



# Improving Otitis Media (OM) Care with EHR-Based Clinical Decision Support and Feedback

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**Study Funded by:** AHRQ R18 HS017042-02

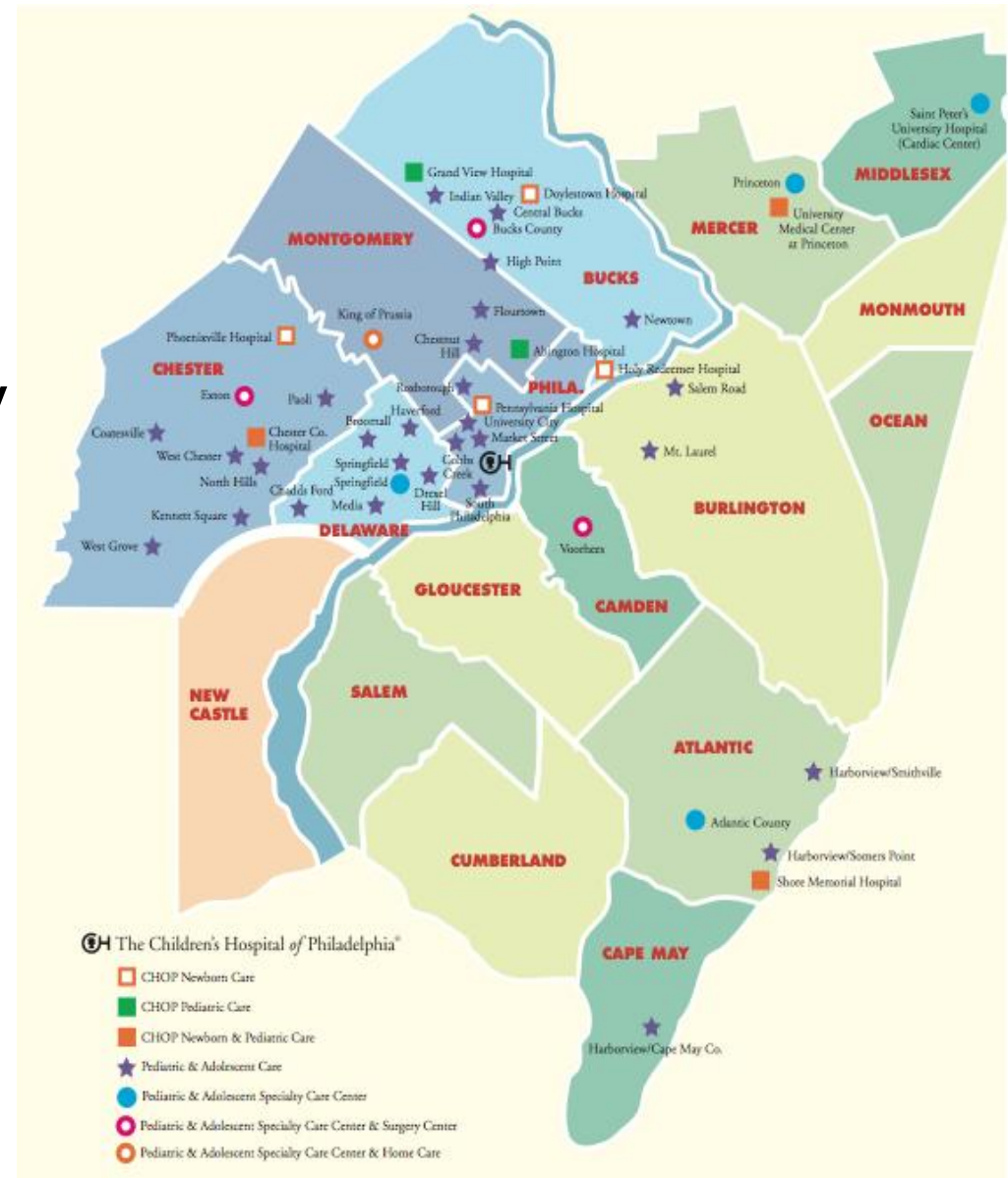


# Study Aims

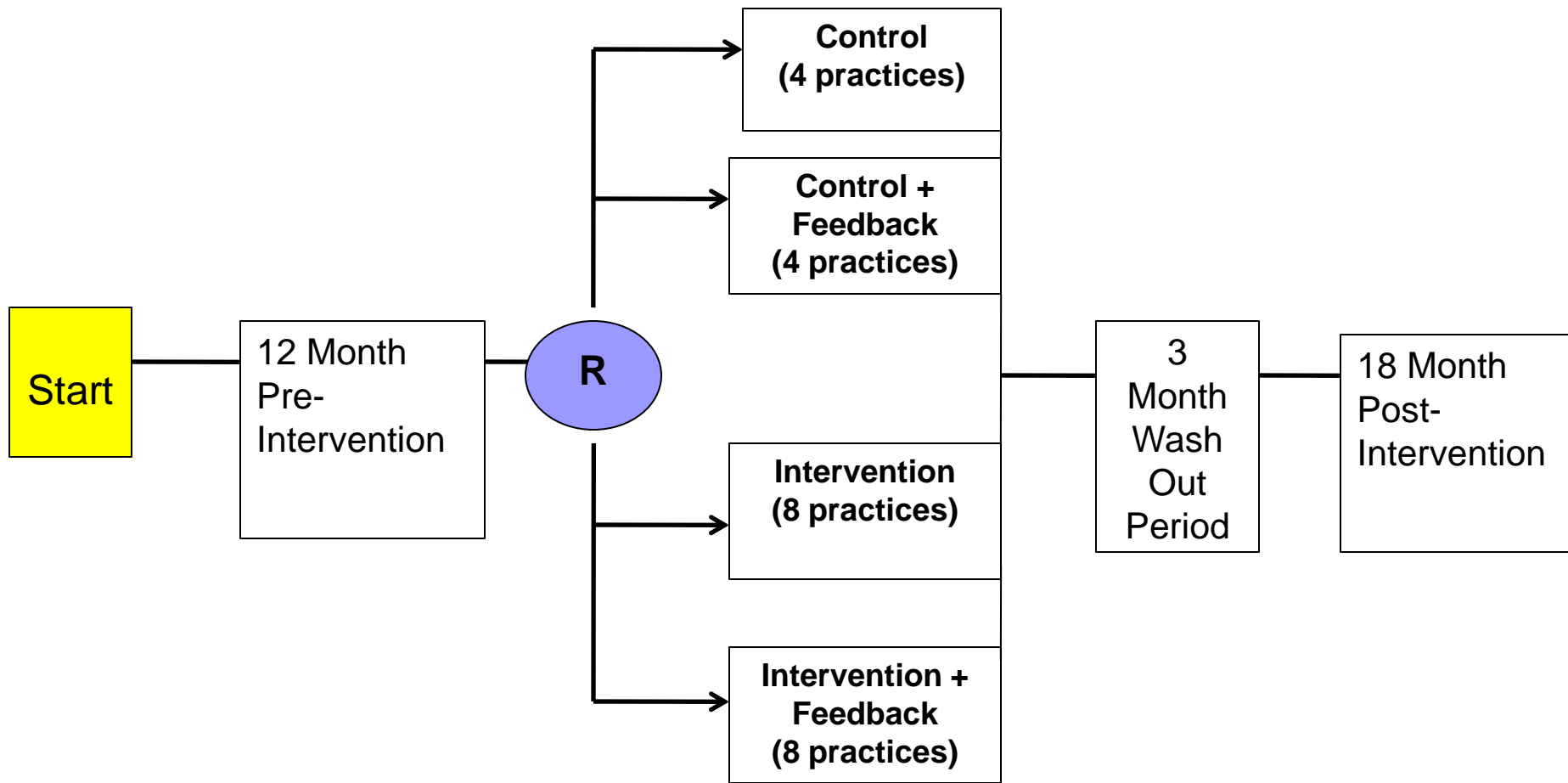
- To develop an integrated (education, CDS, feedback) intervention to improve the quality of OM care
- To examine the effect of the intervention on quality of OM care
- To elucidate patterns and predictors of clinician adoption of the health IT tool

# Study Setting

- 24 of 27 Ambulatory Care Practices Participated
- Study practices part of an AHRQ funded Practice-Based Research Network



