



# ACTIONABLE DATA FOR STEWARDSHIP


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ELIZABETH DODDS ASHLEY, PHARM.D, MHS

# Disclosures

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- I consult on antimicrobial stewardship for a host of state societies, hospitals and professional societies
- I borrowed several slides for this presentation- stewardship really is a team effort- thanks to all of my generous colleagues



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**IF YOU CAN'T  
MEASURE IT, YOU  
CAN'T CHANGE IT**

PETER DRUCKER

PICTUREQUOTES.com



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The Pew Charitable Trusts / Research & Analysis / Trends in U.S. Antibiotic Use

ISSUE BRIEF

## Trends in U.S. Antibiotic Use

New data needed to improve prescribing, combat threat of antibiotic resistance

March 22, 2017 | Antibiotic Resistance Project

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SHARE      

**Making Health Care Safer**  
**Antibiotic Rx in Hospitals: Proceed with Caution**

Antibiotics save lives, but poor prescribing practices are putting patients at unnecessary risk for preventable allergic reactions, super-resistant infections, and deadly diarrhea. Errors in prescribing decisions also contribute to antibiotic resistance, making these drugs less likely to work in the future.

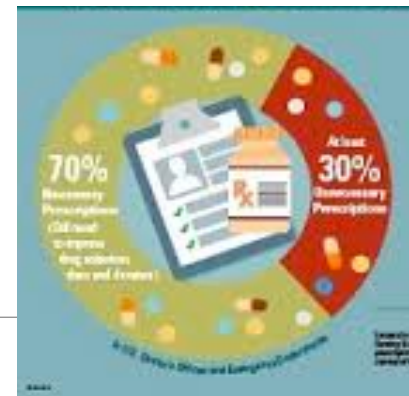
To protect patients and preserve the power of antibiotics, hospital CEOs/medical officers can:

- Adopt an antibiotic stewardship program that includes,

**Antibiotic Rx for Hospitals**  
 Proceed with Caution



SOURCE: CDC Vital Signs, March 2014, www.cdc.gov/vitalsigns



**1 in 2**  
 More than half of all hospital patients receive an antibiotic.

**3x**  
 Doctors in some hospitals prescribed 3 times as many antibiotics as doctors in other hospitals.

**30%**  
 Reducing the use of high-risk antibiotics by 30% can lower deadly diarrhea infections by 26%.



**1/3** antibiotic prescriptions are unnecessary\*

→ See page 4  
 Want to learn more? Visit

[www.cdc.gov/vitalsigns](http://www.cdc.gov/vitalsigns)

National Center for Emerging and Zoonotic Infectious Diseases  
 Division of Healthcare Quality Promotion



**Antibiotic Stewardship in Nursing Homes**

**4.1 MILLION**  
 Americans are admitted to or reside in nursing homes during a year\*

**UP TO 70%**  
 of nursing home residents received antibiotics during a year\*\*

**UP TO 75%**  
 of antibiotics are prescribed incorrectly\*\*\*



CDC recommends **7 CORE ELEMENTS** for antibiotic stewardship in nursing homes:  
 Leadership Commitment • Accountability • Drug Expertise • Action • Tracking • Reporting • Education

ANTIBIOTICS ARE RESPONSIBLE FOR ALMOST

**1 OUT OF 5**  
 EMERGENCY DEPARTMENT VISITS FOR ADVERSE DRUG EVENTS



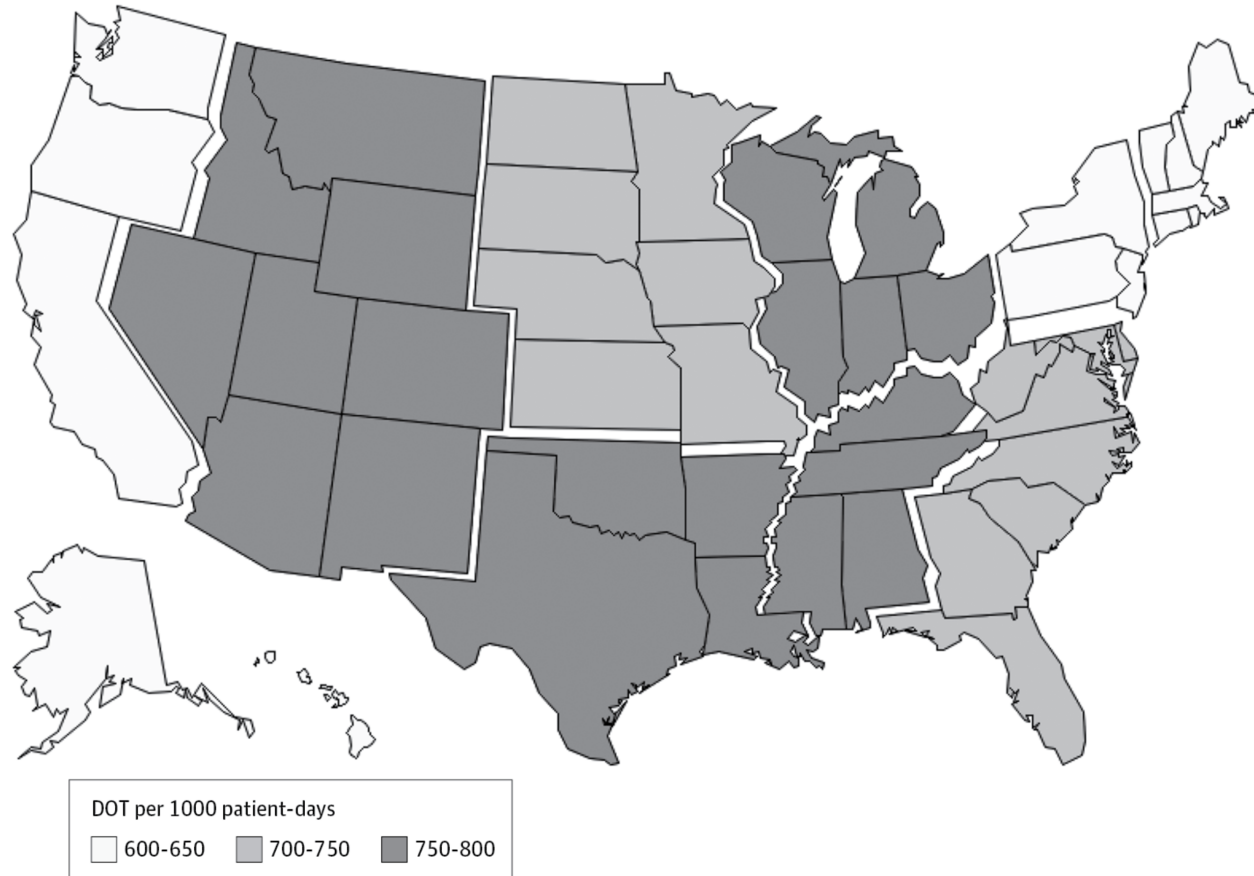
ANTIBIOTICS ARE THE MOST COMMON CAUSE OF EMERGENCY DEPARTMENT VISITS FOR ADVERSE DRUG EVENTS IN CHILDREN UNDER 18 YEARS OF AGE.

\*Source: CDC Vital Signs, March 2014, www.cdc.gov/vitalsigns  
 \*\*Source: CDC Vital Signs, March 2014, www.cdc.gov/vitalsigns  
 \*\*\*Source: CDC Vital Signs, March 2014, www.cdc.gov/vitalsigns



National Center for Emerging and Zoonotic Infectious Diseases  
 Division of Healthcare Quality Promotion

# National Trends in Inpatient Antibiotic Use 2006-2012



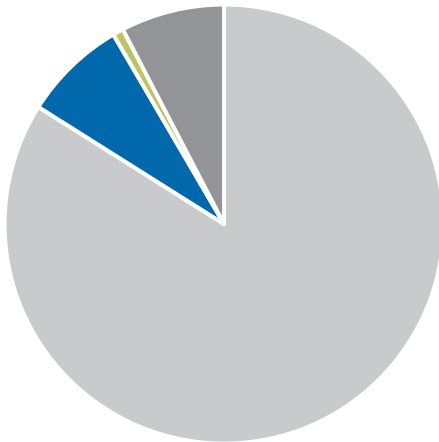
Baggs J et al. *JAMA Intern Med* 2016;176:1639-48.

