



# Leveraging Technology and Informatics for Antimicrobial Stewardship

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# Disclosure

All planners, presenters, and reviewers of this session report no financial relationships relevant to this activity.

# Learning Objectives

- List antimicrobial stewardship tools available in electronic health record (EHR) platforms.
- Describe how the EHR and clinical decision support systems (CDSS) can be used together as a successful antimicrobial stewardship tool.
- Review commonly used CDSS and their role in enhancing antimicrobial stewardship.

# Introduction

- Electronic health records (EHR) and Clinical Decision Support Systems (CDSSs)
- EHR: Epic System Corporation and Cerner Corporation
  - Largest U.S. market share
- Add-on CDSSs
  - Used for many years for antimicrobial stewardship and infection control activities
  - Enhance quality of care and improve patient outcomes

# Antimicrobial Stewardship

- **Antimicrobial Stewardship (AS)**
  - “Coordinated interventions designed to improve and measure the appropriate use of antibiotic agents by promoting the selection of the optimal antibiotic drug regimen including dosing, duration of therapy, and route of administration”
- **Antimicrobial Stewardship Programs (ASP)**
  - Programs dedicated to improving antimicrobial use

Fishman N. *Infect Control Hosp Epidemiol* 2012;33(4):322-7.

Barlam TF, et al. *Clin Infect Dis* 2016;62:e52-77.

*Clinical Infectious Diseases*

**IDSA GUIDELINE**

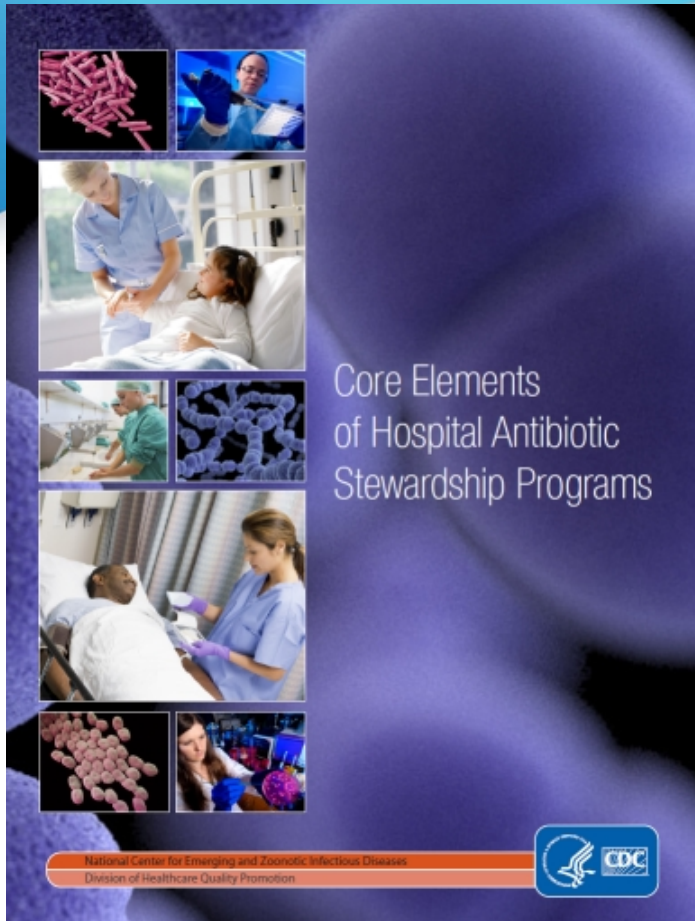


# Implementing an Antibiotic Stewardship Program: Guidelines by the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America

Tamar F. Barlam,<sup>1,2</sup> Sara E. Cosgrove,<sup>2,3</sup> Lilian M. Abbo,<sup>3</sup> Conan MacDougall,<sup>4</sup> Audrey N. Schuetz,<sup>5</sup> Edward J. Septimus,<sup>6</sup> Arjun Srinivasan,<sup>7</sup> Timothy H. Dellit,<sup>8</sup> Yngve T. Falck-Ytter,<sup>9</sup> Neil O. Fishman,<sup>10</sup> Cindy W. Hamilton,<sup>11</sup> Timothy C. Jenkins,<sup>12</sup> Pamela A. Lipsett,<sup>13</sup> Preeti N. Malani,<sup>14</sup> Larissa S. May,<sup>15</sup> Gregory J. Moran,<sup>16</sup> Melinda M. Neuhauser,<sup>17</sup> Jason G. Newland,<sup>18</sup> Christopher A. Ohl,<sup>19</sup> Matthew H. Samore,<sup>20</sup> Susan K. Seo,<sup>21</sup> and Kavita K. Trivedi<sup>22</sup>

Barlam TF, et al. *Clin Infect Dis* 2016;62:e52-77





- Leadership Commitment
- Accountability
- Drug Expertise
- Tracking
- Reporting
- Education



# New Antimicrobial Stewardship Standard

APPLICABLE TO HOSPITALS AND CRITICAL ACCESS HOSPITALS

**Effective January 1, 2017**

## Medication Management (MM)

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### **Standard MM.09.01.01**

The [critical access] hospital has an antimicrobial stewardship program based on current scientific literature.

**Note:** *An example of an educational tool that can be used for patients and families includes the Centers for Disease Control and Prevention's Get Smart document, "Viruses or Bacteria—What's got you sick?" at <http://www.cdc.gov/getsmart/community/downloads/getsmart-chart.pdf>.*

4. The [critical access] hospital has an antimicrobial stewardship multidisciplinary team that includes the following members, when available in the setting:
  - Infectious disease physician

[https://www.jointcommission.org/assets/1/6/HAP-CAH\\_Antimicrobial\\_Prepub.pdf](https://www.jointcommission.org/assets/1/6/HAP-CAH_Antimicrobial_Prepub.pdf);

accessed 9/25/17





## **Antimicrobial Use and Resistance (AUR) Module**

- Two options: **Antimicrobial use (AU)** and Antimicrobial resistance (AR)
- Voluntarily reporting to National Healthcare Safety Network (NHSN)
- **Purpose:** facilitate risk adjusted inter- and intra-facility benchmarking of antimicrobial usage
- **Metrics:** days of antimicrobial therapy (DOT)/ 1000 days present
- **Data Source:** e-MAR and/or bar coding medication record (BCMA)
- **Format:** Health Level (HL7) Clinical Document Architecture

# ASP and Information Technology

## IDSA guidelines

- Incorporate computerized CDSS at the time of prescribing into ASPs

## CDC core elements

- Tracking: monitoring antibiotic prescribing and resistance patterns

## Joint Commission standard

- Hospital collects, analyzes, and reports data on its ASP

# Impact of CDSS on Antibiotic Use

- Reduced use of broad spectrum antibiotics
- Improved antibiotic selection and dosing
- Fewer prescribing errors and adverse events
- Decrease in antibiotic costs and length of stay

# Audience Poll

- How many of you currently use or plan to use one of these electronic systems for antibiotic stewardship?
  - A. EHR only
    - EPIC
    - Cerner
    - Other (Meditech or homegrown)
  - B. Add-on CDSS (non-EHR based)
  - C. Both A and B
  - D. Other

# Audience Poll

- What is your current role?
  - A. Antimicrobial stewardship or ID pharmacist
  - B. Informatics/IT pharmacist
  - C. Administrative (including Director or VP of Pharmacy)
  - D. Pharmacy student or resident
  - E. Other



# Single Electronic Health Record: Customizing Epic for Antimicrobial Stewardship

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# Learning Objectives

- **List antimicrobial stewardship tools available in electronic health record (EHR) platforms.**
- Review commonly used clinical decision support systems (CDSSs) and their role in enhancing antimicrobial stewardship.
- Describe how both EHR and CDSS can be used together as a successful antimicrobial stewardship tool.

# Epic EHR System

- One of the leading providers of EHR systems in U.S.
- 25.8% of the U.S. acute care hospital market share in 2016
- Fully integrated system incorporating all areas of patient care into a single database
- Primary focus on clinical functionality and patient care

Forrest GN, et al. *Clin Infect Dis* 2014; 59 (S3):S122-33.

<http://www.beckershospitalreview.com/healthcare-information-technology/epic-cerner-hold-50-of-hospital-ehr-market-share-8-things-to-know.html>; accessed 9/16/17



# Antimicrobial Stewardship Tools

## Entry level tools

- iVents
- Order panels and order sets
- IV to PO algorithms
- Order form and dose-checking
- Best practice advisories
- Patient scoring and monitoring
- 96-hour stop date
- Antibiotic indications

## Advanced tools

- Epic 2014 and 2016 version
- Available at additional cost AS module (Willow)
- Infection control module (ICON)

Forrest GN, et al. *Clin Infect Dis* 2014; 59 (S3):S122-33.

# Antimicrobial Stewardship Module

- AS Dashboard
  - Organizes all AS tools in one place
- AS Scoring System
  - Identifies patients for AS interventions
  - Allows easy documentation and communication
- iVents
  - Documentation of AS interventions
  - Integrated into AS dashboard
  - Allows for easy copy/paste into progress notes

# ICON Module

- Enhances infection control activities
- Antibiotic use reports
  - Days of therapy (DOT)/1000 patient days present calculation using e-MAR data
  - Option to submit to NHSN-AUR module
- Workbench reporting
  - Real-time antibiogram reporting

# The Johns Hopkins Health System

- Academic hospitals
  - The Johns Hopkins Hospital- 1,194 beds
  - Johns Hopkins Bayview Medical Center- 440 beds
  - Johns Hopkins All Children's (not using Epic)- 259 beds
- Community hospitals
  - Howard County General Hospital- 282 beds
  - Sibley Memorial Hospital- 318 beds
  - Suburban Hospital- 222 beds
- Epic was implemented at 5 hospitals

# The Johns Hopkins Hospital AS Program

- Adult inpatients - 2002
- Pediatric inpatients - 2012
- CDDS
  - Theradoc® ~ 15 years
  - Epic AS and ICON module - 2016

## Stewardship Interventions

- Pre-authorization
- Prospective audit and feedback
- Syndrome interventions
- Rapid diagnostics interventions
- Pharmacy-driven interventions
- Guidelines for antibiotic use

## Metrics

- DOT/1000 patient days present

# Customization of AS Module

- AS module was developed by academic hospitals AS teams
- We started with a wish list
  - Patient identification
    - Scoring system (customized rules) vs. workbench reports
  - Documentation of AS interventions
    - AS interventions types and subtypes (iVents)
  - Indications requirement for select antibiotics
- Weekly calls with Epic build team for 1 year

# Antimicrobial Stewardship Dashboard

Antimicrobial Stewardship Dashboard - JHH - Personal

**Stewardship News** Just now  
There are no posts to show

**Stewardship Scoring** <sup>5</sup>

▼ Patient Scoring System  
Antimicrobial Stewardship Patient List

**Stewardship Reports** <sup>4</sup>

▼ Reporting Workbench Reports

Report Name	Results	Status
CIM Positive Cultures - AMS		Ready to run ▼
JHH AMS CRE - Positive Cultures (Last 14 days)		Ready to run ▼

**In Basket Glance** <sup>5</sup> Just now

	New	Total
Staff Message	2	2
IDS Non-oncology Prescription	1	1
IDS Prescription	0	37
Oral Chemo Adherence	15	16

**Stewardship Common Links**


▼ Hyperspace Links  
Create New I-Vent  
Review I-Vents  
Stewardship Reports  
Verification Queue

▼ Web Links  
CDC website  
Pubmed  
IDSA Guidelines  
Lexicomp

▼ Hopkins Links  
Antimicrobials Approval Policy  
Antibiotic Guidelines (Yellow Book)  
Antimicrobial Stewardship Program Website  
Antimicrobial Renal Dosing Adjustment Guidelines (need link)  
Antibiotic Guides