# Study Design: Cluster Randomized Trial





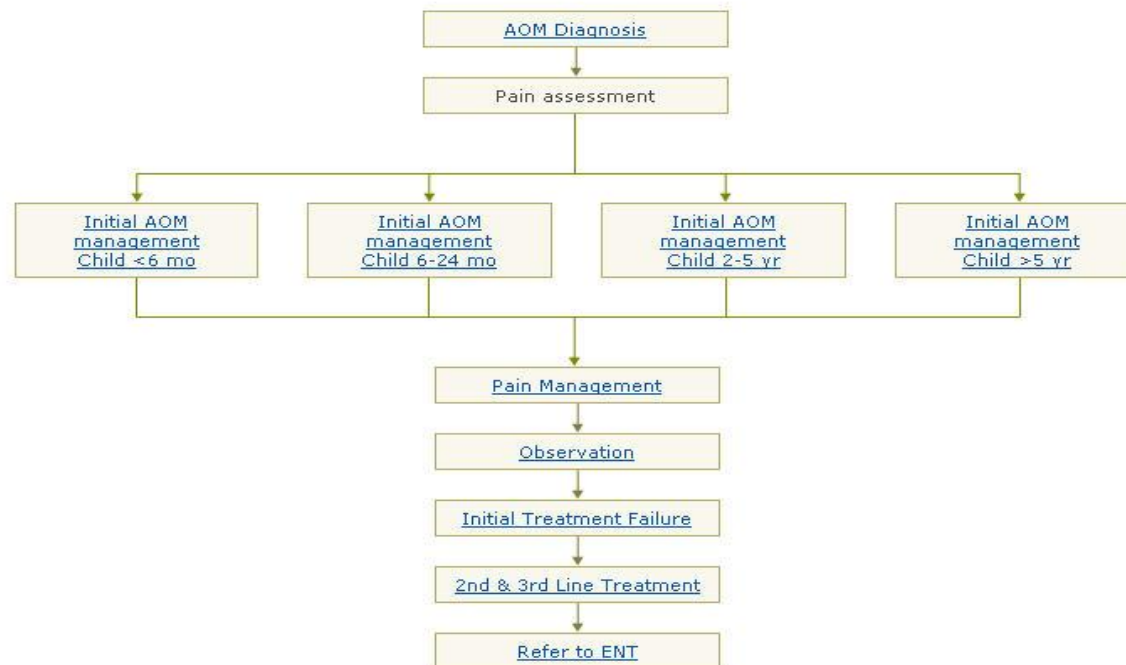
# EHRs at CHOP

- All ambulatory care sites use the same EHR system
- Implementation began in 2001
- All sites have been using EHRs since 2006

# Web-Accessible AOM Guidelines

## Acute Otitis Media (AOM) Treatment, Children 2 Months to 12 Years Old\*

\*Applies to children without signs or symptoms of systemic illness unrelated to the middle ear. Children with conditions that may alter the course of otitis media such as cleft palate, genetic conditions such as Down Syndrome, immunodeficiencies, and cochlear implants, are excluded from these guidelines.