# What Drugs are Being Used?

A single day sample:

- 11,282 patients in 183 hospitals

Of the 49.9% of Patients  
Who Received Any Antibiotic



- Treatment
- Surg Prophy
- Medical Prophy
- Non-Infectious

	Percentage of Total
Fluoroquinolone	14.1%
Parenteral glycopeptides	12.3%
Penicillin combinations	11%
Third generation cephalosporins	10.5%
First generation cephalosporins	10%

Magill SS et al. JAMA 2014;312:1438-46.



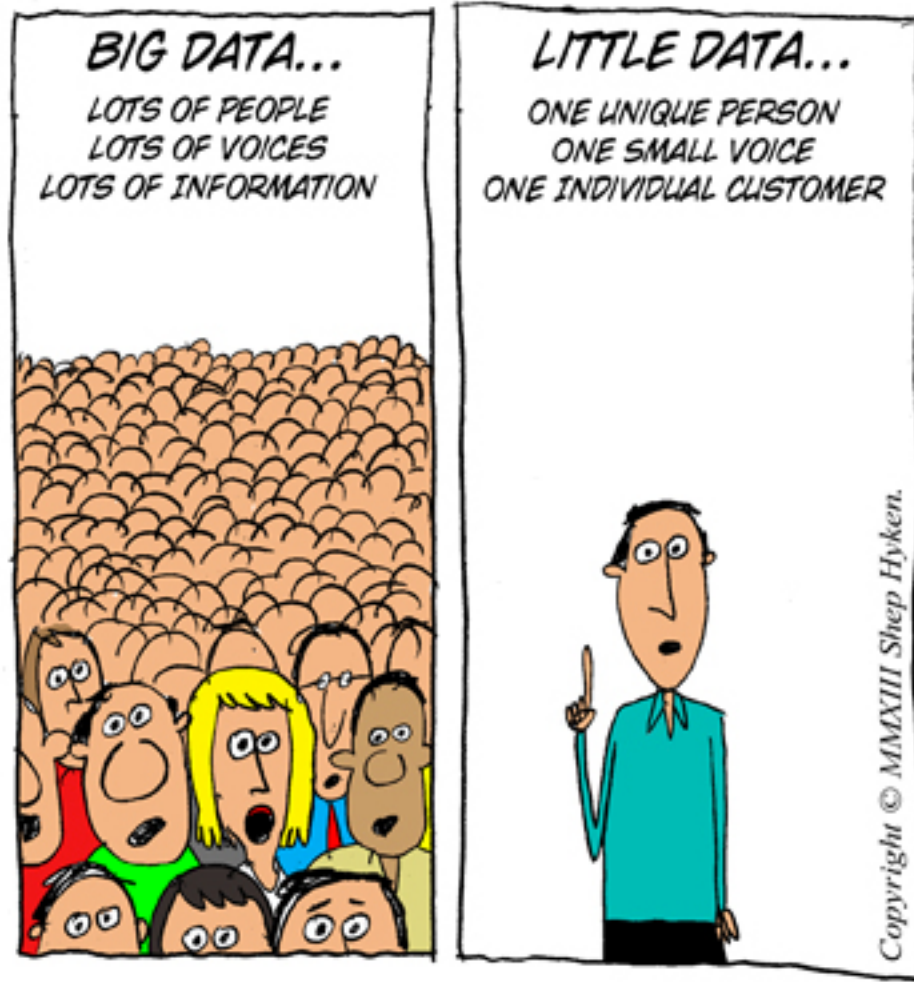
WHAT IS THE MOST USEFUL DATA  
TO DRIVE ACTION?

# Global to Fingertip

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**BIG DATA SPOTS A TREND, WHILE LITTLE DATA SPOTS AN OPPORTUNITY.**

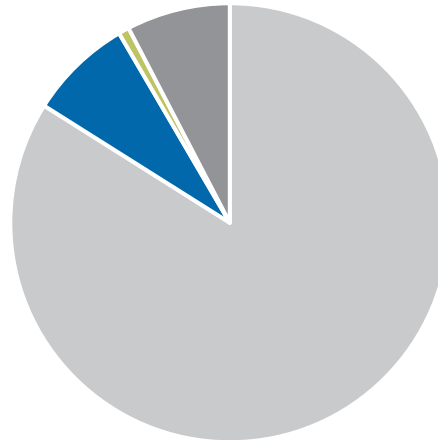
# Example- Big Data

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A single day sample:

- 11,282 patients in 183 hospitals

Of the 49.9% of Patients  
Who Received Any Antibiotic



▪ Treatment ▪ Surg Proph ▪ Medical Proph ▪ Non-Infectious

Magill SS et al. JAMA 2014;312:1438-46.

# Example- Local Data

	Sample Hospital		
	Numerator	Denominator	Rate
Days of Therapy / Thousand Patient Days	259,601	276.29	939.61
	DOT	1K Patient Days	
Length of Therapy / Thousand Patient Days	133,494	276.29	483.17
	LOT	1K Patient Days	
Length of Therapy / Admission	133,494	38,290	3.49
	LOT	Admissions	
% of patient admissions in which antimicrobials were given			62.54%