▼ Pediatric Links  
Peds ID Approval website  
Peds ID Guidelines website

**Antimicrobial Stewardship I-Vent Distribution** Just now

 Click to run the report

Report: RX Stewardship I-Vent Distribution (last 30 days)

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# Customized Rules

Column Name	Rules	Score	Description
RX AMS DE-ESCALATION EXISTS	RX AMS DE-ESCALATION ENTEROCOCCUS SUSCEPTIBLE TO AMPICILLIN	5	Flag patients with Enterococcus faecalis spp in blood susceptible to ampicillin who are on vancomycin or linezolid (limit to blood cultures from last 5 days).
	RX AMS DE-ESCALATION MSSA (IN BLOOD) VANC SCORING	5	Flag patients with MSSA (methicillin/oxacillin susceptible staph aureus) in blood and on vancomycin (IV) (limit to cultures from last 5 days).
	RX AMS DE-ESCALATION MICAFUNGIN	3	Flag patients who are on micafungin and have positive blood cultures for candida that is susceptible to fluconazole.
	RX AMS DE-ESCALATION MSSA (NON BLOOD) VANC SCORING	3	Flag patients who are on vancomycin and have MSSA isolated from non-blood cultures. (lower score for non-blood)
RX AMS RESTRICTED ABX OUTSIDE TIMEFRAME (SCORING SYSTEM)	RX AMS RESTRICTED ABX OUTSIDE TIMEFRAME	5	Flags patients with open i-vents for overnight restricted antimicrobials
RX AMS PRELIMINARY POSITIVE BLOOD CULTURE	RX AMS PRELIMINARY POSITIVE BLOOD CULTURE	5	Flags patients with preliminary positive blood cultures within the last 5 days.
RX AMS THERAPEUTIC DRUG MONITORING	RX AMS THERAPEUTIC DRUG MONITORING	3	Flags patients with TDM for the following antimicrobials within the last 3 days; Voriconazole, Itraconazole, Posaconazole, 5FC, Vancomycin, Tobramycin, Amikacin, and Gentamycin
RX AMS VERIGENE	RX AMS VERIGENE	5	Flags patients with preliminary positive blood cultures that have Verigene identifications available within the past 3 days.



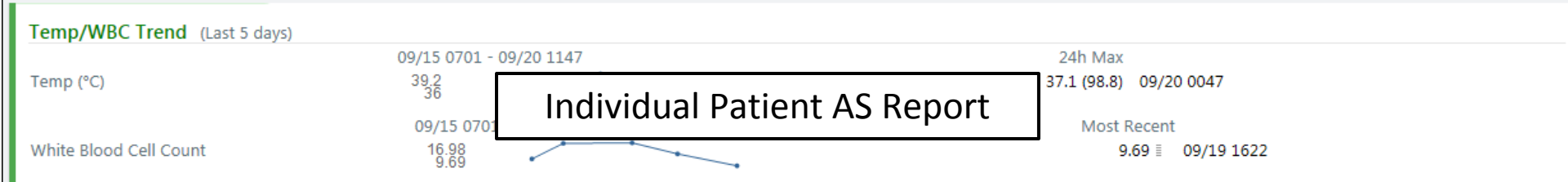
### Standard AS columns

AMS Score	AMS Score Change	AMS Last Reviewed	AMS I-Vents
14	=	18 hrs 53 mins	—
14	=	0 hrs 0 mins	🚩
12	=	0 hrs 4 mins	—
12	+ 12	Never reviewed	—
12	↓ 10	20 hrs 29 mins	—
10	+ 10	Never reviewed	—
9	=	4 hrs 29 mins	—

### Customized alerts

Bug-Drug Mismatch	Verigene Results	Positive Blood Culture (Preliminary)	De-Escalation of Therapy	Duplicate Coverage Exists	Final Culture Results	Vanc Zosyn Mero Greater Than 3 Days	Restricted Antimicrobi Overnight	Therapeutic Drug Monitoring	TDM (Antimicrobi I-Vents)	Fungemia
—	—	●	—	—	●	●	—	●	●	—
—	—	●	—	—	●	—	●	—	—	—
—	—	—	●	—	●	●	—	●	●	—
—	—	—	—	—	—	—	—	●	—	—
—	—	●	—	—	●	—	—	—	—	—
—	—	●	—	—	—	—	●	—	●	—
—	—	—	—	—	●	●	—	●	—	—

[Stewardship Report](#)
[Anti-infective](#)
[Kinetics](#)
[MAR ADMINISTRATIONS](#)
[All Flowsheet Data](#)
[TDM Score](#)
[Handoff](#)
Stewardship Report



#### Anti-Infectives

Medication	Dose/Rate, Route, Frequency	Last Action
ceFEPime (MAXIPIME) 1 g/50 mL iso-osmotic (w/ dextrose) Premix	1 g, IV, Q24H	New Bag/Given: 09/20 0230

# Stewardship Report

Stewardship Report | Anti-infective | Kinetics | MAR ADMINISTRATIONS | All Flowsheet Data | TDM Score | Handoff

Stewardship Report

## Stewardship Navigator

Jump to Navigator for Antimicrobial Review

### Infection Monitoring Report

Temp/WBC Trend (Last 7 days)

Temp (°C) 09/07 0701 - 09/14 0957 24h Max 36.6 (97.9) 09/13 2021

White Blood Cell Count 09/07 0701 - 09/14 0957 Most Recent 23.3 09/13 1959

#### Anti-Infectives

Medication	Dose/Rate, Route, Frequency	Last Action
cefTRIAxone (ROCEPHIN) 1 g/50 mL iso-osmotic (w/ dextrose) Premix	1 g, IV, Once	Ordered
cefTRIAxone (ROCEPHIN) 2 g/50 mL iso-osmotic (w/ dextrose) Premix	2 g, IV, Q12H	Ordered
linezolid (zyVOX) IVPB 600 mg/300 mL Premix	600 mg, IV, Q12H	New Bag/Given: 09/14 0636

Antimicrobial Stewardship : 20 © 2017 Epic Systems Corporation. Used with permission Document Scoring System Review

# Documentation in Scoring System

The screenshot shows a clinical scoring system interface. A dialog box titled "Scoring System Review Notes" is open, displaying the following text:

**Indication:** CAP, no sputum cultures obtained  
**Current treatment:** ceftriaxone 1 g q24h  
**Day of therapy:** 3 of 5  
**Recommendations:** change to oral cefdinir 300 mg q24h, GFR<30  
**Follow-up needed:** none

A text box in the center of the dialog box contains the text "Not a part of medical record".

At the bottom of the dialog box, there is a checkbox labeled "Mark patient as reviewed?" which is checked. To the right of this checkbox is a button labeled "Copy to Note". Below the checkbox are two input fields: "Value:" and "Time spent:", each with a calendar icon. At the bottom of the dialog box are two buttons: "Accept" and "Cancel".

The background interface shows a "Stewardship Report" for "Anti-infective" medication. The medication listed is "cefTRIAxone (ROCEPHIN) 1 g/50 mL iso-osmol". The "Antimicrobial Stewardship : 0" is displayed. The "Open Stewardship Interventions" section is visible. The "Last Action" is "New Bag/Given: 09/12 2330". A link "Document Scoring System Review" is present. The "Handoff" section shows "Stewardship Report".

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# Antimicrobial Stewardship Navigator

**Antimicrobial Stewardship Navigator**

CLINICAL REVIEW

- Bug-Drug Mismatch
- De-Escalation As...
- Duplicate Coverage
- Restricted Therapy
- TDM
- Abnormal Culture

ORDERS AND DOCUMENTATION

- Orders
- Open AMS I-Vents
- New I-Vent
- Progress Notes

**+ New Reading** [Cosign Report](#)

No data found.

**Therapeutic Drug Monitoring**

**+ New Reading** [Cosign Report](#)

No data found.

**Abnormal Preliminary Culture**

**+ New Reading** [Cosign Report](#)

No data found.

**Orders**

[Go to Manage Orders](#)

**Interventions**

**New i-Vent**

[Create New Intervention](#)

**Progress Notes**

**+ Create Note** [Go to Notes](#) [Refresh](#)

You have no filed Progress Notes for this patient within the last 24 hours.

**Flowsheets**

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**ashp 75**  
CELEBRATING 75 YEARS

# Documenting Interventions

**Intervention**

Type: **zz AS: Better Therapeutic Options Existed** Subtype: **More effective therapy existed** Status: **Open** Significance: **40.00** Value: **15 min** Response: **Accepted / Approved**

Outcomes: **Improved Efficacy**

Associated Orders:  Order Name or ID

Associated Users:

User	Role
<input type="text"/>	<input type="text"/>

Scratch Notes:

Documentation:

**Antimicrobial Stewardship Team Note**

Patient:   
MRN#:   
Attending:   
Admission Date:

**Better Therapeutic Options Existed Recommendation:**

Current Antimicrobial Medications

Anti-infectives

Start	Dose/Rate	Route	Frequen cy	Ordered	Stop
09/14/17 1200	ciprofloxacin HCl (CIPRO) tablet 500 mg	Oral	Every 12 hours	09/14/17 1101	09/21/17 1759

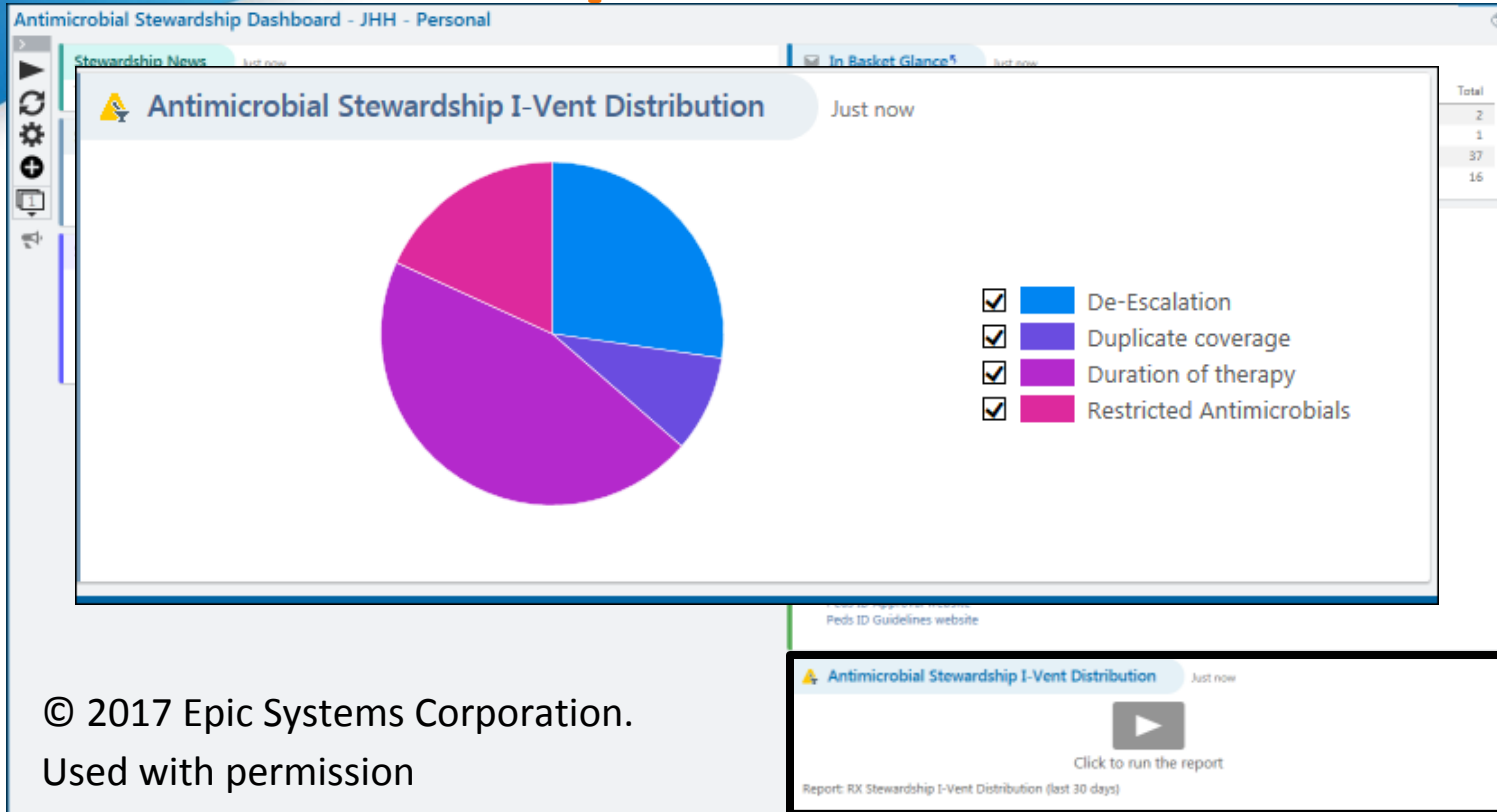
Assessment/Recommendation:

Submitted by:

Not a part of medical record

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# Report: AS I-vents



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# ICON

- Days of antimicrobial therapy (DOT) / 1,000 patient-days present
  - Followed CDC NHSN guidelines
  - Provided specs for customized reports
- Reporting to NHSN AUR module requires extensive validation
- Antibigrams
  - Clinical Laboratory Standards Institute antibiogram rules
  - List of existing antibigrams for each hospital

# Antimicrobial Usage Dashboard

JHH Antimicrobial Usage Dashboard

JHH Aminoglycosides	Just now	<input checked="" type="checkbox"/>	JHH Lipopeptides	Just now	<input checked="" type="checkbox"/>
JHH Azoles	Just now	<input checked="" type="checkbox"/>	JHH M2 ion channel inhibitors	Just now	<input checked="" type="checkbox"/>
JHH B-lactam/ B-lactamase inhibitor combination	Just now	<input checked="" type="checkbox"/>	JHH Macrocyclic	Just now	<input checked="" type="checkbox"/>
JHH Carbapenems	Just now	<input checked="" type="checkbox"/>	JHH Macrolides	Just now	<input checked="" type="checkbox"/>
JHH Cephalosporin 1st generation	Just now	<input checked="" type="checkbox"/>	JHH Monobactams	Just now	<input checked="" type="checkbox"/>
JHH Cephalosporin 2nd generation	Just now	<input checked="" type="checkbox"/>	JHH Neuraminidase inhibitors	Just now	<input checked="" type="checkbox"/>
JHH Cephalosporin 3rd generation	Just now	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
JHH Cephalosporin 4th generation	Just now	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
JHH Echinocandins					<input checked="" type="checkbox"/>
JHH Fluoroquinolones					<input checked="" type="checkbox"/>
JHH Folate pathway inhibitors	Just now	<input checked="" type="checkbox"/>	JHH Phenolics	Just now	<input checked="" type="checkbox"/>
JHH Fosfomycins	Just now	<input checked="" type="checkbox"/>	JHH Polyenes	Just now	<input checked="" type="checkbox"/>
JHH Glycopeptides	Just now	<input checked="" type="checkbox"/>	JHH Polymyxins	Just now	<input checked="" type="checkbox"/>
JHH Glycylcyclines	Just now	<input checked="" type="checkbox"/>	JHH Rifampin	Just now	<input checked="" type="checkbox"/>
JHH Ketolides	Just now	<input checked="" type="checkbox"/>	JHH Streptogramins	Just now	<input checked="" type="checkbox"/>
JHH Lincosamides	Just now	<input checked="" type="checkbox"/>	JHH Tetracyclines	Just now	<input checked="" type="checkbox"/>
JHH Antimicrobial Usage Reporting Workbench Reports					

- DOTs/1000 patient days present
- Reported by drug class
- Can add customized drugs/locations

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# Table Format Display: Drug Class

JHH Carbapenems

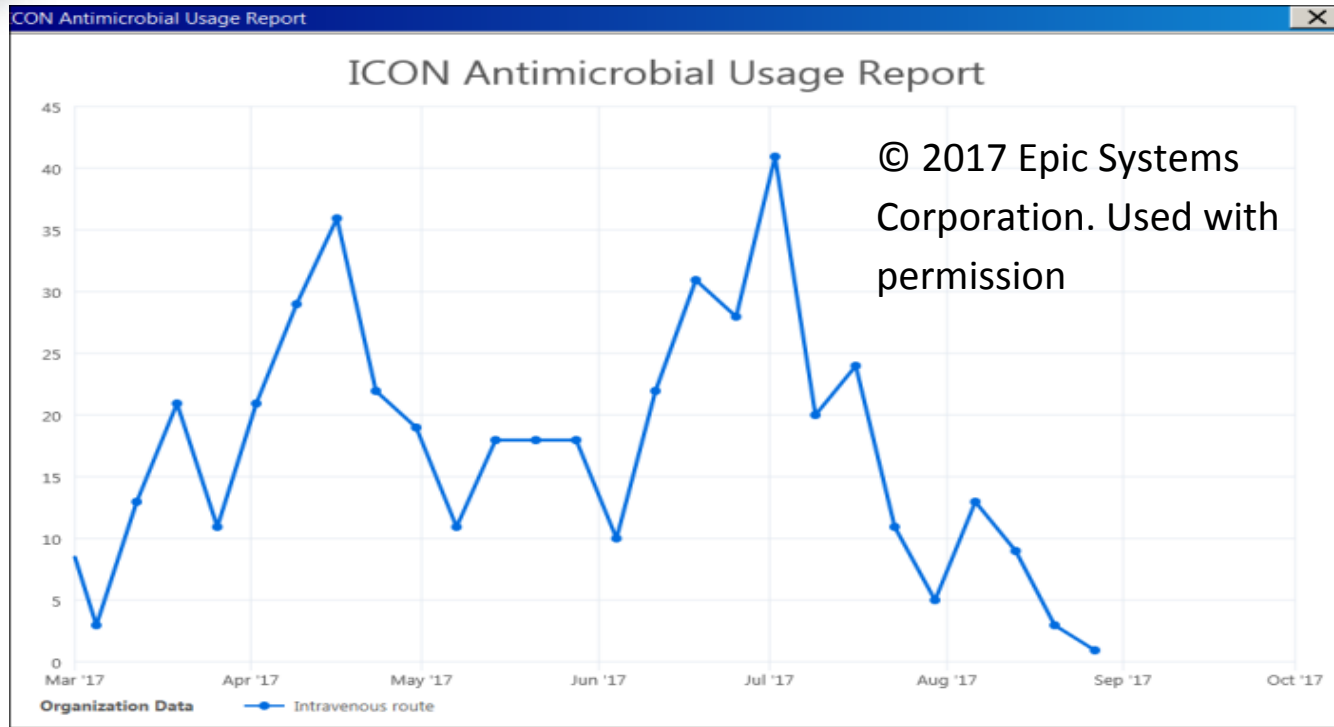
Just now

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	Mar	Apr	May	Jun	Jul	Aug	MTD
> Location							
> Doripenem							
>  Intravenous route	0.00	0.00	0.00	0.00	0.00	0.00	0.00
> Ertapenem							
>  Intravenous route	5.00	4.00	4.00	1.00	0.00	0.00	0.00
> Imipenem with Cilastatin							
>  Intravenous route	0.00	0.00	0.00	0.00	0.00	0.00	0.00
> Meropenem							
>  Intravenous route	0.00	0.00	0.00	0.00	0.00	0.00	0.00

# Graphic Display

## Single Agent, Single Unit





# Antibiogram Reporting

-	-	-	-	-	-	-	-
4	98	82	88	92	100	-	-
-	-	-	81	66	81	-	-
0	0	90	98	100	100	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	100	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-
100	-	-	-	-	-	-	-
-	70	0	72	-	-	67	60
63	95	63	95	87	-	89	95
100	100	100	100	100	-	100	100
83	100	87	100	100	-	100	100
56	99	65	100	92	-	94	97
85	92	88	100	99	-	68	86

ASP VERSION JHH Adult ICU All Sources Antibiogram [5023522]

Criteria Display Override General

Search Discrete Microbiology Results

From date: 1/1/2016 To: 12/31/2016

Filter criteria

Enter Search Values

- Organism
- Numerator susceptibilities
- Calculation logic
- Analysis period
- Isolate threshold
- Which isolate to use?
- Display: Format
- Display: Specialized view report
- Filter: Collection department
- Filter: Collection hospital
- Filter: Ordering department

All of the above

Antibiotics

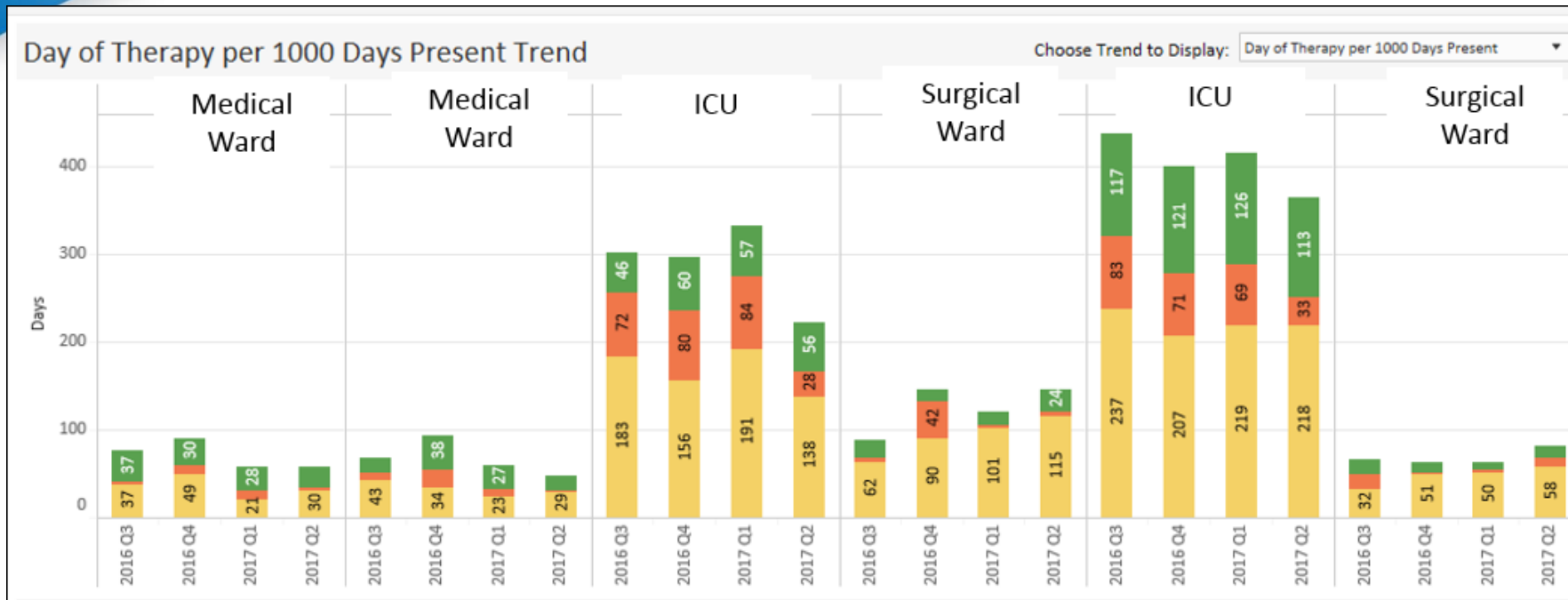
- 1 PENICILLIN
- 2 AMPICILLIN
- 3 AMPICILLIN + SULBACTAM
- 4 OXACILLIN
- 5 PIPERACILLIN + TAZOBACTAM
- 6 CEFAZOLIN
- 7 CEFOTAXIM
- 8 CEFTRIAXONE
- 9 CEFEPIME
- 10 AZTREONAM