### Learn More

[Antibiotic Treatment Cost for Acute Otitis Media](#)

### Related Links

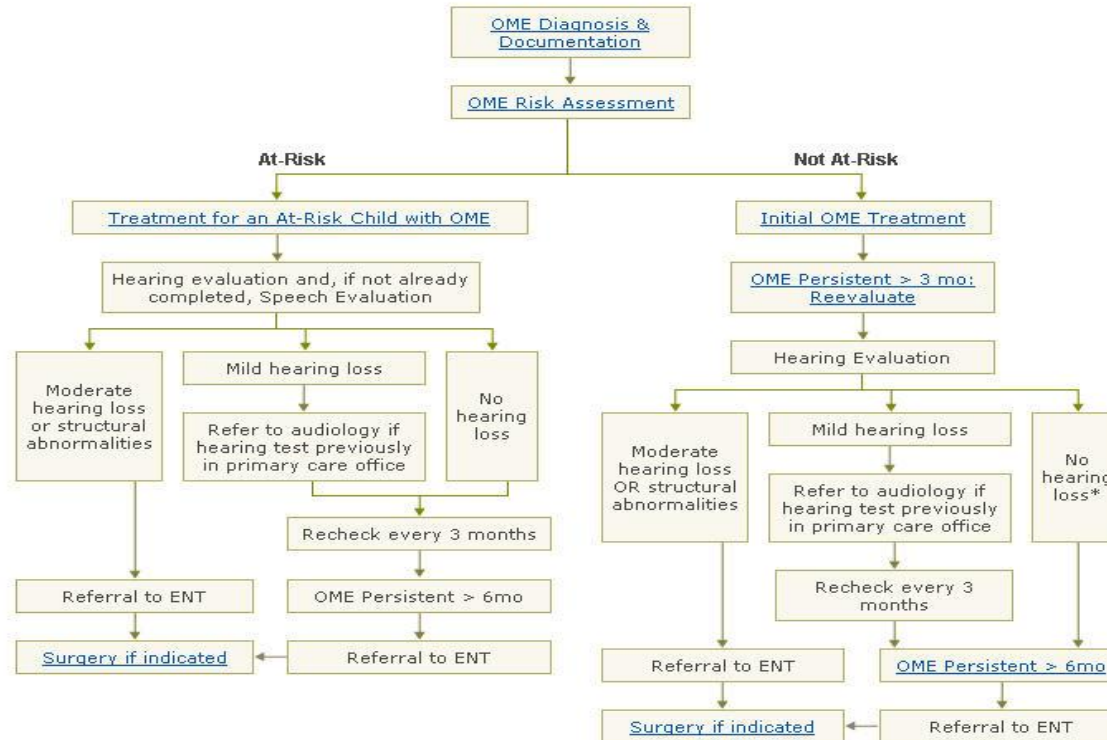
[Diagnosis and Management of Acute Otitis Media](#) ↗+

### Site Tools

[Back to Otitis Media Pathways](#)

# Web-Accessible OME Guidelines

Otitis Media with Effusion (OME) Treatment Pathway, Children 2 Months-12 Years



\*For those with no hearing loss, clinicians may consider rechecks as deemed necessary.

Related Links

[Otitis Media With Effusion](#)  
📄+

Site Tools

[Back to Otitis Media Pathways](#)





# Problem List

The screenshot displays the EpicCare interface for a patient's problem list. The top navigation bar includes menu items like Desktop, Action, Patient Care, Scheduling, Reports, Tools, and Help. Below this, a secondary bar contains icons for Home, Schedule, In Basket, Chart, Encounter, Tel Enc, Patient Lists, Change PCP, Login Ctxt, Secure, Scheduling, Epic Help, Print, and Log Out. The patient's name is partially visible, along with their Allergies: "No Known Drug, food, latex, contact, rad Con...".

The main content area is titled "Problem List" and features a search bar with "Add" and "CodeSearch" buttons. A table lists the following problems:

Priority	Class	Noted	Resolved	Updated
			<input checked="" type="checkbox"/>	

- ▶ **CHR SEROUS OM SIMP/NOS [381.10]**  
Freq OM. Has ENT appt next week- BMTs recommended
- ▶ **FEVER [780.6]**
  - 9/07: bagged specimen grew 10-50,00 enterococcus. Fever defervesced without abx. Started on abx after fever down. Will not pursue uti workup based on this history. Will follow closely for other signs of uti

The left sidebar contains a vertical menu with options: SnapShot, Chart Review, Flowsheets, Doc Flowsheet, **Problem List**, History, Letters, Demographics, Growth Chart, Results Review, Medications, Allergies, Enter/Edit Resul..., Audiogram, Patient Files, Order Entry, Imm/Injections, FYI, and MyChart Encou... At the bottom of the sidebar are "Hotkey List" and "Exit Workspace" buttons.

The bottom status bar shows a "Call Center, Results, Chart Cosign, Charts, Expiring Orders, Overdue Results, Staff Message" notification and the time "10:27 AM".

# Encounter History

epic

Desktop Action Patient Care Scheduling Reports Tools Help

Schedule In Basket Chart Encounter Tel Enc Patient Lists Change PCP Login Ctxt Secure Scheduling Epic Help Print Log Out

Home

Allergies: No Known Drug, food, latex, contact, rad Con... PCP: INS BLUE SHIELD OT...

INS BLUE SHIELD OT... Last refresh: 11:01 AM

**Chart Review**

Filters Clear All Filters Text Search Select All Deselect All Review Selected Master Report Flowsheet

Encounters Notes Laboratory Imaging Procedures ECG Other Orders Medications Letters Media Misc Reports

Filtered: Hide Add'l Visits  Hide Add'l Visits  Well Child  My Visits Clear All

Date	Type	Class	Dept	Provider	Description
	Office Visit				
	Pre, Pend	Day Surgery			
	Telephone				Fever-over the weekend... Earache
	Telephone				Routin Child Health Exa...
	Office Visit				ENT/ORL Audiometric Ev...
	Office Visit	Outpatient			Suppur Otitis Media NOS...
	Office Visit				Acute Supp Otitis Media...
	Telephone				Other-DAD CALLED A W...
	Telephone				Fever
	Telephone				Congestion-afebrile, sle...
	Office Visit				Acute Serous Otitis Medi...
	Nurse Triage				
	Nurse Triage				
	Telephone				Ear Problem
	Office Visit				Acute Supp Otitis Media...
	Telephone				Question
	Telephone				Other-HAD RECTAL FEV...
	Office Visit				Suppur Otitis Media NOS...
	Office Visit				Routin Child Health Exa...
	Telephone				Medication Question-M...