# Top agents used

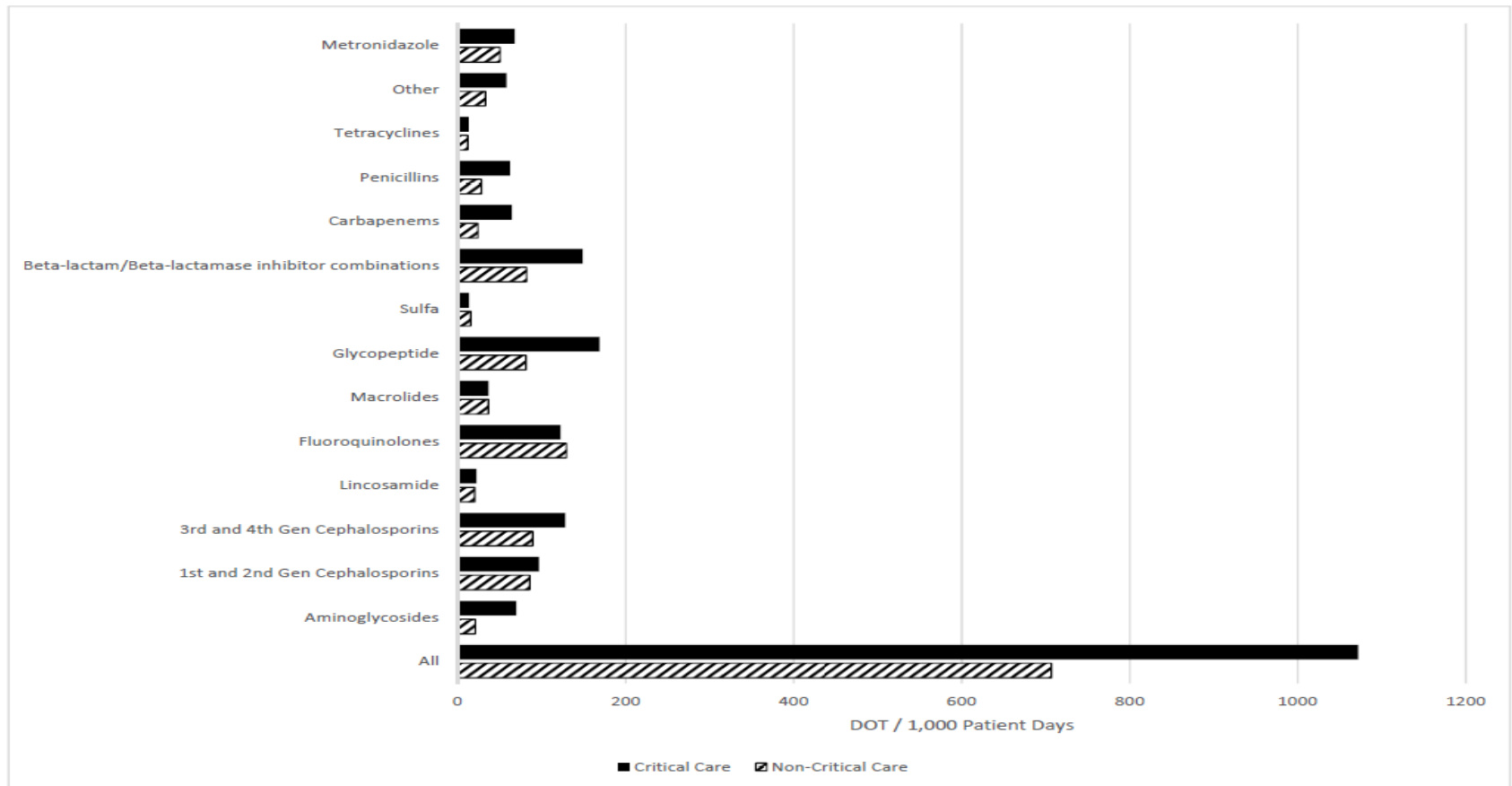
## Big

	Percentage of Total
Fluoroquinolone	14.1%
Parenteral glycopeptides	12.3%
Penicillin combinations	11%
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## Little

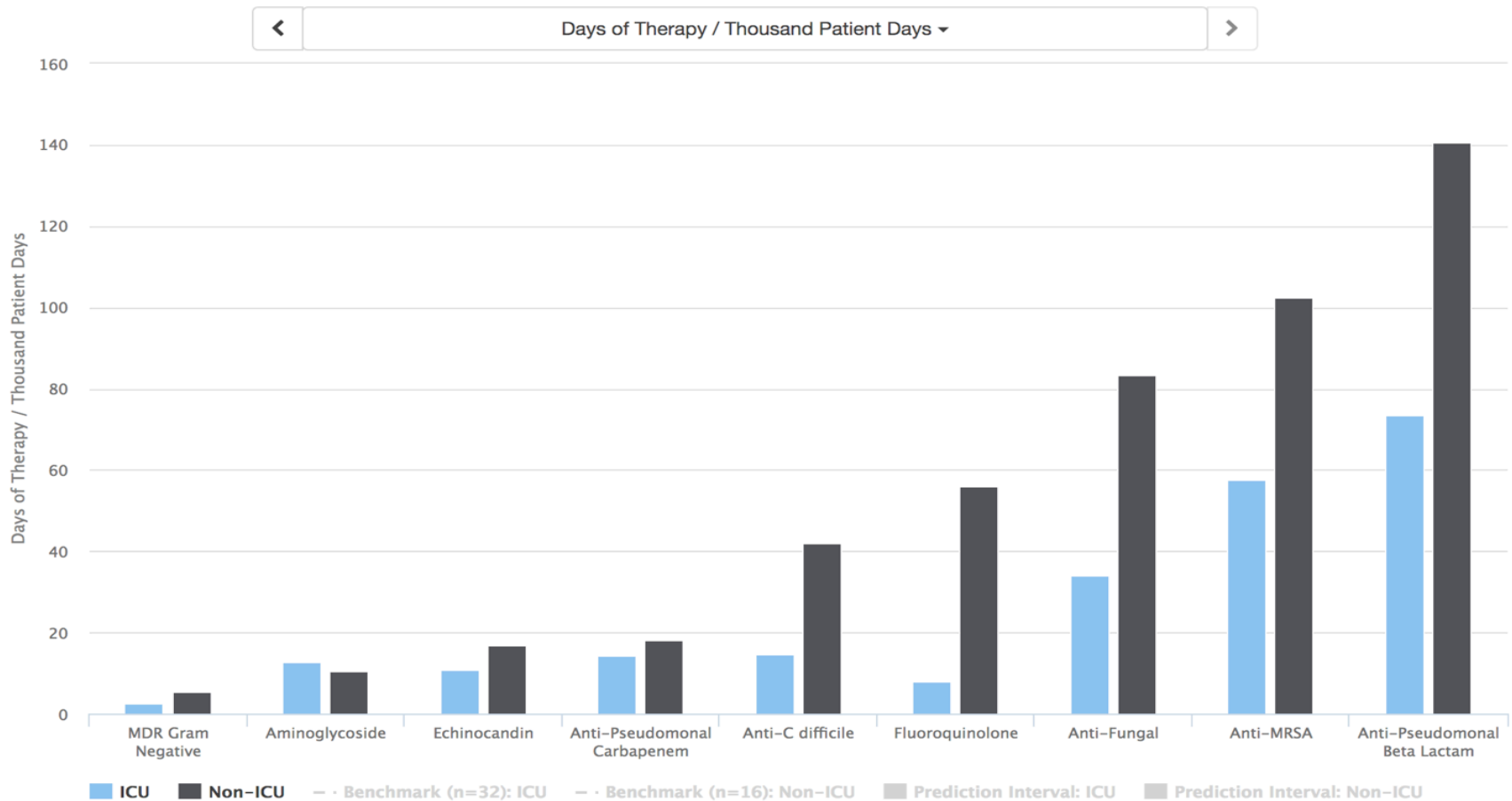
	DOT	Percentage of Total DOT
Vancomycin	36176	13.93
Piperacillin with tazobactam	28418	10.94
Acyclovir	14285	5.5
Cefazolin	14279	5.5
Sulfamethoxazole with Trimethoprim	10865	4.18
Fluconazole	10831	4.17
Cefepime	10724	4.13
Ciprofloxacin	10110	3.89
Ceftriaxone	8880	3.42
Metronidazole	8229	3.17

# Nationally: More Antibiotics are Used in ICU



Baggs J et al. *JAMA Intern Med* 2016;176:1639-48.