# Extraction of Data

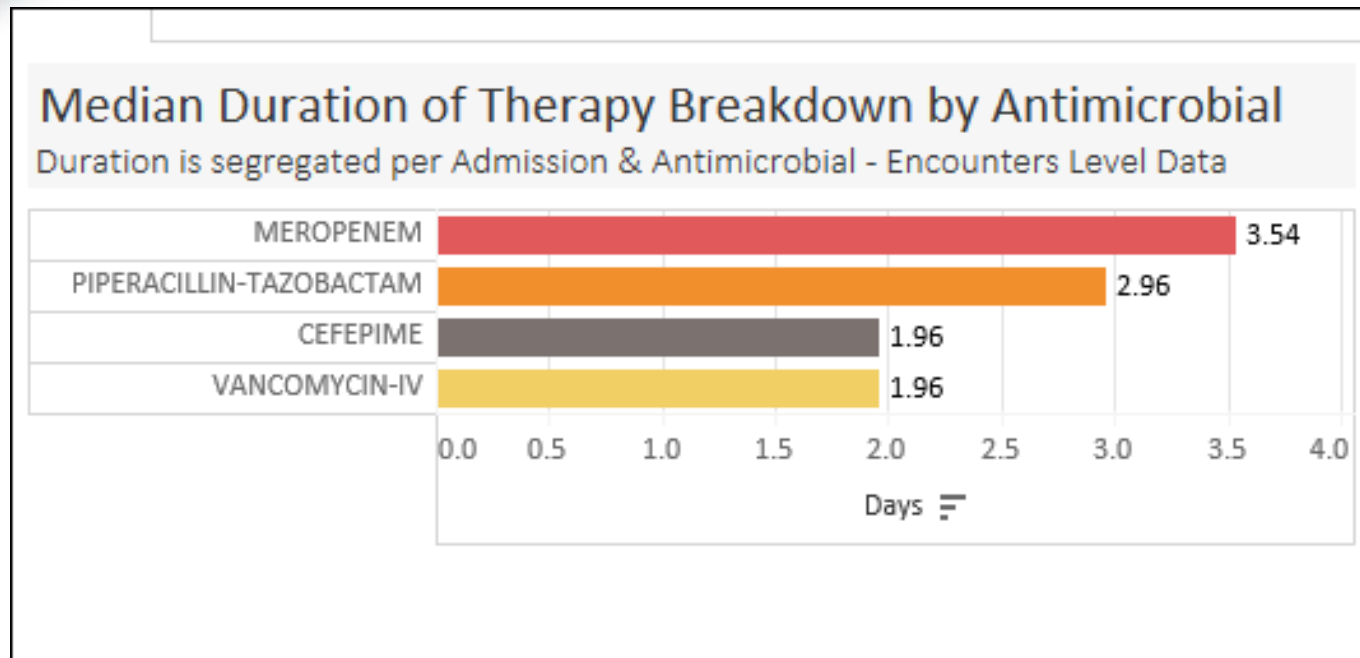
- Data from Epic can be extracted only in Excel format
- We used Tableau to build AS Dashboards
  - Allows more user customization in real time
  - Fast analytics
  - Easy to use and share
  - Automatic updates
  - User customization
  - Allowed us to get more than DOT/1000 patient days

<https://www.tableau.com/>; accessed 9/25/17

# Tableau Report: DOT/1000 Patient Days Present



# Tableau Report: Duration of Therapy



# Impact on Clinical Outcomes

- 1 study reviewed iVents documentation by ASP
  - AS interventions resulted in decrease in antibiotic use
  - Easy documentation allowed ASP to demonstrate their impact
- 1 study integrated CDSS with Epic
  - Decrease in use of all antibiotics, ant-MRSA and anti-pseudomonal agents

Cook PP, et al. *Antimicrob Agents Chemother* 2011; 55:5597-601.

Schulz L, et al. *Infect Control Hosp Epidemiol* 2013; 34:1259-65.



# Barriers and Challenges

- Resources for implementation and maintenance
  - Costs of software and hardware
  - IT personnel
  - Time to develop, build, test
- Administrative, ethical, legal issues
  - Electronic alerts can result in premature antibiotic discontinuation
- Excessive alerts - “alert fatigue”

# Which of the following AS tools are available in Epic?

- A. Real-time antibiogram reporting
- B. Identification of patients for AS interventions
- C. Days of therapy (DOT)/1000 patient days present metric
- D. All of the above

# Enhancing ASP Activities: Patient Lists

- ✓ Prospective audit and feedback – real time alerts
  - ✓ Bug and drug
  - ✗ Diseases based (e.g., community-acquired pneumonia)
  - ✓ Customizable
- ✓ Treatment guidelines- order sets
- ✓ Entry level AS tools

# Enhancing ASP Activities: Reports

- ✓ Antibigrams
  - ✓ Real time
  - ✓ Some user customization in real time
- ✓ Antibiotic use data - DOT/1000 patient days present
  - ✓ Real time- graphs and tables
  - ☒ User customization in real time
  - ✓ NHSN AUR reporting
- ☒ Patient outcomes tracking in real time
- ✓ Prescriber metrics and patient outcomes data

# How to Make Customization Successful

- Presence of and leadership by AS team
  - Experience of AS team in performing AS interventions
  - Be prepared! Have a wish list! Dedicate your time to this up front!
  - Don't give up easily when encountering barriers
  - Make sure to test your alerts before go-live
- Dedicated IT resources upfront
  - Have someone with microbiology background if possible
- Community hospitals- partner with other hospitals within health-system

# Key Takeaways

- Key Takeaway #1
  - Epic AS module can increase effectiveness and efficiency of ASP personnel
- Key Takeaway #2
  - Implementation can be costly and resource demanding upfront
- Key Takeaway #3
  - Single EHR record and customizable alerts allows for adaptation by many users

# Acknowledgements

- The Johns Hopkins Hospital ASP team
  - Sara Cosgrove, MD, MS
  - Kate Dzintars, PharmD, BCPS, AQ-ID
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  - Jennifer Townsend, MD
- Hopkins Epic IT team
  - Amanda Miller, BS, M(ASCP)<sup>CM</sup>
  - Nicole Mudassar, MLS (ASCP)



# Optimizing “Add on” Clinical Decision Support Systems for Antibiotic Stewardship

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# Learning Objectives

- List antimicrobial stewardship tools available in electronic health record (EHR) platforms.
- Review commonly used clinical decision support systems (CDSS) and their role in enhancing antimicrobial stewardship.
- Describe how both EHR and CDSS can be used together as a successful antimicrobial stewardship tool.



# In the Beginning, there was....

- HELP – Health Evaluation through Logical Processing
- Daily at 1pm, a computer-generated alert printed out a therapeutic antibiotic monitor report in ID department
- Utilized computer algorithms to screen for inconsistencies between antibiotics and microbiology test results
- In once year, 420 actionable alerts led to change or start therapy in 125 cases
- Physicians were previously unaware of relevant susceptibility test results in 49% of alerts

# And Then (in the 2000's) Came...

- An explosion of add on clinical decision support systems (CDSS) that run in parallel to Electronic Health Records (EHRs)
- Differentiators
  - Infection Prevention
  - Drugs covered
  - Reports
  - Customization
  - Portability
  - Timeliness to generate real time alerts

# Assessment Question #1

How many commercial “add on” clinical decision support systems are currently available in the United States that have functionality for antibiotic stewardship?

- A. 4
- B. 6
- C. 10
- D. 14

# “Add On” CDSS Vendors

Product Name	Company (also known as)	AU/AR Reporting
360 Care Insights	Truven Health Analytics	None
Bluebird	Intelligent Medical Systems	AU,AR
ICNet	Baxter Healthcare	AU
ILUM	ILUM Health Solutions (Merck HSS)	AU
IPAC	CKM Healthcare	Unknown
Medici	Asolva Inc	AU
Midas Health Analytics Solutions	Conduent Health	None

AU= Ability to report to CDC Antibiotic Use (AU) module in NHSN as of 10/1/17  
AR= Ability to report to CDC Antibiotic Resistance module in NHSN as of 10/1/17

Source <http://www.sidp.org/aurvendors>

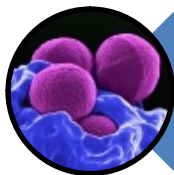
# “Add On” CDSS Vendors

Product Name	Company (also known as)	AU/AR Reporting
Patient Event Advisor	BD (Medmined)	AU
QC Pathfinder	Vecna Technologies	None
RL Solutions	RL Solutions	AU
Sentri 7	Wolters Kluwer (Pharmacy One Source)	AU
Teqqa	Teqqa	AU
Theradoc	Premier	AU,AR
VigiLanz	VigiLanz	AU,AR

AU= Ability to report to CDC Antibiotic Use (AU) module in NHSN as of 10/1/17  
AR= Ability to report to CDC Antibiotic Resistance module in NHSN as of 10/1/17

Source <http://www.sidp.org/aurvendors>

# Categories of “Add on” Systems



Antibiotic Stewardship Only



Total Medication Stewardship



Total Medication Stewardship (including antibiotics) + Infection Prevention

# VALUE OF AN “ADD ON” CDSS



# Decreases Inappropriate Antibiotic Use

- 5 year quasi experimental, time interrupted series at a 677 bed academic medical center in Quebec.
- Utilized a CDSS + ASP team + prospective audit and feedback.
- N =35,778 pts reviewed.
  - Antibiotic defined daily dose/1000 patient days decreased by 32.4 (p<0.01)
  - Average length of stay decreased 0.92 days (p<0.01);
  - Spend decreased \$19,649 (p=0.01)

# Improves Clinical Workload Efficiency

- Academic Medical Center
  - 92 rule based alerts
  - 80 full time pharmacists + residents
  - 24/7 alerting
  - Total 399,979 alerts generated annually
  - 19% related to antibiotics
  - 17,333 documented interventions (4.3%) annually

# Integrates with Rapid Diagnostics to Provide Real Time Actionable Results

- University of Michigan Health System study compared outcomes in 501 patients with bacteremia or candidemia
  - Pre- intervention group (n=256) and post intervention (n=245)
- Post intervention group combined MALDI TOF results with ASP intervention using add on CDSS
- Decreased time to organism identification (84.0 vs 55.9 hours,  $p < 0.001$ )
- Improved time to effective antibiotic therapy (30.1 vs 20.4 hours,  $p = 0.21$ )
- Additional benefits with mortality, length of ICU stay, and recurrent bacteremia

# Improves Quality of Care

- Disease state
  - Candidemia
  - HIV
  - Asymptomatic bacteriuria
- Core Measure compliance
  - Influenza vaccination
  - Sepsis

# Sepsis Bundle

Notifications ▾ Treatment Actions ▾ Cases ▾ **Reports ▾** Antibigram ▾ ⚙️ ▾

Sepsis Process Export to PDF Save Report  Weekly  Monthly  Quarterly Recreate Report

Show the previous  months

Table ▾

Adherence Rate ▾

Measure ▾	Month	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Overall
		Measure													
3hr All Bundle Measures Met		63%	61%	63%	60%	65%	63%	74%	84%	89%	94%	96%	96%	100%	76%
3hr Blood Culture		70%	62%	63%	62%	67%	65%	75%	85%	91%	98%	98%	96%	100%	78%
3hr Broad Spectrum Antibiotic		82%	88%	89%	93%	88%	88%	90%	95%	98%	98%	96%	96%	100%	91%
3hr Fluid Bolus		80%	87%	93%	98%	93%	89%	97%	97%	99%	97%	95%	91%	100%	93%
3hr Lactate Result		83%	80%	96%	95%	91%	90%	88%	95%	97%	96%	98%	96%	100%	91%