[Load more](#)

21 records loaded, more records to load | 21 records satisfy filters

Hotkey List Exit Workspace

Call Center, Results, Chart Cosign, Charts, Expiring Orders, Overdue Results, Staff Message 11:16 AM

# Antibiotic History

Desktop Action Patient Care Scheduling Reports Tools Help

Home Schedule In Basket Chart Encounter Tel Enc Patient Lists Change PCP Login Ctxt Secure Scheduling Epic Help Print Log Out

Home

Allergies: **No Known Drug,food,latex,contact,rad Con...** PCP: [REDACTED] INS: [BLUE SHIELD OT...](#)

Snapshot **Chart Review** Last refresh: 11:02 AM

Chart Review Filters Clear All Filters Select All Deselect All Review Selected

Encounters Notes Laboratory Imaging Procedures ECG Other Orders **Medications** Letters Media Misc Reports

Filtered: Therapeutic Class  Current Meds Only  Antibiotics  steroids [Clear All](#)

Date	AMB/IP	Medication	Order Detail	Provider	End Date
[REDACTED]	AMB	OMNICEF 125 MG/5ML OR SUSR	1 tsp (125 mg) by mout...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AZITHROMYCIN 100 MG/5ML OR...	1 1/2 tsp today, then 3/4...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AUGMENTIN ES-600 600-42.9 MG...	3/4 tsp by mouth 2 time...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AUGMENTIN ES-600 600-42.9 MG...	3/4 tsp by mouth 2 time...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AUGMENTIN ES-600 600-42.9 MG...	3/4 tsp by mouth 2 time...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AZITHROMYCIN 100 MG/5ML OR...	1 tsp (100 mg) by mout...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	SULFAMETHOXAZOLE-TRIMETHO...	1 tsp by mouth twice dai...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	SULFAMETHOXAZOLE-TRIMETHO...	1 tsp by mouth twice dai...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	OMNICEF 125 MG/5ML OR SUSR	1 1/4 tsp daily for 10 days	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AUGMENTIN 400-57 MG/5ML OR ...	2.5 ml twice daily x 10 ...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AMOXICILLIN 250 MG/5ML OR SUSR	1 tsp by mouth twice dai...	[REDACTED]	[REDACTED]
[REDACTED]	AMB	AUGMENTIN 200-28.5 MG/5ML O...	4 ml by mouth, twice dai...	[REDACTED]	[REDACTED]

Hotkey List

Exit Workspace

14 records loaded, all records loaded 12 records satisfy filters

Call Center, Results, Chart Cosign, Charts, Expiring Orders, Overdue Results, Staff Message 11:01 AM

# Audiograms

Desktop Action Patient Care Scheduling Reports Tools Help

Home Schedule In Basket Chart Encounter Tel Enc Patient Lists Change PCP Login Ctxt Secure Scheduling Epic Help Print Log Out

Allergies: No Known Drug,food,latex,contact,rad Con... PCP: INS: BLUE SHIELD OT...

**Audiogram**

11/13/06 Frequency, Hz

125 250 500 1000 2000 4000 8000

dB

0

20

40

60

80

100

120

ANSI

**AUDIOGRAM CODE**

AIR RIGHT LEFT

Unmasked ○ ×

Masked ▲ ▣

BONE

Unmasked < >

Masked [ ]

Vibrotactile <v >v

AIDED Both Ears RA AL

COCHLEAR IMPLANT RC CL

NO RESP. /

FIELD-Not Ear-specific SN Sw

**Speech Tests**

Condition	SAT			SRT			Word Recognition		
	%	dB	S/N	%	dB	S/N	%	dB	S/N
SOUND FIELD	20								

MLV: "uh oh"

**TYMPANOGRAM**  
TympStar CSHRm139

Ear	MEP	SC	Volume
Right	---	---	0.6
Left	15	0.1	0.6

C 0.5  
m p  
i  
a  
n  
c  
e  
m L

226 Hz

1.5  
1.0  
0.5  
0  
-0.5  
-1.0  
-1.5

Pressure, daPa

-400 -200 0 200

**RESULTS:**

CSH AUDIOLOGY

**AUDIOMETER** Orbiter CSH1

**TRANSDUCERS** Speakers

**RELIABILITY** Good

**RESPONSE** VRA

Import Undo Export

Print

Hotkey List

Exit Workspace

Call Center, Results, Chart Cosign, Charts, Expiring Orders, Overdue Results, Staff Message

1:26 PM

# Referrals

epic ROBERT G - SPRING 2007 STAGE - 3 PHILLI PC GEN PEDS

Desktop Action Patient Care Scheduling Reports Tools Help

Schedule In Basket Chart Encounter Tel Enc Patient Lists Change PCP Login Ctxt Secure Scheduling Epic Help Print Log Out

Home

Allergies: No Known Drug,food,latex,contact,rad Con... PCP: INS BLUE SHIELD OT...