# Local Use Stratified by ICU

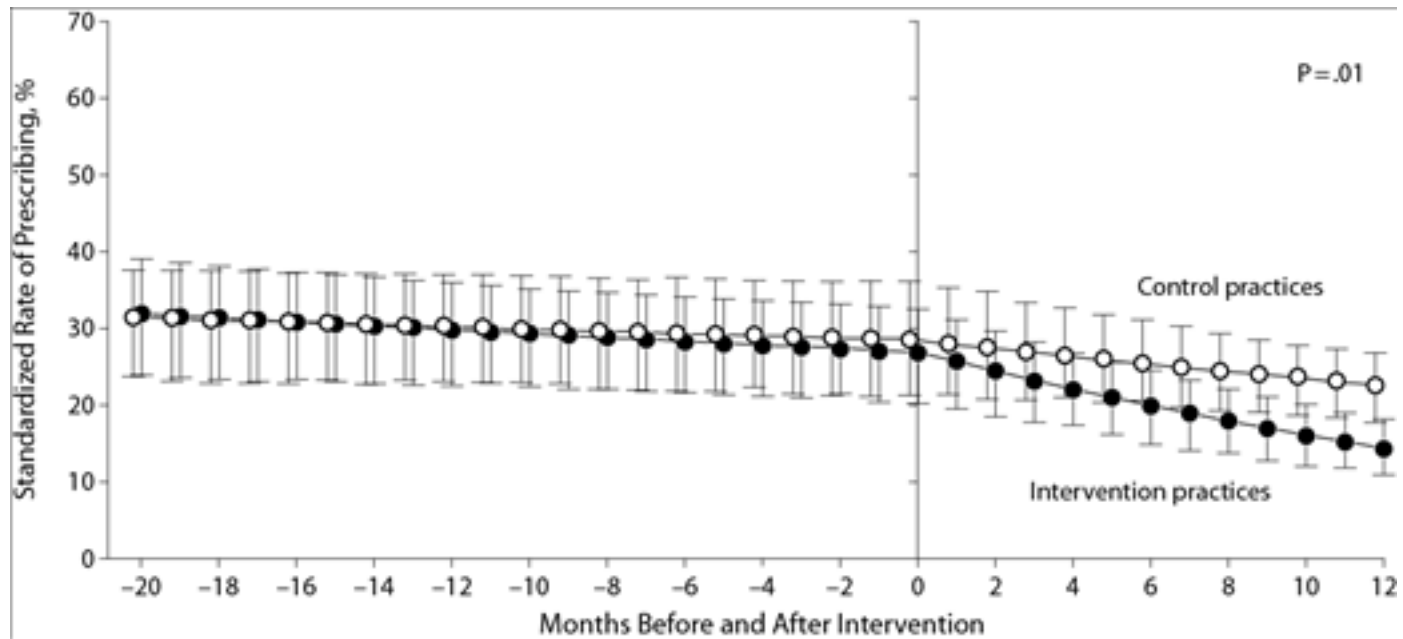


# Who is using all this therapy?

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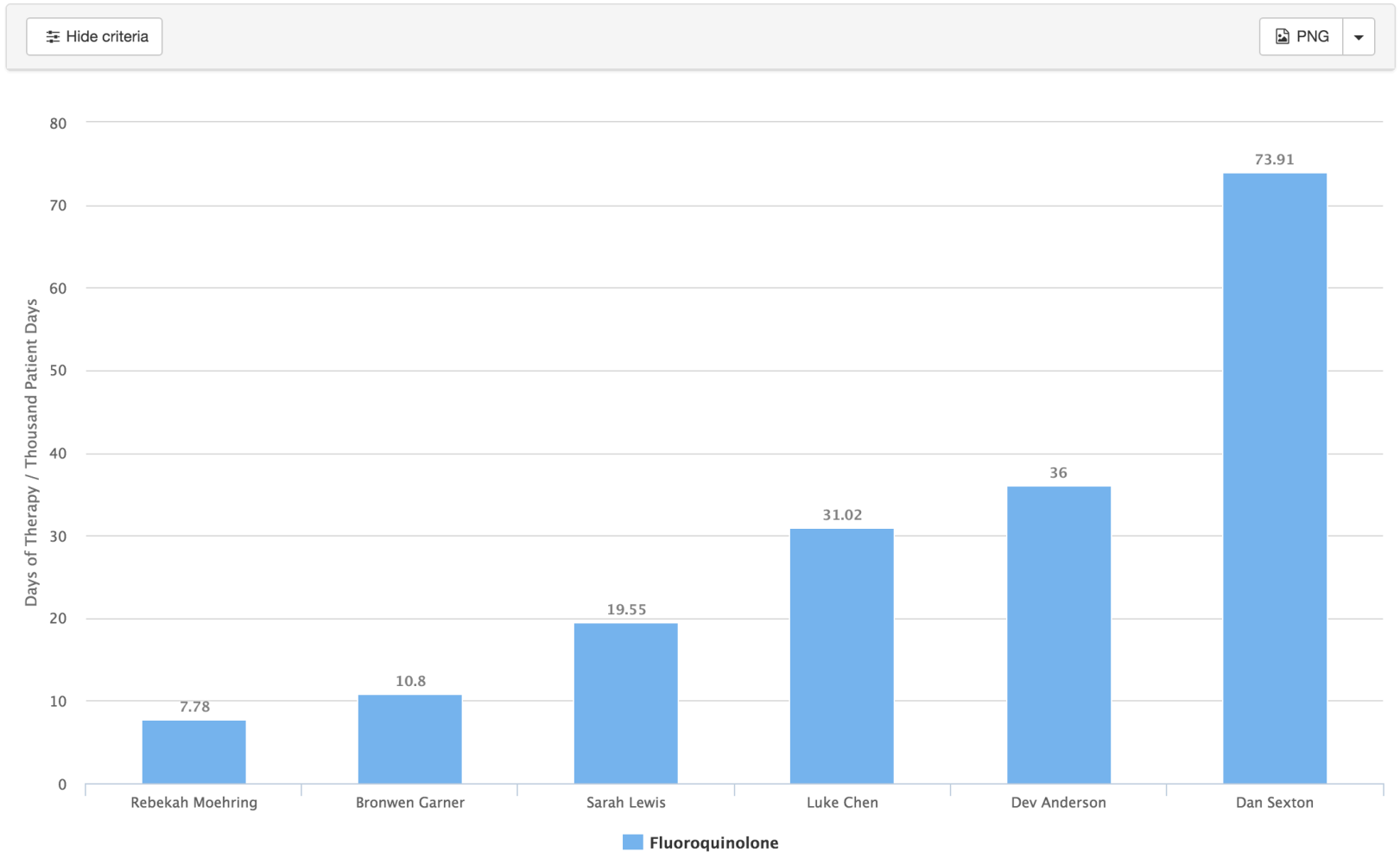
# Example- Big Data