Image Source: Teqqa. Used with Permission

# COMMONALITIES ACROSS SYSTEMS FOR ANTIBIOTIC STEWARDSHIP

# General Functionality

Department	Areas of Interest/Focus
Infection prevention	<ul style="list-style-type: none"><li>• NHSN tracking and reporting requirements</li><li>• Identification of outbreaks/infection clusters</li><li>• Ability to identify organisms with unusual resistance patterns</li></ul>
Microbiology	<ul style="list-style-type: none"><li>• Antibigram capabilities (CLSI compliant)</li></ul>
Prescribers/ASP Team	<ul style="list-style-type: none"><li>• Ability to suppress or triage alerts</li><li>• Individual customization of alerts</li></ul>
Pharmacy	<ul style="list-style-type: none"><li>• Basic ASP interventions</li><li>• Intervention tracking</li><li>• Target medication monitoring</li><li>• Drug utilization reporting (e.g. Days of Therapy per 1000 pt days)</li></ul>

# Basic Stewardship Interventions

- Bug- Drug Mismatch
- Positive culture but no antibiotic
- Receiving antibiotic but no positive culture
- IV to PO
- Antibiotic time out

- Duration of therapy alerts
- Duplicate antibiotic therapy
- Dose adjustments due to renal or hepatic function
- Therapeutic drug monitoring
- Restricted drug monitoring



**DIFFERENTIATORS FOR ANTIBIOTIC  
STEWARDSHIP  
OR “THIS IS NOT YOUR MOTHER’S  
CLINICAL DECISION SUPPORT SYSTEM  
ANYMORE”**

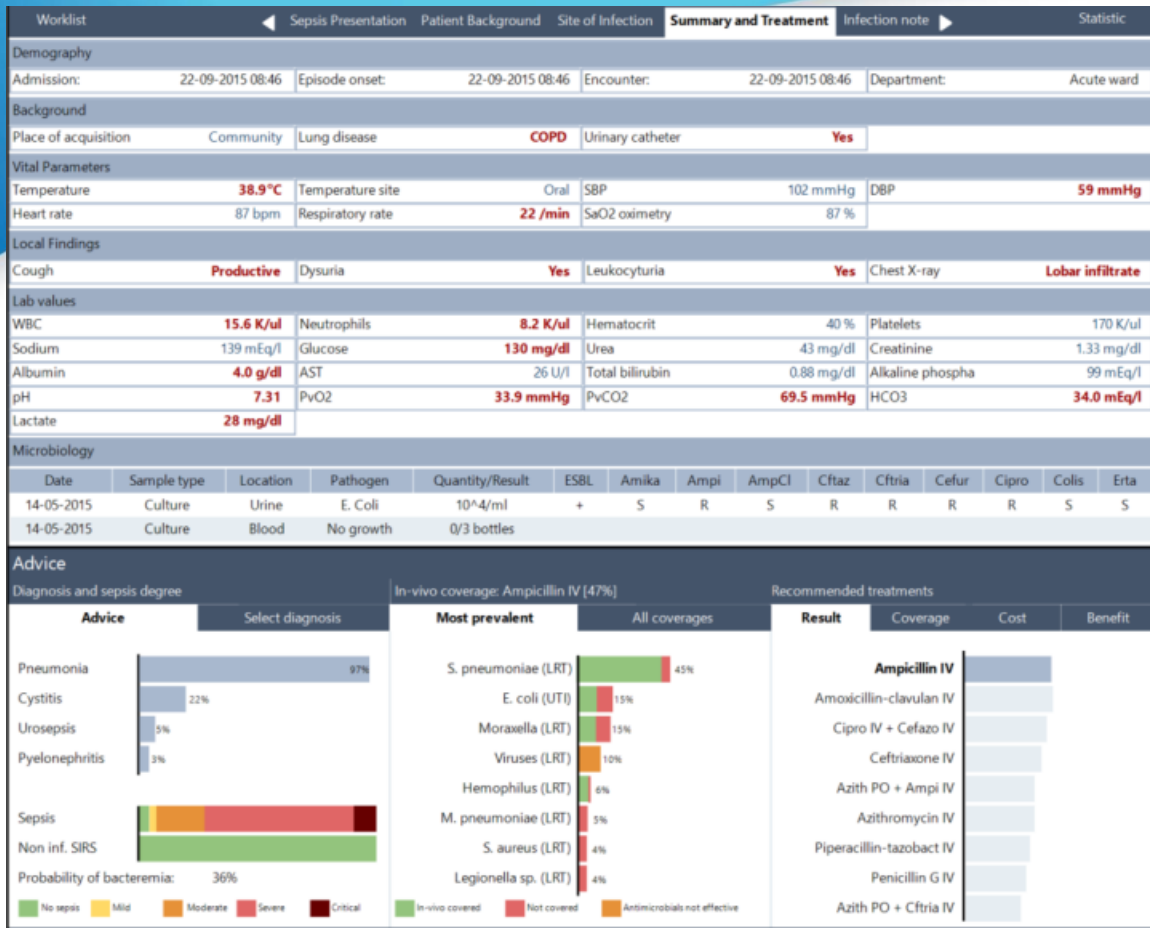
# Unique features

- Interface with drug information systems
- Smart phone /tablet integration
- Key word searches
- Links to institutional guidelines
- Dose recommendations based on patient specific information
- Manages prior authorization
- Predictive analytics

# Assessment Question #2

Which of the following is an example of how predictive analytics can be applied to antibiotic stewardship through a clinical decision support system?

- A. Identification of patients in the early stages of sepsis
- B. Review of previous culture(s) and susceptibilities to predict potential cause of a new infection in a patient
- C. Assessing available patient parameters and cross referencing it to a population based database
- D. All of the above

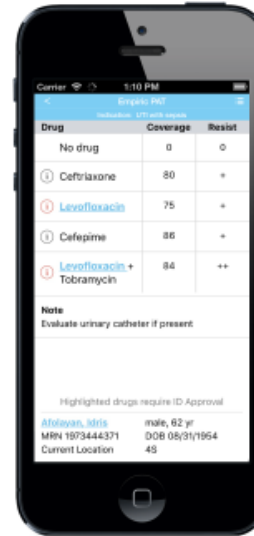


# Predictive Analytics

Image Source: TREAT SYSTEMS. Used with permission.

# Intersection of Population and Personal Health

- Personalized Antibiotic Therapy
  - Therapy recommendations based on individual patient characteristics and population parameters



Drug	Coverage	Result
No drug	0	o
① Ceftriaxone	80	+
① Levofloxacin	75	+
① Cefepime	86	+
① Levofloxacin + Tobramycin	84	++

Note  
Evaluate urinary catheter if present

Highlighted drugs require ID Approval

Atolwan, Mrid male, 62 yr  
MRN 1973444371 DOB 08/31/1954  
Current Location 43

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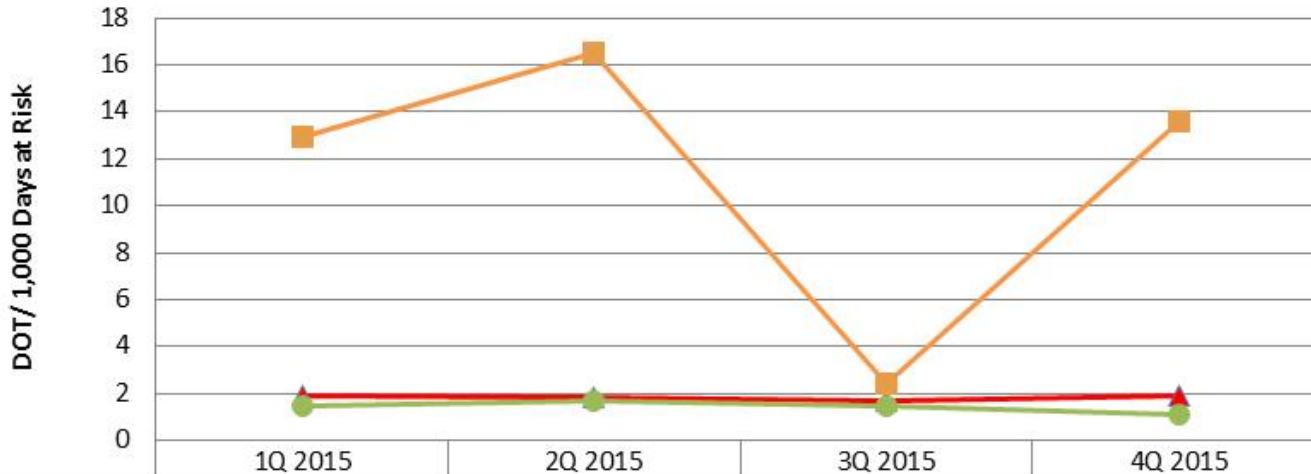
# Outpatient Integration

Antimicrobials	Clinic	Percent of Visits with Antimicrobial Prescription
Amoxicillin-clavulanic acid	WEST CHESTER FAMILY PRACTICE C...	
Azithromycin	INTERNAL MEDICINE ASSOC DELAW...	
Ciprofloxacin	{{(RADIOLOGY RESULTS)}} -	
Amoxicillin	{{(UNSPEC LAB DEPT)}} -	
Cefuroxime	{{(OAPU HUP)}} -	
Trimethoprim-Sulfamethoxazole	{{(SPU4 PRMC)}} -	
Fluconazole	ACCESS MANAGEMENT HUP -	
Doxycycline	APHERESIS -	
Nitrofurantoin	AUDIOLOGY HUP -	
Clarithromycin	AUDIOLOGY PMWS -	
Levofloxacin	AUDIOLOGY RADNER -	
	BERWYN PA 1001 CHESTERBROOK B... -	
	CARDIOLOGY HUNTINGDON VALLEY -	
Route	Prescriber	
PO	Julio Davis	
Other	Leon Richardson	
IV	Jennifer Anderson	
	Jeremy Salmeron	
	Marjorie Thomas	
	Agatha Monroe	
	Alon Chapel	
	Alfredo McGee	
	Allison Bennett	
	Allison Starkey	
	Allison Worren	
	Alissa Moore	
	Alona Pool	
	Alta Cordero	
	Alton Hunter	
	Alvin Baker	
	Alyson Stanley	
	Amber Matthews	
	Amelia Hayes	
	Amy Spinelli	
	Andrea Ford	
	Andrea Sabatini	
	Andrew Rieth	
	Angela Castillo	
Diagnosis Groups		
Skin and Soft Tissue Infections	35	
Upper Respiratory Tract Infections	67	
Gastrointestinal Infections	8	
Lower Urinary Tract Infections	76	
Upper Urinary Tract Infections	50	
Lower Respiratory Tract Infections	57	
Diagnoses of Interest		
Diagnosis	ICD-9 Code	
UNSPECIFIED LOCAL IN...	686.9	
PYOGENIC GRANULOMA...	686.1	
PILONIDAL CYST WITH...	685.1	
IMPETIGO	684	
CELLULITIS AND ABSCE...	682.9	
CELLULITIS AND ABSCE...	682.7	
CELLULITIS AND ABSCE...	682.6	
CELLULITIS AND ABSCE...	682.5	
CELLULITIS AND ABSCE...	682.4	
CELLULITIS AND ABSCE...	682.3	
CELLULITIS AND ABSCE...	682.2	
CELLULITIS AND ABSCE...	682.0	
CARBUNCLE AND FURU...	680.9	