Snapshot Chart Review Last refresh: 01:23 PM

Chart Review Filters Clear All Filters Select All Deselect All Review Selected

Encounters Notes Laboratory Imaging Procedures ECG **Other Orders** Medications Letters Media Misc Reports

**Filtered: Department Specialty** Clear All

Attachment Type	Encounter Type	Description	Status
Authorizing Provider	Episode	SCHEDULE SURGERY	Final result
<input checked="" type="checkbox"/> Department Spe...	Ordering Provider	CONSULT TO AUDIOLOGY (CHOP)	Final result

Department Specialty	#Ord
<input type="checkbox"/> General Pediatrics	25
<input checked="" type="checkbox"/> Otorhinolaryngology	2

**Date Range** [Click for Filter Options](#)

From:  To:

Save Edit Clear All Filters Close

27 records loaded, all records loaded 2 records satisfy filters

Hotkey List Exit Workspace

Call Center, Results, Chart Cosign, Charts, Expiring Orders, Overdue Results, Staff Message 1:41 PM

# Intervention: History of Present Illness / Physical Exam

History of Present Illness	Physical Exam																																																		
Fever of 102.5°F (39.2°C) in the past 24 hours: <input checked="" type="radio"/> Yes <input type="radio"/> No	General appearance: <input checked="" type="radio"/> Well <input type="radio"/> Ill																																																		
Tmax: <input type="text" value="103"/> Duration (days): <input type="text" value="3"/>																																																			
Normal: <table border="0"><tr><td></td><td>Right</td><td>Left</td></tr><tr><td></td><td><input type="checkbox"/></td><td><input checked="" type="checkbox"/></td></tr></table>		Right	Left		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<table border="0"><tr><td></td><td>Right</td><td>Left</td><td>Not assessed</td></tr><tr><td>Normal:</td><td><input checked="" type="checkbox"/></td><td><input checked="" type="checkbox"/></td><td></td></tr><tr><td>Unable to visualize:</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>TM Injected:</td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Bulging:</td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Otorrhea:</td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Effusion/Air fluid level:</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Decreased mobility:</td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr><tr><td>Tubes in place:</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Perforation:</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr><tr><td>Other:</td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td></td></tr></table>		Right	Left	Not assessed	Normal:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		Unable to visualize:	<input type="checkbox"/>	<input type="checkbox"/>		TM Injected:	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Bulging:	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Otorrhea:	<input checked="" type="checkbox"/>	<input type="checkbox"/>		Effusion/Air fluid level:	<input type="checkbox"/>	<input type="checkbox"/>		Decreased mobility:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Tubes in place:	<input type="checkbox"/>	<input type="checkbox"/>		Perforation:	<input type="checkbox"/>	<input type="checkbox"/>		Other:	<input type="checkbox"/>	<input type="checkbox"/>	
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TM Injected:	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																	
Bulging:	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																	
Otorrhea:	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																	
Effusion/Air fluid level:	<input type="checkbox"/>	<input type="checkbox"/>																																																	
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Other:	<input type="checkbox"/>	<input type="checkbox"/>																																																	
Otalgia: <table border="0"><tr><td></td><td>Right</td><td>Left</td></tr><tr><td></td><td><input checked="" type="checkbox"/></td><td><input type="checkbox"/></td></tr></table>		Right	Left		<input checked="" type="checkbox"/>	<input type="checkbox"/>																																													
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	Right	Left																																																	
	<input checked="" type="checkbox"/>	<input type="checkbox"/>																																																	
Hearing/speech/balance concerns: <input type="radio"/> Yes <input checked="" type="radio"/> No																																																			
	<input type="button" value="Cancel"/> <input type="button" value="Show suggested diagnosis/plan"/>																																																		

- A minimal amount of discrete data is collected to determine the diagnosis and the severity of illness
- This information is needed to determine the recommended treatment

# Treatment Guidelines

Acute Otitis Media (AOM) Treatment, Children 2 Months to 12 Years Old

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## Initial AOM Management: Child 2-5 yr

- Treat pain if present
- OBSERVE if illness is not severe OR the diagnosis is uncertain
  - Severe illness is defined as moderate to severe otalgia or fever  $\geq 39^{\circ}$  C
  - Uncertain AOM diagnosis = acute onset with middle ear inflammation but uncertain effusion
- ANTIBIOTIC TREATMENT when diagnosis is certain AND illness is severe (All 10 days except Zithromax, 5 days):
  - If non-penicillin allergic: Amoxicillin (Amoxil) 80-90 mg/kg/day
  - If Type I Penicillin allergic: Azithromycin (Zithromax)
  - If Non-Type I Penicillin allergic: Cefuroxime (Ceftin), Cefpodoxime (Vantin), or Cefdinir (Omnicef)
  - Perforation: If a perforation exists, add Ofloxacin (Floxin/Ocuflox) 5 drops into the affected ear(s) twice daily for 10 days



# Intervention: Assessment and Plan

Assessment and Plan			
Type	AAP Guideline	Action	Reason Declined
Diagnosis	Acute Otitis Media	<input checked="" type="radio"/> Accept/Sign <input type="radio"/> Decline	
Analgesic	IBUPROFEN 100 mg/5 mL susp, give 150 mg (=1.5 tsp) po q6h prn	<input checked="" type="radio"/> Accept/Sign <input type="radio"/> Decline	
Antibiotic	AMOXICILLIN-CLAVULANATE 800 mg/5 mL susp, give 720 mg (=6 mL) po bid for 10 days	<input checked="" type="radio"/> Accept/Sign <input type="radio"/> Decline	
Antibiotic	OFLOXACIN 5 gtt bid to affected ear 10 days	<input checked="" type="radio"/> Accept/Sign <input type="radio"/> Decline	
Documentation	Otitis Media Progress Note	<input checked="" type="radio"/> Accept/Sign <input type="radio"/> Decline	

- This section displays the calculated guideline based recommendations for treatment of the patient.
- Each recommended item can be accepted or declined.