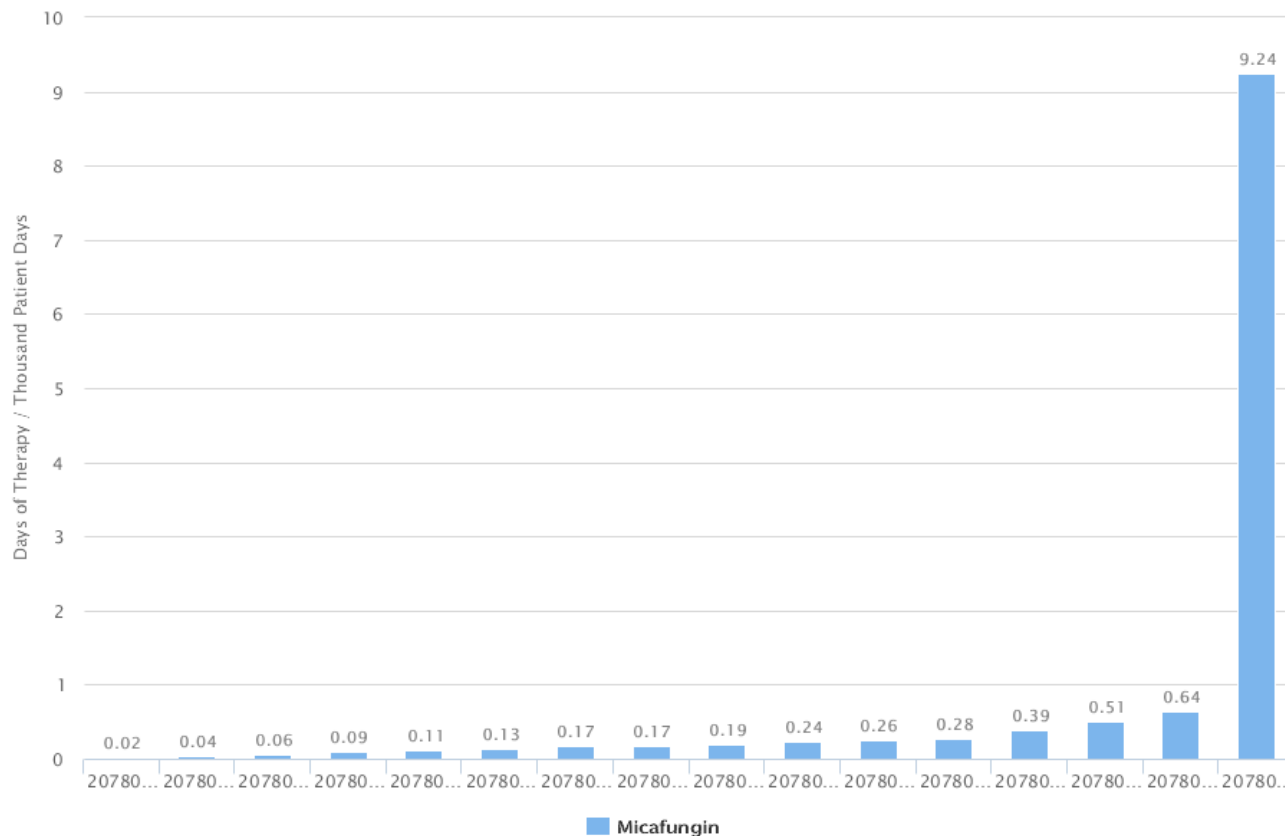
Gerber JS et al *JAMA* 2013;309:2345-52



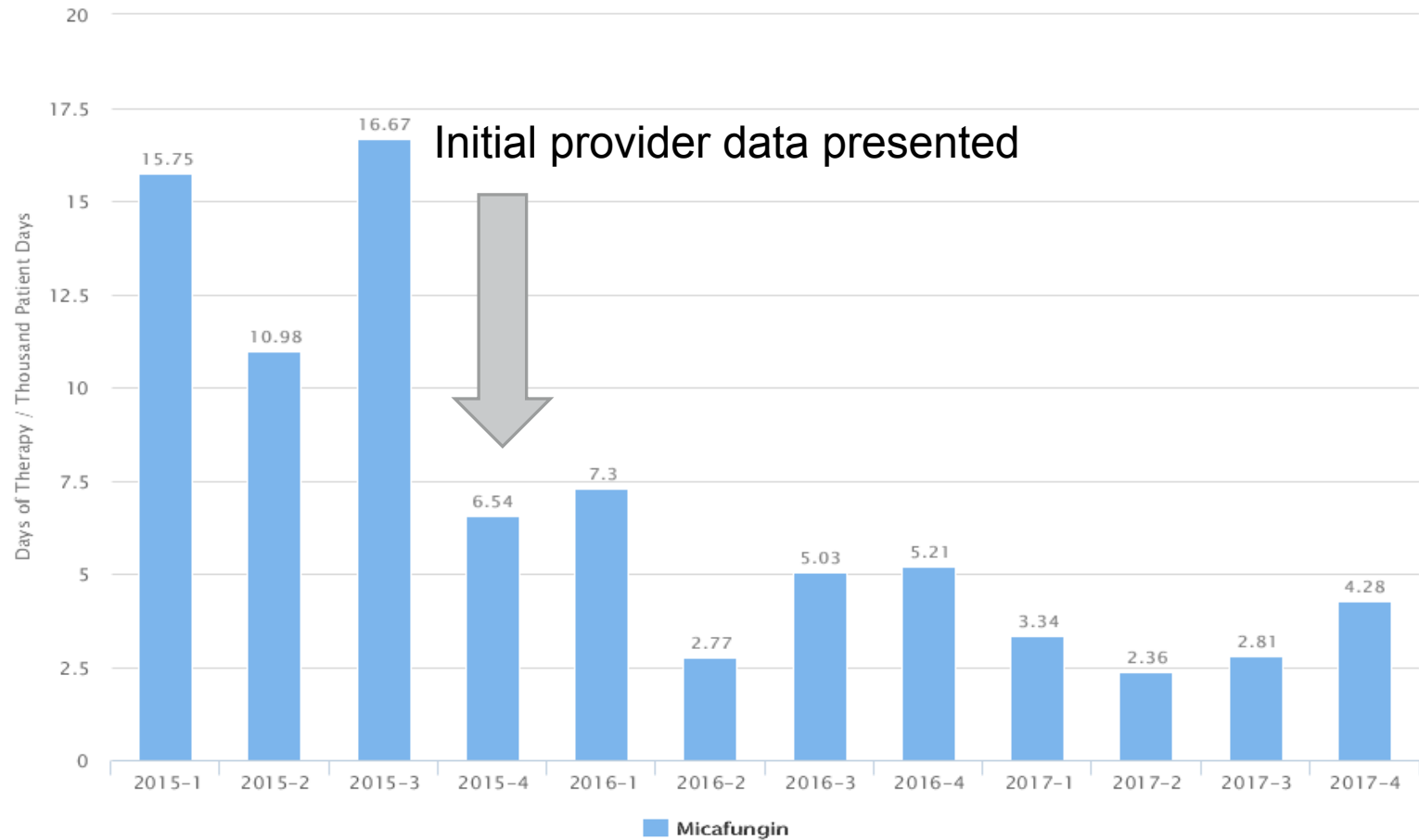
# Provider Feedback Reports



# Sometimes it is more obvious...



# And not too hard to fix..



# DEVELOPING A PATIENT SAFETY OUTCOME MEASUREMENT TOOL FOR ANTIMICROBIAL STEWARDSHIP PROGRAMS

REBEKAH MOEHRING, MD, MPH, ELIZABETH DODDS-ASHLEY, PHARMD AND  
THE STEWARDS STUDY TEAM

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 **Duke University**  
School of Medicine

[dason.medicine.duke.edu](http://dason.medicine.duke.edu)

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ANTIMICROBIAL  
STEWARDSHIP  
OUTREACH  
NETWORK

Phase 1: Measure Development and Selection

**Candidate List of Measures**

1. Relevance/value for ASPs
2. Feasibility of measurement

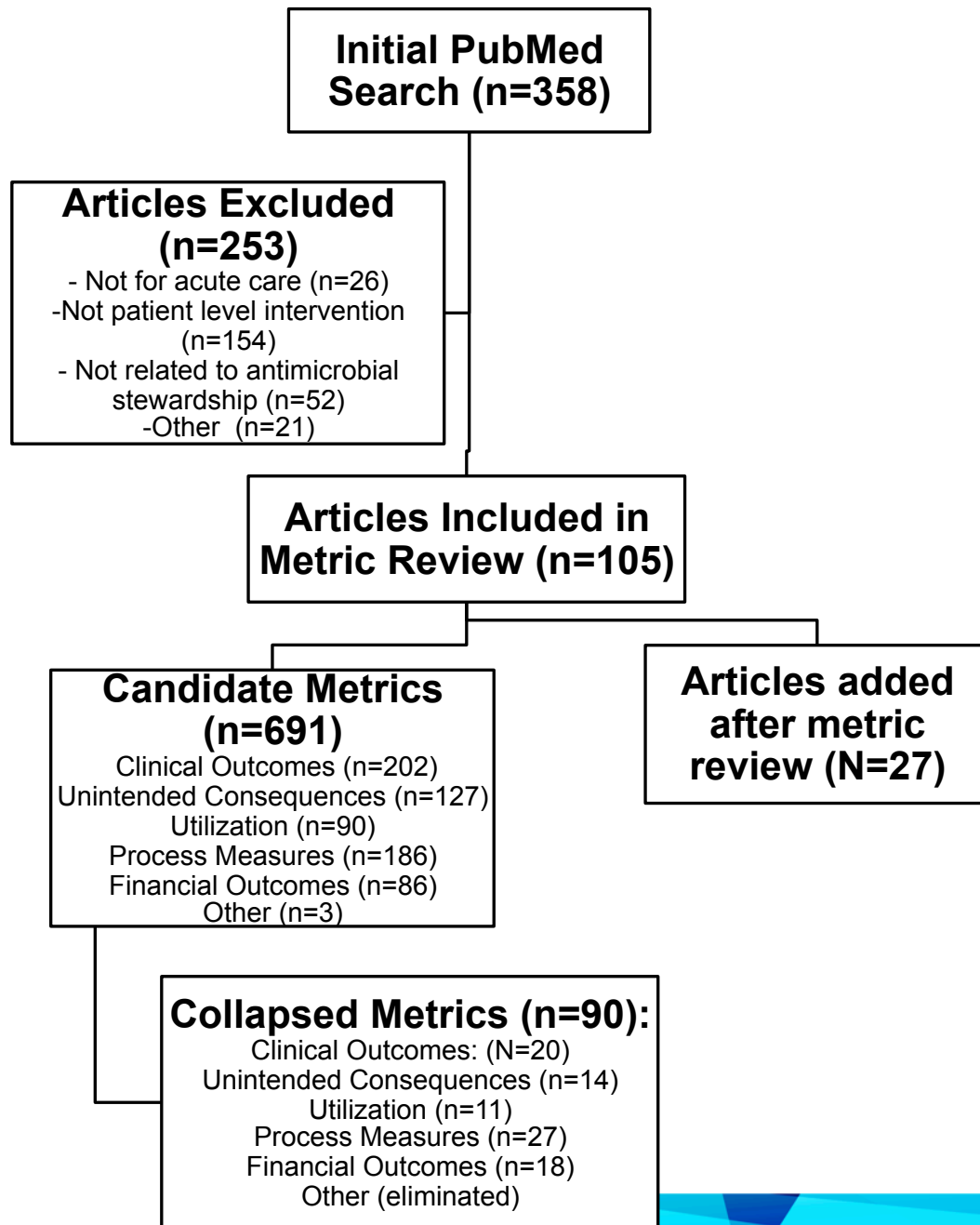


**Expert Panel Consensus**

- Modified Delphi Process for consensus building
- 2 round written surveys
- 1 Webcast/Phone open discussion in-between