Image Source: Teqqa. Used with Permission

# Benchmarking

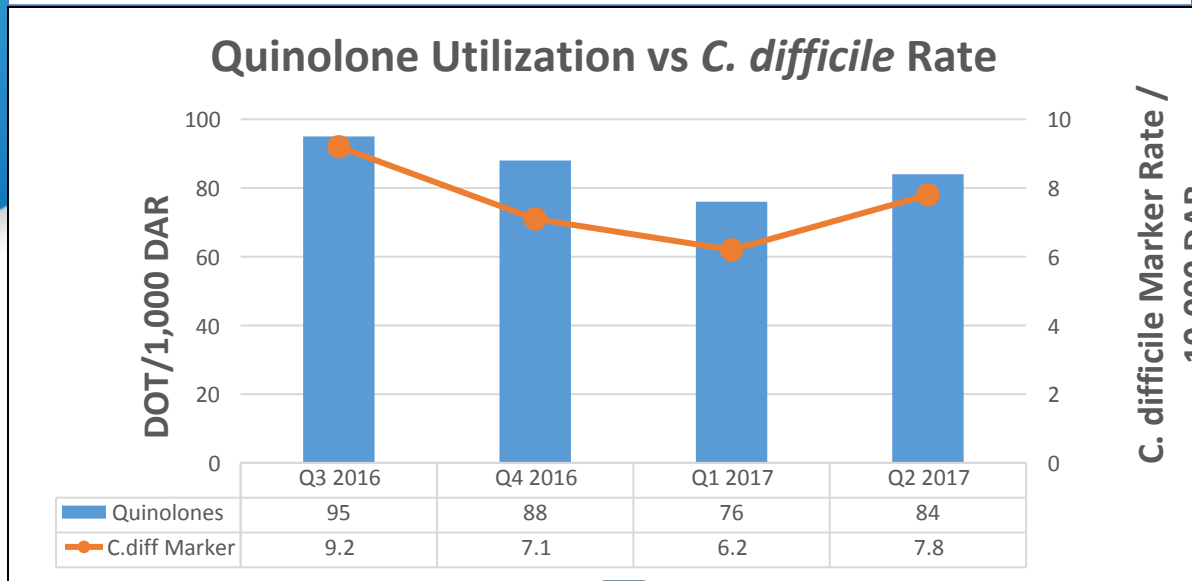
## Tigecycline- National Comparison



	1Q 2015	2Q 2015	3Q 2015	4Q 2015
▲ Teaching (14)	1.9	1.8	1.7	1.9
● Non Teaching (90)	1.5	1.7	1.5	1.1
■ Your Institution	12.9	16.5	2.4	13.6

Image Source: BD MedMined. Used with permission

## Comparison of utilization to resistance rates



# Measuring Economic Impact



## Translate to cost, loss, and length of stay for hospital *C. difficile* cases

NIM Set	Pts w NIM	Set Freq.	DRG-Adjusted Add'l Direct Cost		DRG-Adjusted Add'l Profit/(Loss)		DRG-Adjusted Add'l Length of Stay	
			Average	Cumulative	Average	Cumulative	Average	Cumulative
stool(1)	55	12.11%	\$3,500	\$192,499	(\$3,093)	(\$170,089)	3.51	192.94

Image Source: BD MedMined. Used with permission



# Reporting Capabilities

- User access
- Alert firing patterns
- Pre-populated dashboard
- Readmission tracking and reporting of rates

# Key Takeaways

- Key Takeaway #1
  - Continually refine the add on CDSS after implementation to improve efficiency and eliminate alert fatigue
- Key Takeaway #2
  - Periodic data validation is important
- Key Takeaway #3
  - Monitor for unintended consequences
- Key Takeaway #4
  - Predictive functionality is becoming a strength of the add on CDSS and should be explored



# How to use Electronic Health Records and Clinical Decision Support Systems Together for Antibiotic Stewardship

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System Antimicrobial Stewardship Pharmacist Manager  
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# Learning Objectives

- List antimicrobial stewardship tools available in electronic health record (EHR) platforms.
- Review commonly used clinical decision support systems (CDSSs) and their role in enhancing antimicrobial stewardship.
- Describe how the EHR and CDSS can be used together as a successful antimicrobial stewardship tool.

# Intermountain Healthcare Highly-Integrated Health System



## Hospitals



- Since 1975
- 23 hospitals
  - 2,784 licensed beds

## Select-Health



- Since 1983
- Health plans
  - 700,000+ members

## Medical Group



- Since 1994
- 1,200 employed physicians
  - 558 advanced practice clinicians

## Supply Chain Center



- Since 2015
- Centralized distribution center

Facility	Bed Size
Bear River	16
Delta	18
Fillmore	19
Garfield	14
Heber	19
Sanpete	18

Facility	Bed Size
Cassia	25
Cedar City	48
Orem	24
Layton	43
Park City	30
Sevier	42
TOSH	40

Facility	Bed Size
Dixie	245
LDS Hospital	241

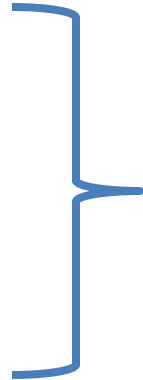
Facility	Bed Size
IMC	504
McKay Dee	305
Primary Children's	289
Utah Valley	395

Facility	Bed Size
Alta View	71
American Fork	89
Logan	146
Riverton	97

# Hospitals

# Maximizing Technology

- Empiric therapy
- Therapy modification
- Data tracking and reporting
- Research



All can be aided by  
add-on CDSS systems

# Empiric Therapy

## Objective:

- Reduce inappropriate variability in empiric antibiotic use

## Strategies:

- Align antibiotic selection with local antibiogram in order sets
- Risk stratify who should receive broad-spectrum therapy



# Order Set

Search:  Advanced Options  Type: Inpatient

Up Home Favorites  Folders Copy Folder: EASTENEH\_INP\_FAVS Search within: All

Plans

Add to Phase  Check Alerts Comments Start: Now  Duration: None

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Component	
<input type="checkbox"/>			Common Concerns SURG	
Antibiotics				
<input checked="" type="checkbox"/>			CHOOSE EITHER ceftriaxone + metronidazole OR Ertapenem	
<input checked="" type="checkbox"/>			cefTRIAxone	<input type="button" value="v"/> 2,000 mg, IV Piggyback, Injectable, every Begin 24 hours after preoperative dose.
<input checked="" type="checkbox"/>			metroNIDAZOLE (metroNIDAZOLE (Appendicitis only))	<input type="button" value="v"/> 1,000 mg, IV Piggyback, Soln-IV, every 24 Begin 24 hours following preoperative dose
<input type="checkbox"/>			Ertapenem for documented cephalosporin allergy; for anaphylactic Beta-lactam allergies call ID or the antibiotic stewardship pr	
<input type="checkbox"/>			ertapenem	<input type="button" value="v"/> 1,000 mg, IV Piggyback, Syringe-inj, ever Begin 24 hours after preoperative dose;

Drop-down menu allows adjustment in dose

First-line (preferred) antibiotics are auto-checked  
Alternative provided for patients with allergies

# Risk Stratification

## Patient Information

EMPI	Patient Name	Gender	DOB
540958523	TEST, ALERT	M	05/05/1955

## DRIP Score

- \* Risk Factors
- (2) Antibiotic use (IV or PO, in the last 60 days)
  - (2) Resident of Long Term Care Facility (current)
  - (2) Tube Feeding (NG/NJ/PEG, current)
  - (2) Infection with a Drug Resistant Pathogen (prior 12 months)
  - (1) Recent Hospitalization (>48 hours in last 60 days)
  - (1) Chronic Pulmonary Disease
  - (1) Poor Functional Status (Non-ambulatory)
  - (1) Gastric Acid Suppression (PPI or H2 blocker, last 14 days)
  - (1) Wound Care (current, or wound on exam)
  - (1) MRSA Colonization (or infection, prior 12 months)
  
  - (0) No Risk Factors

\* Score Date   Facility

Score Total

6

DRIP score  $\geq 4$ :  
Vancomycin, cefepime,  
plus azithromycin

# DRIP Implementation & Results

- ER physicians, inpatient hospitalists and pharmacists

Observed Antibiotic Usage	DRIP n (%) (95% CI)	Usual Care n (%) (95% CI)	Difference, % points (95% CI)	P-value
Inadequate Spectrum	6 (0.67) (0.31-1.5)	3 (0.93)	-0.25 (0.74 - -2.1)	NS
Any Broad Spectrum Antibiotic Use	199 (22.6) (19.7-25.1)	99 (30.6) (25.8-35.8)	-8.3 (-2.8 - -14.1)	0.003

# Practical Considerations

## Strengths of add-on systems

- Provide data for developing order sets
- Facilitates complicated risk scores
- Relatively easy to extract data and update risk scores

## Limitations of add-on systems

- Not easily integrated into workflow
- Dependent upon what data shared from EHR
- Needs to be tailored to the setting

# Therapy Modification

## Objective:

- Use the narrowest agent via the most optimal route for the shortest duration

## Strategies:

- Intravenous (IV) to oral (PO) conversion alerts
- Bug-drug mismatch alerts for therapy escalation
- Finalized culture results alerts for de-escalation
- Duration of therapy alerts



# Decision to Implement a Separate Clinical Decision Support System (CDSS)

We decided we needed a CDSS in order to:

- Prioritize who would benefit from infectious diseases review
- Expand prospective review to weekends and holidays
- More efficiently track and quantify interventions

# Selection Criteria for our CDSS

After careful consideration, we chose our product based on:

- Clinically meaningful, consistently updated, rule based alerts
- Easy to use and thus easy to train all pharmacists to use it
- Integrated and useful reports
- Highly qualified and timely customer support

# CDSS Implementation

After reviewing  
CDS systems and  
selecting best fit

Work with IT to  
send and validate  
data interfaces  
(months)

Review pre-  
packaged alert  
options; determine  
team members

ID pharmacist  
focused use and  
evaluation  
(2 weeks)

Develop usage  
guidelines for  
pharmacists  
(6 - 8 weeks)

Education

Work with CDSS to  
solidify priority list  
of alerts; develop  
standardized  
reports

Official roll out  
date for use by  
frontline  
pharmacists  
(2 weeks)

Trouble-shooting;  
data feedback to  
frontline  
pharmacists

Ongoing:

- Education
- Addition, deletion, and refinement of alerts
- Data tracking and reporting



# Different Practice Models

## Hospital A

Two unit-based pharmacists evaluate and acknowledge all alerts

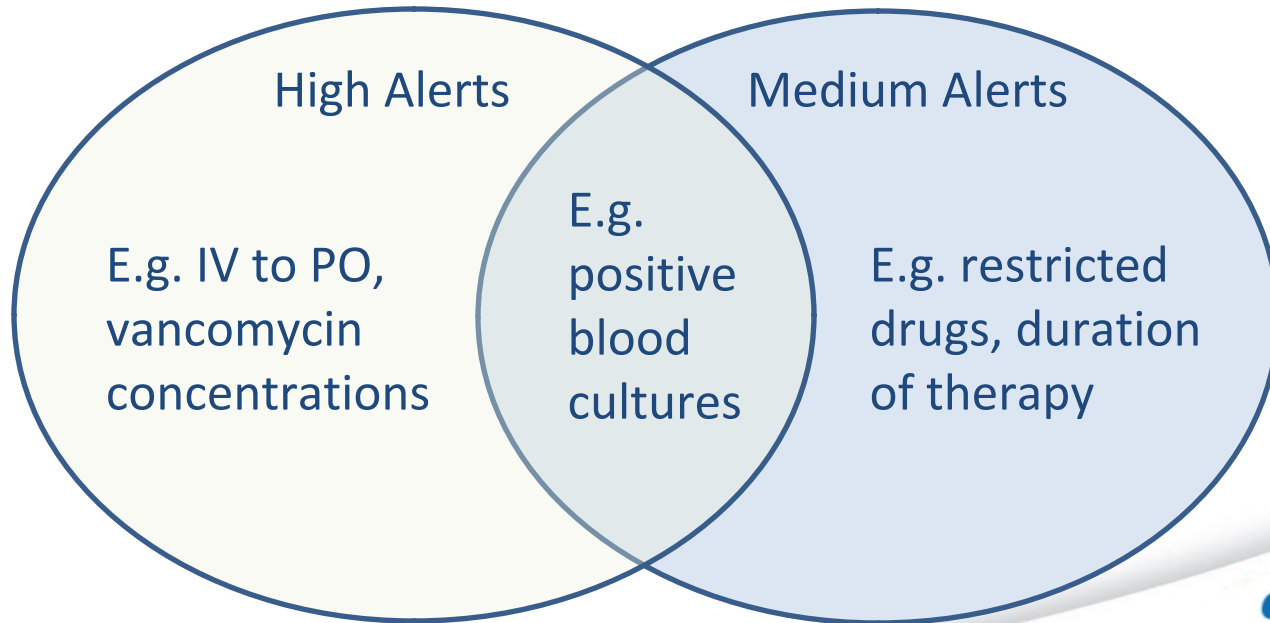
## Hospital B

The ID pharmacist evaluates and acknowledges all alerts

## Hospital C

All unit-based pharmacists evaluate one set of alerts; ID pharmacist evaluates another set