# Intervention: Otitis Media Assistant Order Set

The screenshot displays the EpicCare SmartSet interface for a patient named Laura, a 4-year-old female. The interface is titled "OTITIS MEDIA HEALTH INFORMATION TECHNOLOGY SMART SET" and includes a navigation pane on the left with options like Snapshot, Chart Review, and Medications. The main content area shows a list of items under "DOCUMENTATION", "DIAGNOSIS", "ANTIBIOTIC", "PAIN MEDICATION", and "OTITIS MEDIA SELECTABLE ITEMS". A "SmartSet Notes" panel is on the right, and a "Legend" at the bottom right explains symbols for standing orders, future orders, interaction alerts, and previously defaulted items. The status bar at the bottom indicates "Loading SmartSet succeeded."

Desktop Action Patient Care Scheduling Reports Tools Help

Home Schedule In Basket Chart Encounter Tel Enc Patient Lists Change PCP Login Ctxt Secure Scheduling Epic Help Print Log Out

Home Test, Laura EpicCare

Test, Laura 4 y.o. female (1/1/2004) Allergies 31000092 No Known Drug,food,latex,contact,rad Con... PCP Amy Chang INS BLUE CROSS BL...

SnapShot  
Chart Review  
Flowsheets  
Doc Flowsheet  
Problem List  
History  
Letters  
Demographics  
Growth Chart  
Results Review  
Medications  
Allergies/AdvRx  
Enter/Edit Resul...  
Audiogram  
Patient Files  
Order Entry  
Imm/Injections  
Visit Navigator  
SmartSet - O...

OTITIS MEDIA HEALTH INFORMATION TECHNOLOGY SMART SET

Association Primary Dx Edit Item Favorite Pharmacy Providers Questionnaire Health Maint Accept/Pend Accept/Sign Sign/Print Cancel

- DOCUMENTATION
  - PROGRESS NOTE
    - OMHIT PROGRESS NOTE
- DIAGNOSIS
  - [382.01] Acute Otitis Media w/ Drum Rupture
    - [382.01] Acute Otitis Media w/ Drum Rupture
- ANTIBIOTIC
  - Amoxicillin - Pot. Clavulanate 600/mg/mL Susp 10 Day
    - Amoxicillin - Pot. Clavulanate 600/mg/mL Susp 10 Day
  - Ofloxacin 0.3 % Opth Soln 10 Day
    - Ofloxacin 0.3 % Opth Soln 10 Day {Drug-Drug Moderate NSAIDs / Quinolones}
- PAIN MEDICATION
  - Ibuprofen 100 mg/5mL Susp
    - Ibuprofen 100 mg/5mL Susp
- OTITIS MEDIA SELECTABLE ITEMS
  - DOCUMENTATION
  - MEDICATIONS: ANTIBIOTICS
  - MEDICATIONS: PAIN
  - PROCEDURES
  - REFERRALS
  - DIAGNOSIS
  - PATIENT INSTRUCTIONS
    - OMHIT PATIENT INSTRUCTIONS (ENGLISH)
  - Follow Up - Select One

SmartSet Notes

Legend

- Standing order
- Future order
- Interaction alert
- Previously defaulted

Right click data row to edit | Loading SmartSet succeeded.

Start Citrix Access Platform - T... Epic ROBERT G - SPRING 200... 10:11 AM

# Progress Note

Additional Progress Notes - Test,Laura

100% [Clipboard] [Print] [List] [More] Arial 11 B I U S A

abc [Undo] [Redo] [Help] [New] [Open] [Save] [Print] [Find]

HPI:  
Laura is a 4 year old female here with her {GUARDIAN:61}. Chief Complaint  
Patient presents with  
▪ Frequent Ear Infections

Fever present within 24 hours: **YES**, for **3** days, Tmax: **104**  
Right ear: **EAR PAIN** and **OTORRHEA**  
Left ear: no ear pain or otorrhea  
Hearing/speech/balance concerns: no

History of **3 Acute Otitis Media (AOM)** episodes and **2 Otitis Media with Effusion (OME)** episodes within the past 6 months, the most recent AOM episode began **4/18/2008**, the most recent OME episode began **4/18/2008**.  
Last antibiotic was **AMOXICILLIN** on **4/18/2008**.  
No risk factors noted in the past.  
No recent audiology evaluation.

ROS: Other symptoms include: {ROS positive:11047}.  
There has been no {ROS negative:11048}

Pain: {pain:11028:"Pain issues as per nursing documentation."}

ALLERGIES: No known drug,food,latex,contact,rad contrast,blood  
MEDICATIONS: Reviewed.  
CHRONIC PROBLEMS: Reviewed.

PHYSICAL EXAMINATION  
GENERAL: **ill appearance**  
EARS: Right: **TM INJECTED, BULGING, OTORRHEA, DECREASED MOBILITY**; Left: normal