**Pilot Sites (N=5)**

- Structured Interview:
  - Active patient-level interventions ongoing/planned in next 1 year
  - Data collection + assessments ongoing/planned in next 1 year
  - Relationships with local IT



# Expert Survey Design

## CANDIDATE METRICS IN FIVE DIFFERENT CATEGORIES:<sup>1</sup>

Clinical Outcomes
Unintended Consequences
Utilization
Process Measures
Financial

## 9-POINT LIKERT RATE AGREEMENT ON 4 CRITERIA:

a) This metric is associated with improved antimicrobial prescribing
b) This metric is associated with improved patient care
c) This metric is useful in targeting stewardship efforts
d) This metric is feasible to monitor in any hospital with an electronic health record

- Encouraged additional suggestions, feedback, and open text comments.
- If experts suggest a new metric (or related ones), then address during discussion for consideration of addition to Round 2.

## Round 1 Survey Metrics (n=90):

Clinical Outcomes (n=20)

Unintended Consequences (n=14)

Utilization (n=11)

Process Measures (n=27)

Financial Outcomes (n=18)

**Retained or  
Equivocal**  
N=28

**Refined**  
N=10

**Added**  
N=3

**Removed**  
N=49  
[All in Financial  
category were  
eliminated (n=18)]

Round 2 Survey (N=41)



# Group 1: Ready for Immediate Use and Tracking

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1. *C. difficile* infection, LabID Event. CO-HCFA and HO-
2. *C. difficile* infection, LabID Event. HO-
3. Drug-resistant infection: rate of resistant pathogen(s) isolated from clinical cultures (excludes nares and peri-rectal swabs used for active surveillance).
4. Days of therapy (DOT)/Admission
5. DOT/ Patient days
6. Redundant Therapy Events

# Redundant Events: Spectrum Groups

Agents that have overlapping spectrum of activity

SPECTRUM GROUP	AGENTS INCLUDED IN GROUP
ANTI-PSEUDOMONAL	Amikacin, Cefepime, Ceftazidime, Ceftolozane/tazobactam, Ciprofloxacin, Colistin, Doripenem, Gentamicin, Imipenem/cilastin, Levofloxacin, Meropenem, Piperacillin, Piperacillin/tazobactam, Polymixin B, Ticarcillin, Ticarcillin/clavulanate, Tobramycin
GRAM-POSITIVE	Ceftaroline, Clindamycin, Dalbavancin, Daptomycin, Dicloxacillin, Linezolid, Minocycline, Oritavancin, Quinupristin-dalfopristin, Tedizolid, Telavancin, Tigecycline, Trimethoprim-sulfamethoxazole, Vancomycin (IV route ONLY)
ANTI-ANAEROBE	Amoxicillin-clavulanate, Ampicillin, Ampicillin-sulbactam, Cefoxitin, Clindamycin, Ertapenem, Imipenem, Meropenem, Metronidazole, Moxifloxacin, Piperacillin, Piperacillin-tazobactam
ANTI-FUNGAL	Amphotericin B, Amphotericin B liposomal, Anidulafungin, Caspofungin, Fluconazole, Itraconazole, Micafungin, Posaconazole, Voriconazole
BETA-LACTAM	Amoxicillin, Amoxicillin with Clavulanate, Ampicillin, Ampicillin-sulbactam, Aztreonam, Cefaclor, Cefadroxil, Cefazolin, Cefdinir, Cefditoren, Cefepime, Cefixime, Cefotaxime, Cefotetan, Cefoxitin, Cefpodoxime, Cefprozil, Ceftaroline, Ceftazidime, Ceftibuten, Ceftizoxime, Ceftolozane/Tazobactam, Ceftriaxone, Cefuroxime, Cephalexin, Dicloxacillin, Doripenem, Ertapenem, Imipenem with Cilastatin, Meropenem, Nafcillin, Oxacillin, Penicillin G, Penicillin V, Piperacillin, Piperacillin with Tazobactam, Ticarcillin, Ticarcillin with Clavulanate

# Redundant Events- Is this actionable?

Category	Total redundant spectrum events	Total redundant therapy days	Mean duration of redundant therapy (days)	% of admissions with redundant spectrum events of all cases in category
Anti-pseudomonal	3,956	15,014	3.8	7.9%
Anti-anaerobic	2,542	10,538	4.1	6.0%
Gram-positive	1,346	4,846	3.6	4.3%
Beta-lactam	1,084	3,083	2.8	1.4%
Antifungal	28	126	4.5	0.4%

Dodds Ashley et al IDWeek 2015

Group	Agent Combinations	Events	Redundant DOT
Anti-pseudomonal	Levofloxacin-Piperacillin with Tazobactam	46	214
	Levofloxacin-Meropenem	26	86
	Ciprofloxacin-Meropenem	7	23
	Levofloxacin-Meropenem-Piperacillin with Tazobactam	6	16
	Ciprofloxacin-Piperacillin with Tazobactam	3	10
Anti-anaerobe	Metronidazole-Piperacillin with Tazobactam	18	91
	Meropenem-Metronidazole	14	45
	Clindamycin-Meropenem	5	15
	Clindamycin-Piperacillin with Tazobactam	5	16
	Meropenem-Metronidazole-Piperacillin with Tazobactam	4	14
Gram-positive	Clindamycin-Vancomycin	13	28
	Sulfamethoxazole with Trimethoprim-Vancomycin	13	45
	Clindamycin-Sulfamethoxazole with Trimethoprim-Vancomycin	3	11
	Clindamycin-Sulfamethoxazole with Trimethoprim	2	6
	Linezolid-Sulfamethoxazole with Trimethoprim	2	6
Beta-lactams	Ceftriaxone-Meropenem	25	70
	Ceftriaxone-Piperacillin with Tazobactam	8	22
	Cefazolin-Ceftriaxone	6	12
	Ampicillin-Ceftriaxone	4	14
	Ceftriaxone-Meropenem-Piperacillin with Tazobactam	3	8

# Now this is actionable...

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Of the 24 cases of combination ceftriaxone and meropenem reported for 2016.

We determined that:

- -4 cases included treatment with 3 drugs and did not truly represent combination of greater than 24 hours for the agents of interest
- -1 case represented two consecutive days of switched therapy and also did not truly represent a duplicate event
- -A single provider was responsible for 18 of the remaining 19 courses

**Table 2. Structured Taskforce of Experts Working at Reliable Standards for Stewardship (STEWARDS) Panel-Recommended Metrics for Assessing the Impact of Patient-Level Antimicrobial Stewardship Interventions**