# “High” versus “Medium” Alerts



# Example of Therapy Modification

Search Results

Group by: Rule Name Name

Name	Patient	Unit	Room	Event	Created	Status
+ Positive Blood Culture - Review Microbiology. (ID): 20 Item(s)						
+ Sputum Culture Positive. (ID): 12 Item(s)						
+ Carbapenem-resistant Pseudomonas spp (ID): 2 Item(s)						
- Culture - Positive Anaerobic bacteria any source (ID): 3 Item(s)						

1 Item(s)						
12086...	IM_Orthopedics Nursing Unit		T716	Propionibacterium acnes	09/07/2017 12:33	Not Acknowledged

2 Item(s)						
12085...	IM_Medical Oncology Unit		T914	Veillonella species	09/05/2017 14:52	Not Acknowledged
12085...	IM_Medical Oncology Unit		T914	Bacteroides fragilis	09/05/2017 14:52	Not Acknowledged

Spectrum misses:

- Anaerobic cultures
- Bug-drug mismatches

Image Source: VigiLanz. Used with permission.

# CDSS Education

- Provided educational documents
  - Basic Training Reference Guide
  - Clinical Guidelines and References for Alerts
- Each pharmacist received 1-on-1 hands-on training
- Each pharmacist completed a competency checklist

Intermountain  
Basic Training

If there are any questions, please contact:

Whitney Buckel, PharmD, BCPS  
Antimicrobial Stewardship Clinical Pharmacist  
Intermountain Medical Center  
Office: (801) 507-7784 (office)  
Cell: (360) 609-0608 (cell)  
Lync or Email at [whitney.buckel@imail.org](mailto:whitney.buckel@imail.org).

Why are we doing this? There is a national common goal to reduce antibiotic use in all hospitals, which will be audited by CMS and future regulatory requirement. In addition, this program is a regulatory requirement. Responding to these alerts will facilitate improvement in patient safety.

Contents

Getting Started.....  
Daily Expectations.....  
Leaving Notes for Other Pharmacists .....  
    Not Acknowledged Status.....  
    Follow Up Status .....  
Acknowledging Activations.....  
Rule Specific Information.....  
Continuous Quality Improvement .....  
Expectations for Infectious Diseases Pharmacist ...  
Questions and Answers .....

Below is a list of all activations that have been selected for this training. These have been chosen based on patient safety. The following pages will give information about the activations on a patient.

Contents

*Staphylococcus aureus* positive blood culture....  
*Staphylococcus aureus* positive urine culture.....  
*Clostridium difficile* on no treatment.....  
CSF culture positive – all updates .....  
Positive culture for *Pseudomonas*, *Acinetobacter*  
Respiratory viral panel positive for influenza, *M. pneumoniae*  
Double anaerobic coverage without positive *Clostridium*  
Bug-Drug Mismatch .....  
Blood culture positive .....  
*Streptococcus pneumoniae* or *Legionella* urine a  
Vancomycin-resistant enterococci (VRE) not cured  
Gentamicin, Tobramycin, Amikacin, or Vancomycin  
Finalized culture from any site, other than blood  
IV to PO Conversion .....  
Extended Spectrum beta-lactamase (ESBL), Carbapenem Resistant *Acinetobacter baumannii*  
Gram negative anaerobic culture not on anaerobic  
CSF HSV / VZV Results.....  
Change in SCr increase or decrease by  $\geq 0.5$  or  $\geq 1.0$   
*Candida glabrata* or *Candida krusei* in blood and urine  
On vancomycin and increase in SCr.....

Employee Name:

By the end of this training, I am able to:	Date	Method of Assessment
Successfully log in to Vigilanz		
Set up pharmacy surveillance home page		
Create a saved search		
Set page preferences		
Understand the difference in the following activation statuses: <ul style="list-style-type: none"> <li>Not Acknowledged</li> <li>Follow-up</li> <li>Acknowledged</li> </ul>		
Acknowledge activations, specifically: <ul style="list-style-type: none"> <li>Select appropriate status</li> <li>Select appropriate category</li> <li>Write an appropriate comment</li> </ul>		
Leave a message for another pharmacist: <ul style="list-style-type: none"> <li>Other front-line pharmacists</li> <li>ID/Transplant pharmacist</li> </ul>		
Understand why it is important that I not acknowledge all alerts		
Access documents on TeamSpace		
I have reviewed the Rule List and Expectations		
I know the expectation is to acknowledge 95% of alerts for my unit within 24 hours		
I am committed to continuous quality improvement and will let _____ know if I have any cool ideas!		
Method of Assessment		
<b>O</b> Direct Observation	<b>S</b> Skill Demonstration	
<b>V</b> Verbal Response	<b>T</b> Testing	

Employee Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Evaluator Signature: \_\_\_\_\_ Date: \_\_\_\_\_

# CDSS Documentation

- Minimized entries: Acknowledge, Category and Comment
- Shortened list of categories
  - Originally: 17 options
    - E.g., “Renal function reviewed – recommended to provider – NOT accepted”
  - Now only 7 options
    - E.g., “Antimicrobial dose/route optimization”
- New comment feature: “Great Catch”

# Practical Considerations

Strengths of add-on systems:

- Limited front-end building requirements
- Very easy to add customized alerts
- Easy documentation and data extraction

Limitations of add-on systems:

- Integration into the workflow
- Not just a technical challenge: also requires adaptive change
- Metrics and feedback of metrics to pharmacists is key

Has to be used to be useful!

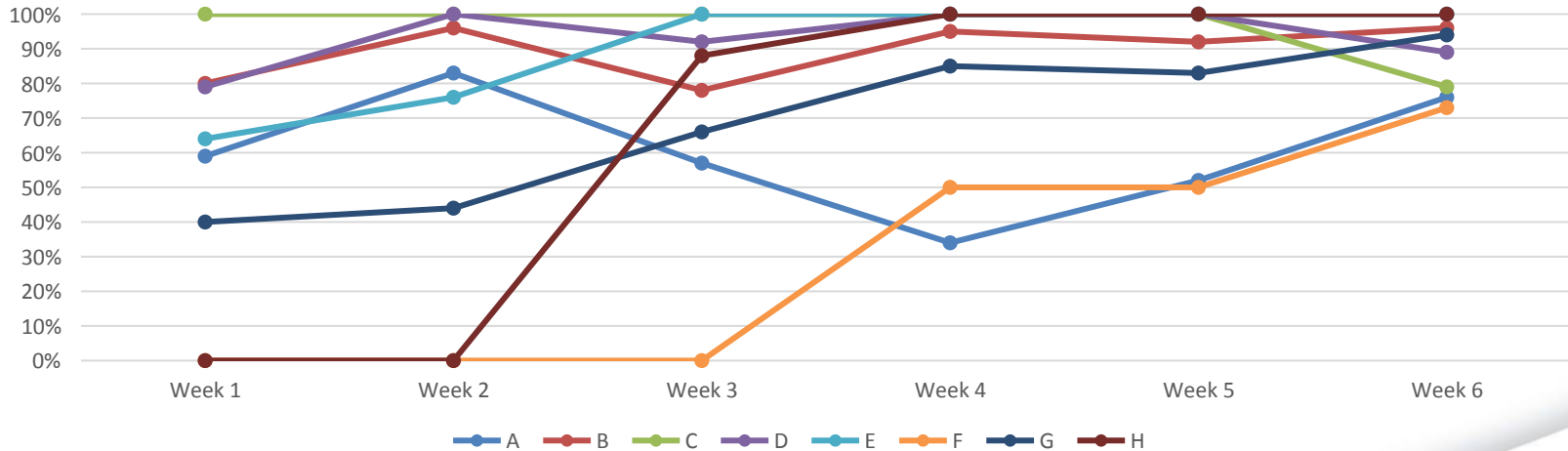
# Tracking and Reporting

- Process Metrics – Focus for Today
  - Alerts and interventions
  - Antibiotic use rates
- Outcomes Metrics
  - Antibiotic resistance and *Clostridium difficile* rates



# Track and Report: Interventions

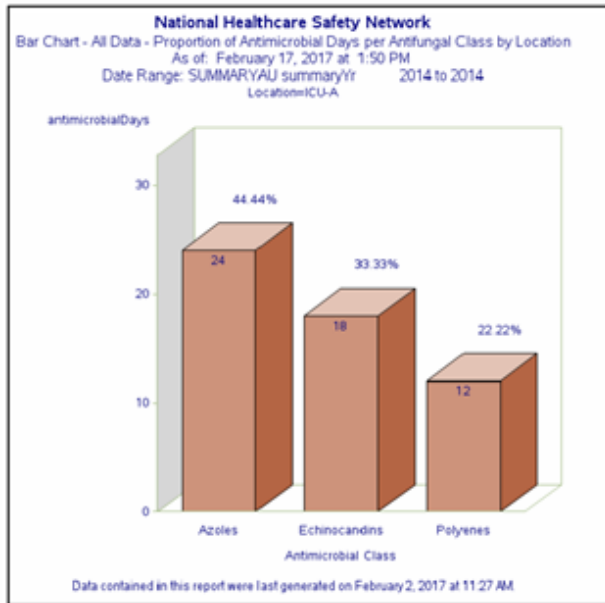
% Alerts Acknowledged at Facilities A-H



# Track and Report: Great Catches

- “Great Catch. Pharmacist notified physician to change therapy based on culture and sensitivity review. Patient was sent home on Augmentin. *E. coli* came back resistant. Notified surgery PA of culture results and she was going to follow up with patient's surgeon to change antibiotics.”
  - - Joylyn Call, PharmD
- “Physician was not aware 2/2 sets positive for *S. aureus* and mBAL too. Physician thought it was 1/2 bottles contaminant. Informed by pharmacist, vancomycin started. Great catch.”
  - - Stephanie Chauv, PharmD