Press F3 key to expand form

Accept Cancel





# Images



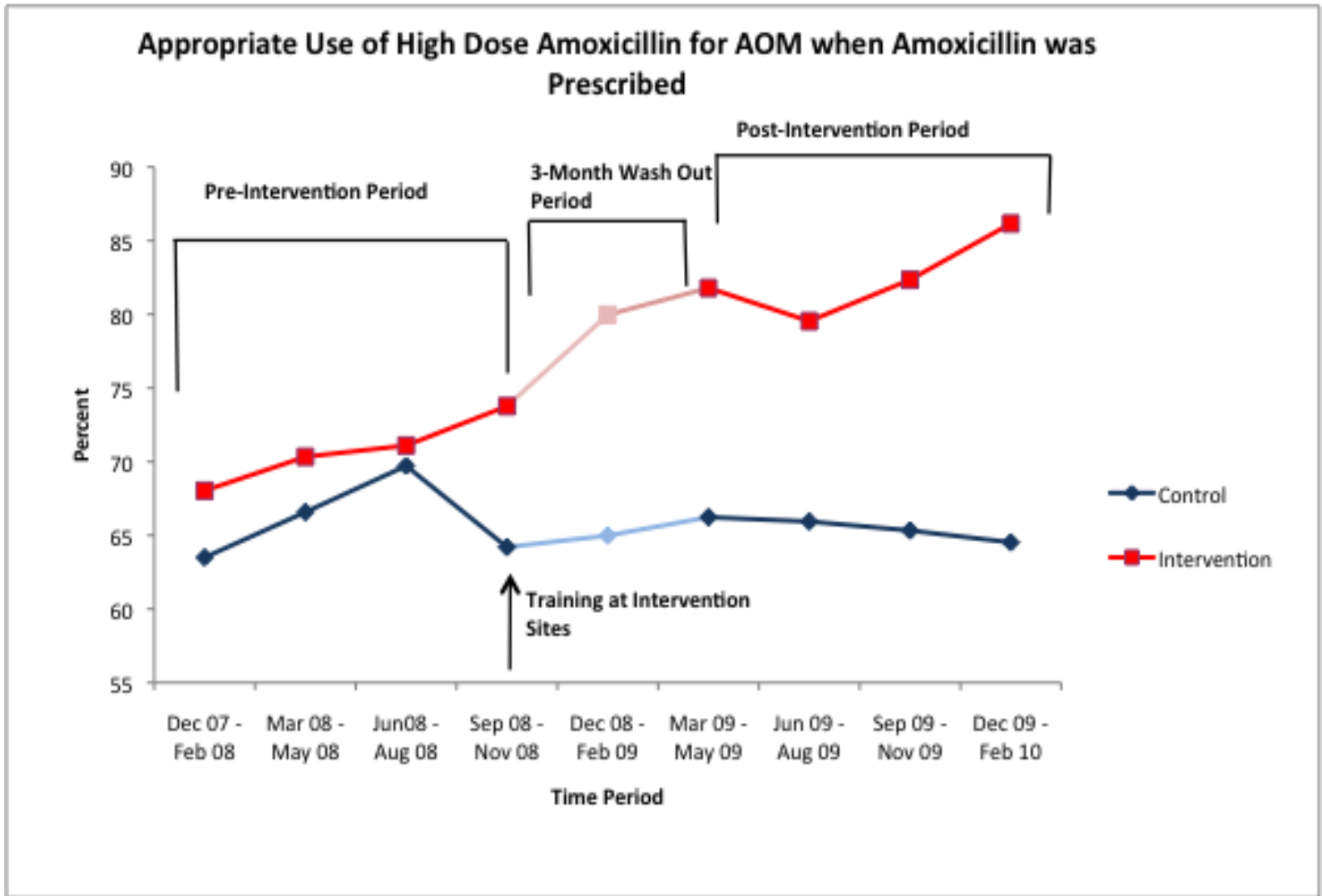
The tympanic membrane is inflamed and bulging, consistent with Acute Otitis Media.

# Encounter Identification

Data Type	Acute OM	OM with Effusion	OM Unclassified	Normal
<b>Text</b>	16% [2]	3% [5]		
<b>ICD-9</b>	21% [3]	0.2% [6]		
<b>Exam</b>	4% [4]	0.1% [7]	22% [8]	33% [1]

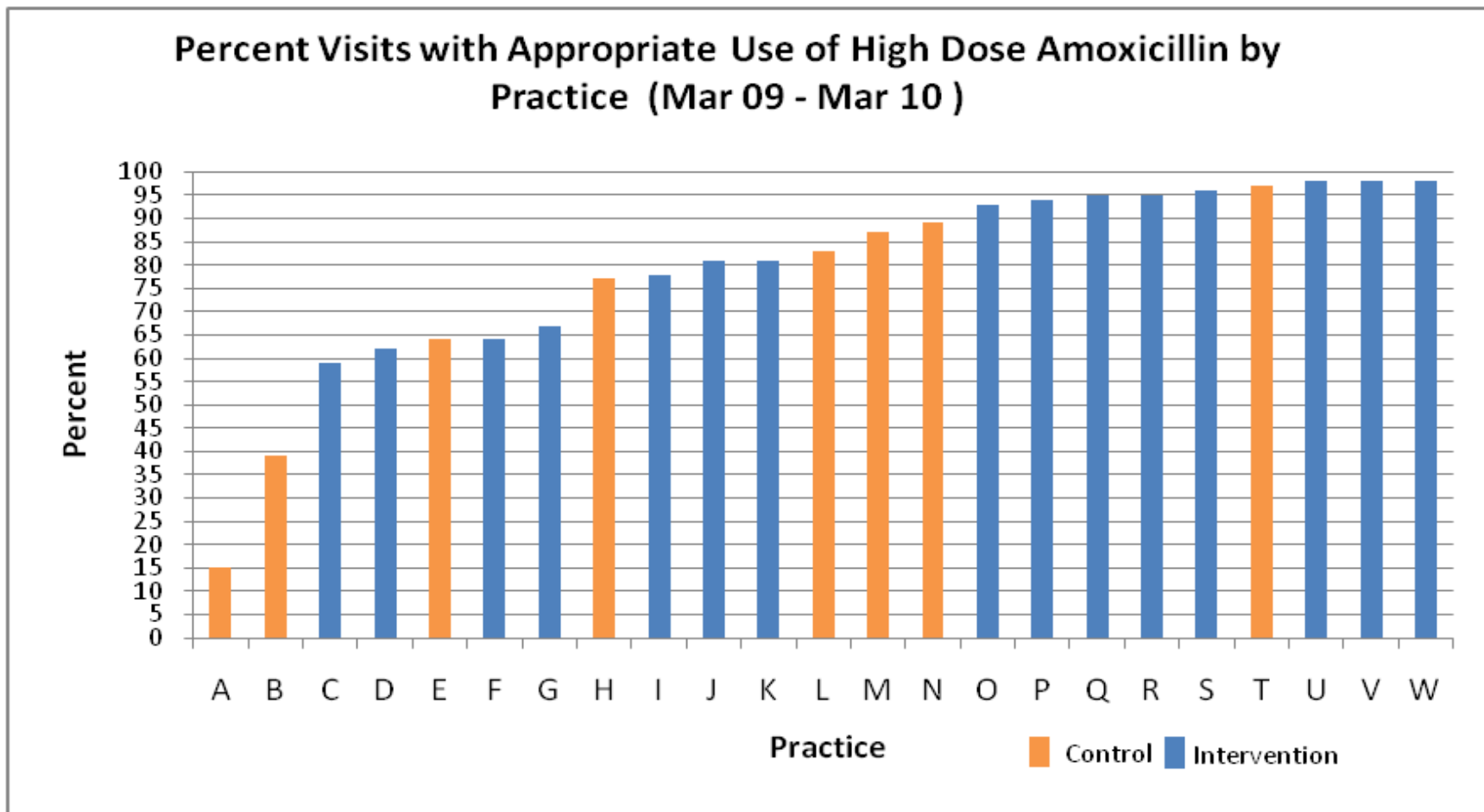
- Percents based on total number of encounters in incident episodes during pre-intervention period
- Encounters were classified using the hierarchy indicated by the numbers in brackets