	Group 1: Ready for Immediate Use and Tracking	Group 2: Identified as Useful but Questionable Feasibility: Recommended for Future Study
Clinical outcomes	None	<ul style="list-style-type: none"> <li>• Readmission: related to infectious diagnoses</li> </ul>
Unintended consequences	<ul style="list-style-type: none"> <li>• <i>Clostridium difficile</i> infection incidence: healthcare facility associated (includes NHSN LabID-defined community-onset, healthcare facility-associated and hospital-onset cases)</li> <li>• <i>Clostridium difficile</i> infection incidence: hospital onset (includes NHSN LabID-defined hospital-onset cases)</li> <li>• Drug-resistant infection: rate of resistant pathogen(s) isolated from clinical cultures (excludes nares and perirectal swabs used for active surveillance).</li> </ul>	<ul style="list-style-type: none"> <li>• Adverse drug events/toxicities</li> </ul>
Utilization	<ul style="list-style-type: none"> <li>• Days of therapy/admission</li> <li>• Days of therapy/patient-days</li> </ul>	<ul style="list-style-type: none"> <li>• Days of therapy/days present</li> <li>• Total duration/admission</li> <li>• Total duration/antimicrobial admission</li> </ul>
Process measures	<ul style="list-style-type: none"> <li>• Redundant therapy events</li> </ul>	<ul style="list-style-type: none"> <li>• Antimicrobial error (wrong drug, dose, route or frequency occurring during ordering or monitoring)</li> <li>• Appropriateness/inappropriateness per institutional guideline/expert opinion</li> <li>• Adherence to guidelines/formulary/protocol/bundle</li> <li>• Appropriate cultures performed per institutional guideline/expert opinion</li> <li>• Excess drug use (antimicrobial use that could have been avoided based on clinical guidelines, shorter recommended duration, stopping therapy due to earlier availability of culture results, etc)</li> <li>• De-escalation performed (number of occurrences)</li> <li>• Culture collected prior to antimicrobial being administered</li> <li>• Time to appropriate therapy</li> <li>• Proportion of patients who received initial antibiotic coverage for a targeted nosocomial pathogen who also had positive clinical cultures (blood, respiratory) for that target pathogen (eg, methicillin-resistant <i>Staphylococcus aureus</i>, <i>Pseudomonas aeruginosa</i>)</li> </ul>

# Inpatient Plus Post-discharge Durations of Therapy to Identify Antimicrobial Stewardship Opportunities at Transitions of Care

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<sup>2</sup> DUKE ANTIMICROBIAL STEWARDSHIP OUTREACH NETWORK (DASON)

<sup>3</sup> CENTERS FOR DISEASE CONTROL AND PREVENTION

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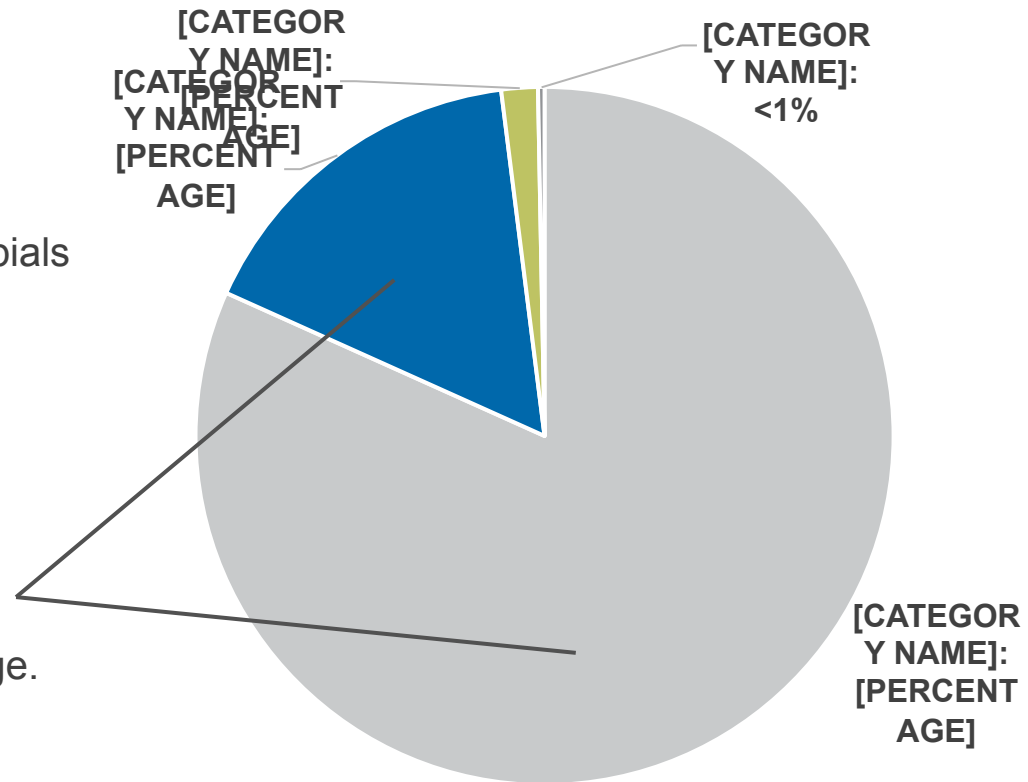
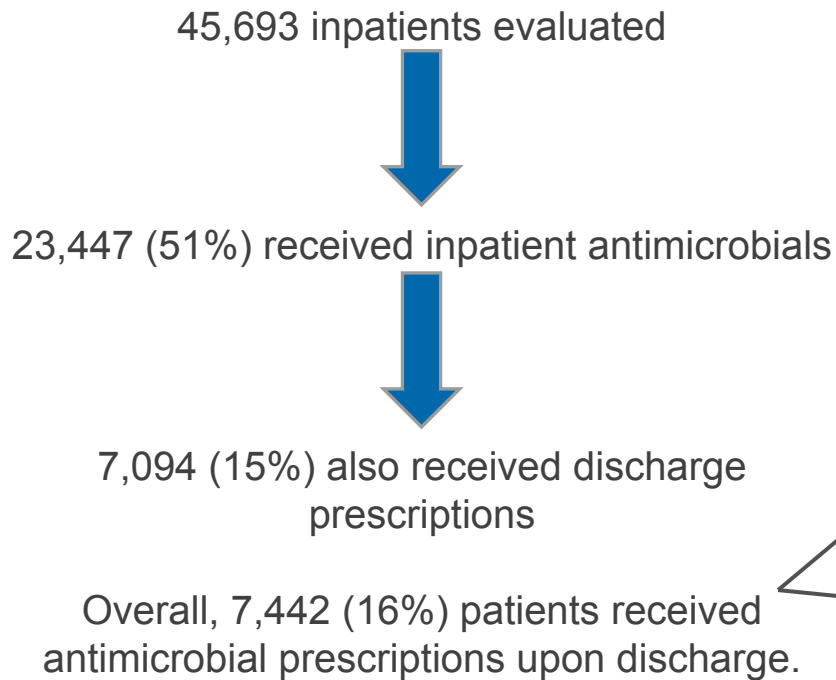
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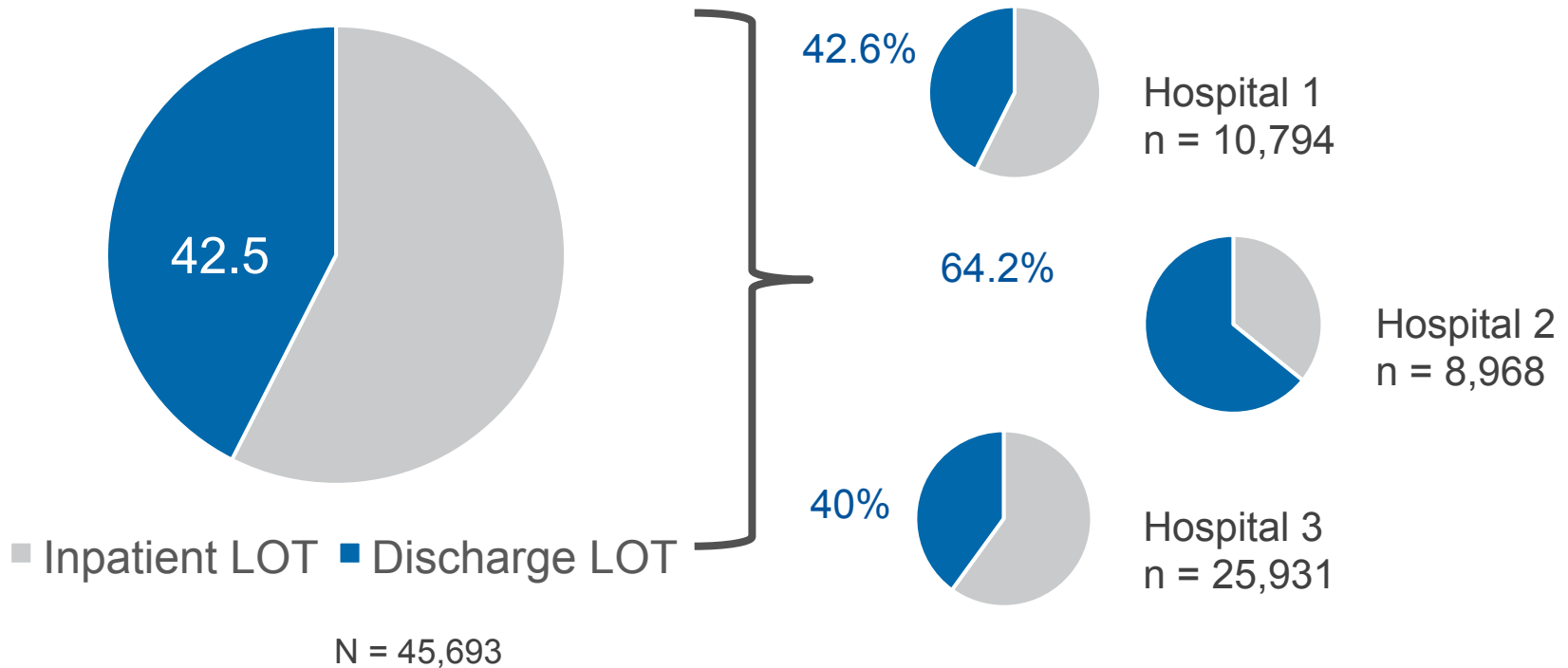
# Overall Antimicrobial Prescribing

