Conventional educational interventions to reduce unwarranted use of antibiotics in ARI have met with limited effectiveness; long-term outcomes are not known

- Computerized clinical decision support, particularly when interposed at the time of an e-prescription, can be both effective and sustainable, but the effect may be limited to targeted antibiotics.

Future Directions

- Multicenter Cluster Randomized Trial
- Outcome studies of other drugs subject to a similar intervention

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