# Track and Report: Antibiotic Use

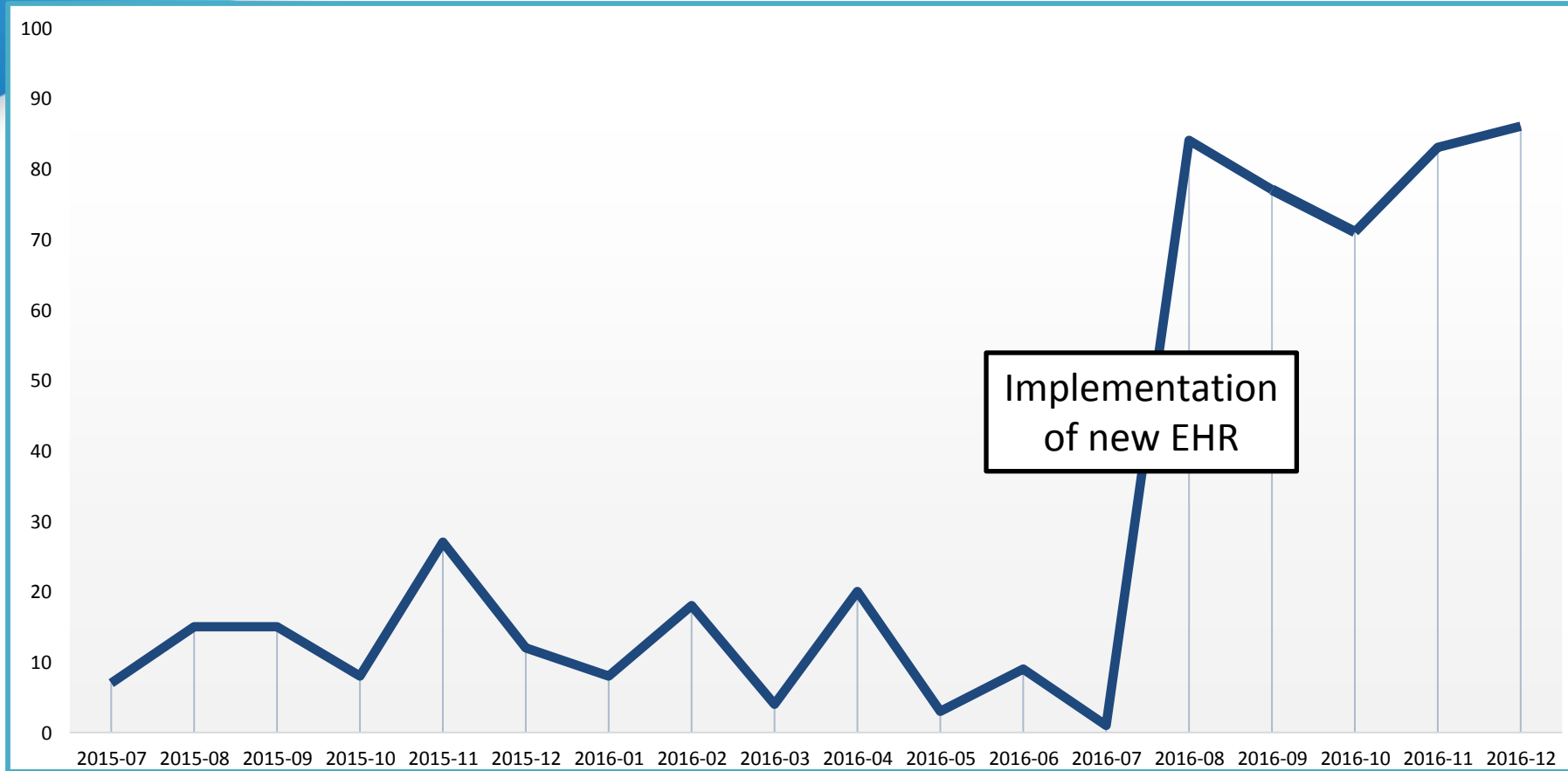


- Overall antibiotic use at a high-level
  - NHSN AUR option reporting to the CDC
    - Numerator: days of therapy (eMAR)
    - Denominator: patient days present
  - CDSS systems and EHRs can work together to process antibiotic use data

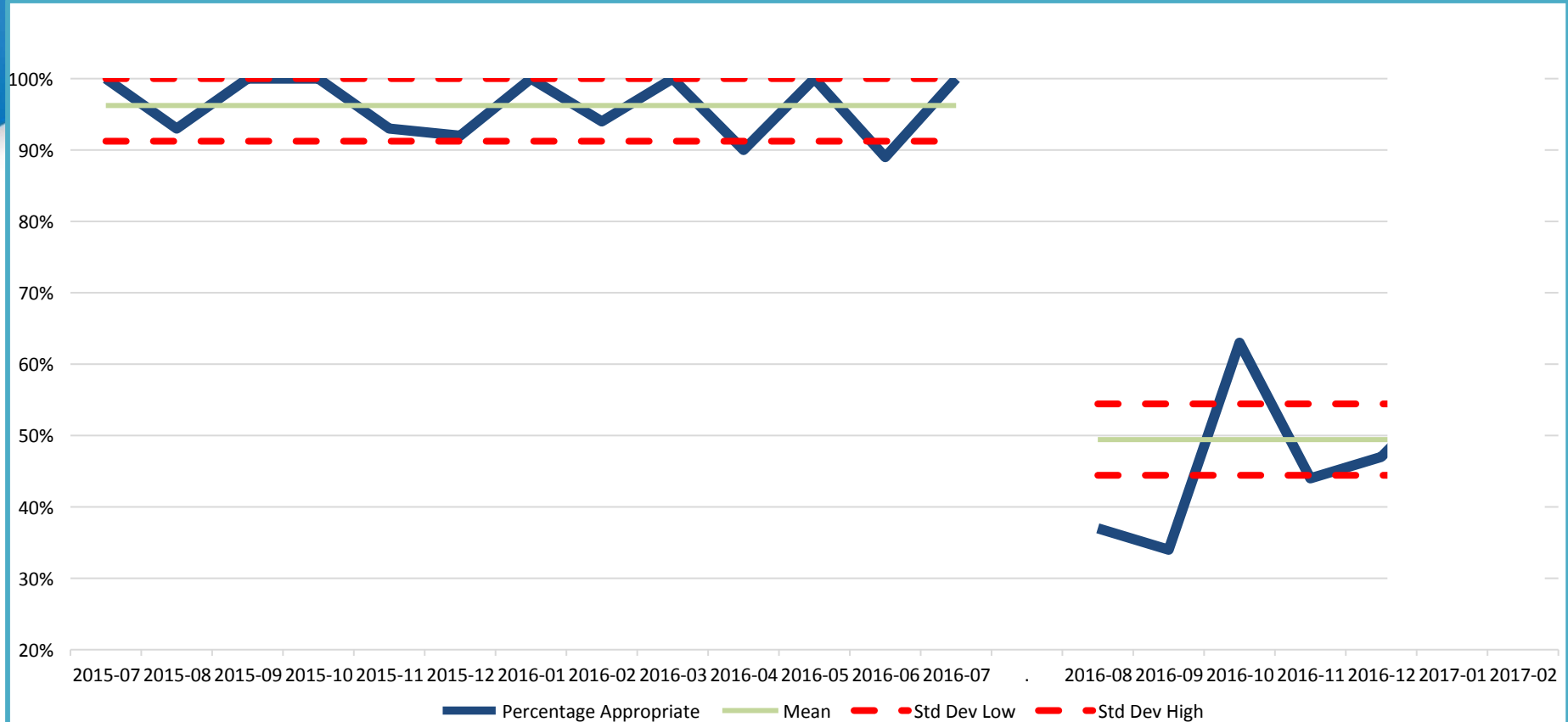
# Track and Report: Antibiotic Use

- Specific antibiotic use or antibiotic use in specific areas
  - Review and identify variation and trends
  - Significant trends can become a targeted project
    - E.g., clindamycin usage after new EMR implementation by Laurie Blankenship, PharmD; Park City Hospital Pharmacy Director

# NUMBER OF CLINDAMYCIN DOSES

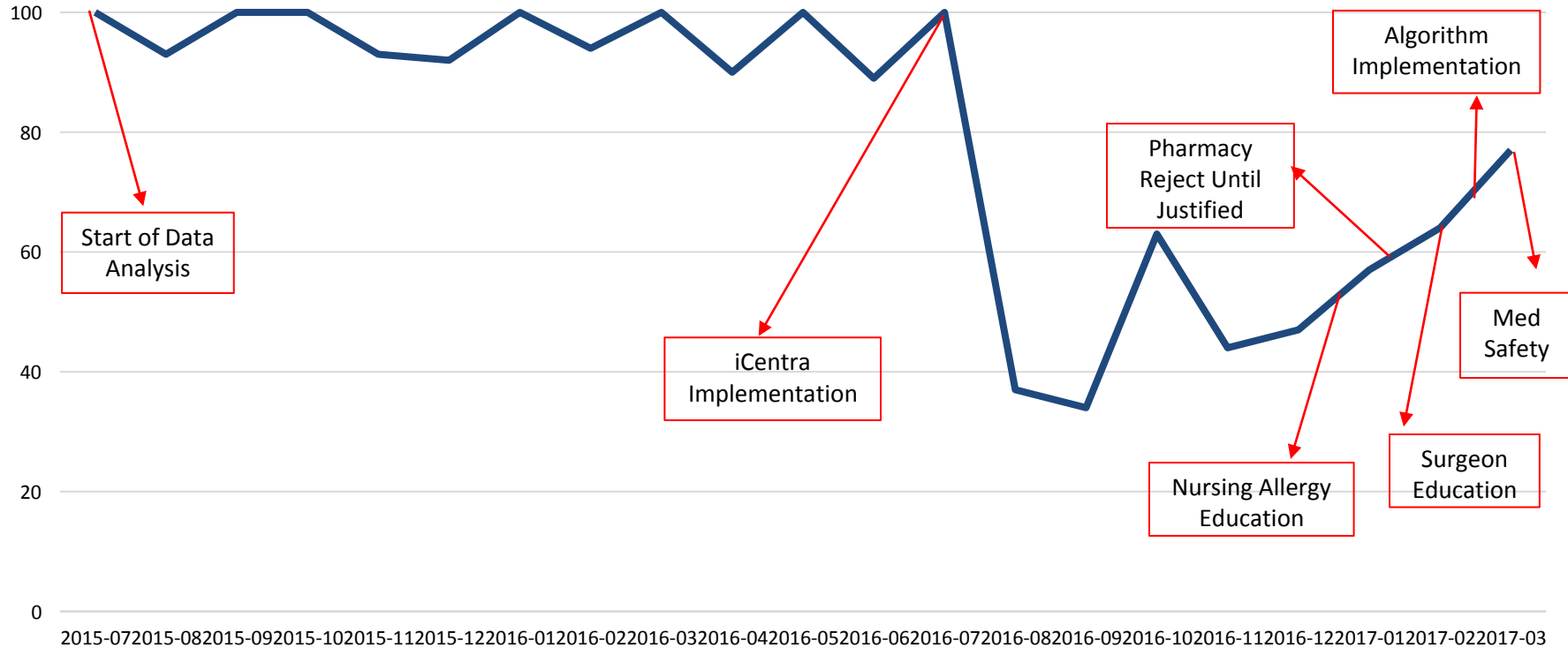


# APPROPRIATENESS OF CLINDAMYCIN DOSES



# INTERVENTION ANNOTATED RUN CHART

## Percentage Appropriate Doses - Clindamycin



# Research

- Retrospective studies
  - Reviewing active alerts and interventions
  - Utilize auto-verify alerts
- Prospective studies
  - Patient identification for enrollment in trials
  - Real-time stewardship interventions



# Self-Assessment Question

When implementing an add-on stewardship program, which of the following is most important:

- A. A detailed documentation process
- B. Utilization of both Infectious Diseases and front-line pharmacists
- C. Having a training assessment tool
- D. Tracking and feeding back data on alerts and interventions

# Key Takeaways: When to Synergize CDSS with or within your EHR

- To implement complicated empiric therapy recommendations
  - Example: Scoring methods for assessing risk for drug resistance, data to develop HER order sets, and empiric-therapy based alerts
- To identify needed therapy modifications
  - Example: Smart alerts to trigger pharmacist evaluation (IV to PO), bug-drug mismatch alerts, and/or rapid diagnostic test results
- To track and report results
  - Example: Alert acknowledgement, intervention, and/or antibiotic use rates

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# Leveraging Technology and Informatics for Antimicrobial Stewardship: Questions?

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