# Results Pre and Post Intervention



*If patient weight < 25kg then high dose was defined as  $\geq 60\text{mg/kg/day}$   
If patient weight  $\geq 25\text{ kg}$  then high dose was defined as  $\geq 1500\text{ mg/day}$*

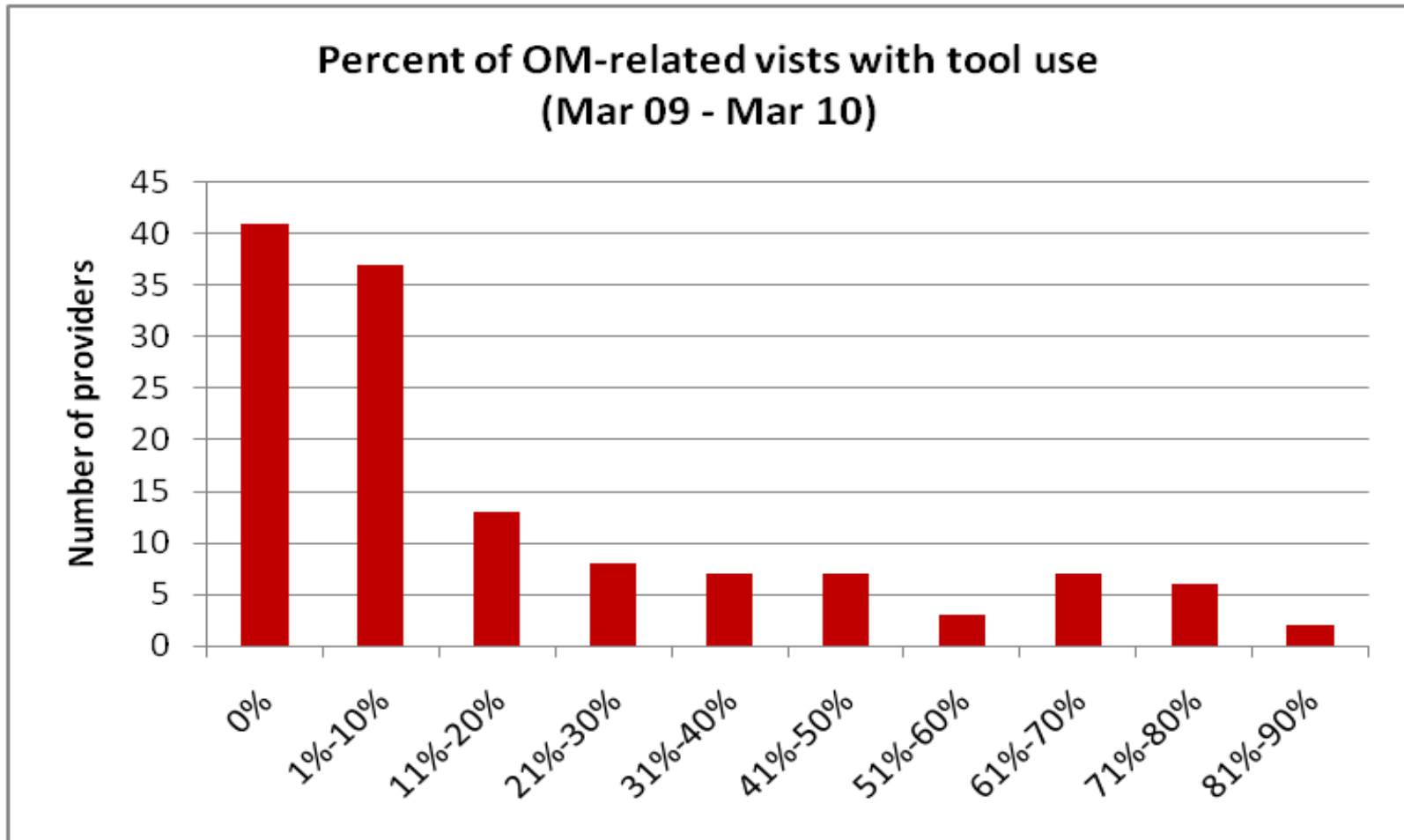
# Practice-Level Variation



*If patient weight < 25kg then high dose was defined as  $\geq 60\text{mg/kg/day}$   
If patient weight  $\geq 25\text{ kg}$  then high dose was defined as  $\geq 1500\text{ mg/day}$*



# Provider-Level Tool Use





# Provider Feedback on Tool

## Positive

- Visual timeline of past OM episodes
- Find pictures useful for resident teaching and parent education
- Medication dosing is provided

## Negative

- Double documentation when patient has conditions other than OM
- Resistance to changing workflow
- Prefer existing features in EHR
- Too many variables to fill in
- Already familiar with Otitis Media Guidelines