Number of Discharge Antimicrobials Prescribed



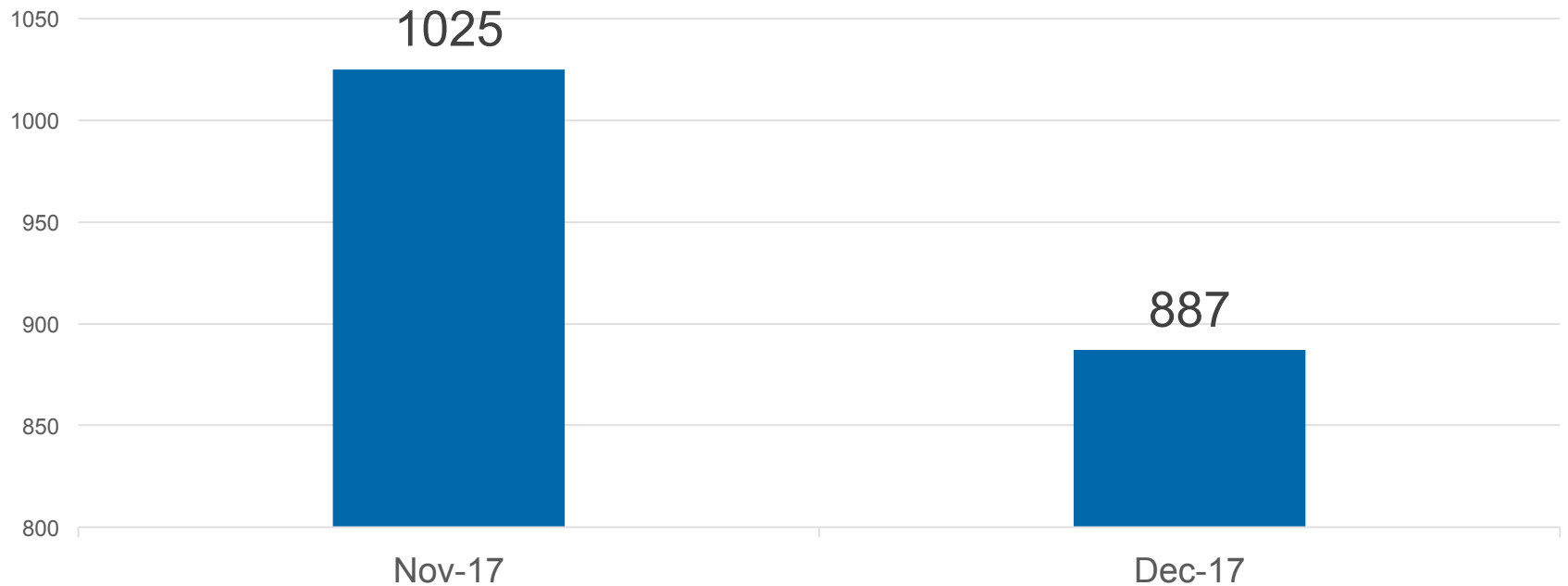


# Total Antibiotic Duration Attributed to Post-discharge Therapy (n = number of inpatients evaluated)

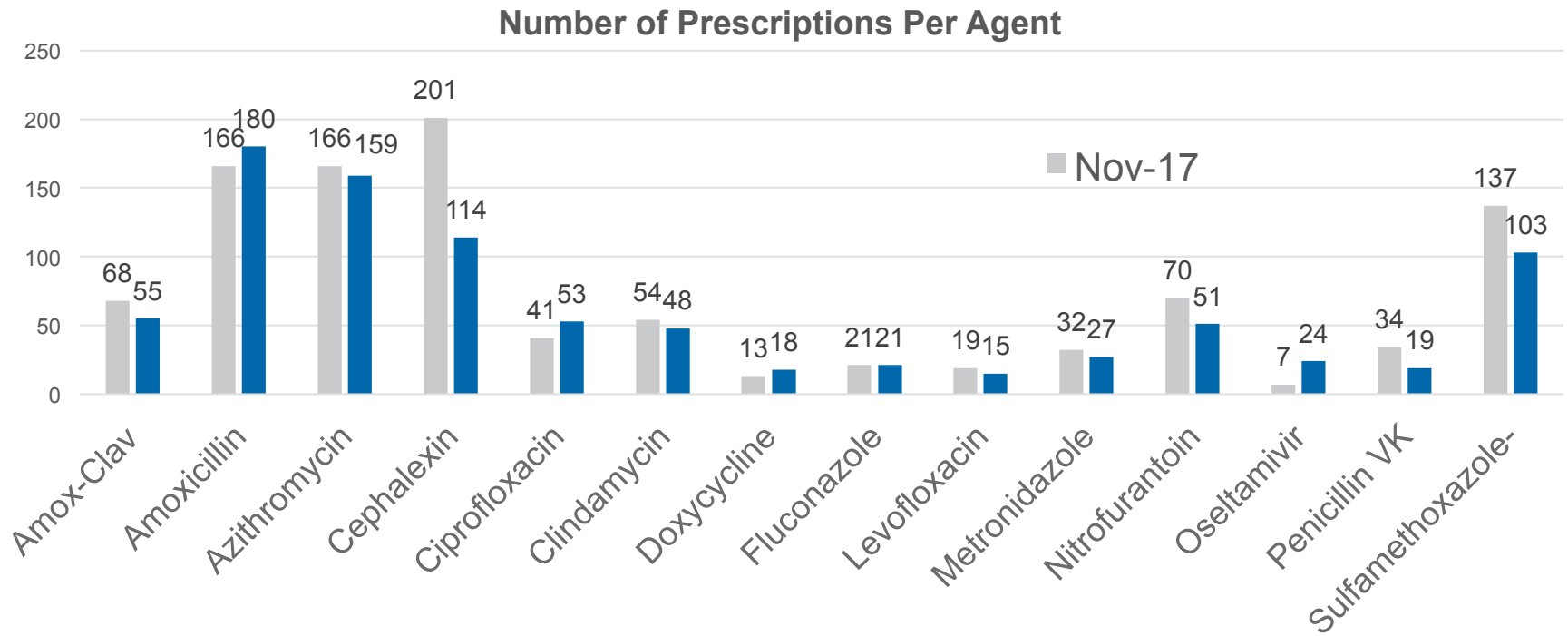


# Local Applications: Total Antimicrobial Prescriptions

Total Antimicrobial Prescriptions Per Month



# ED Antimicrobial Prescriptions



# Median Length of Therapy

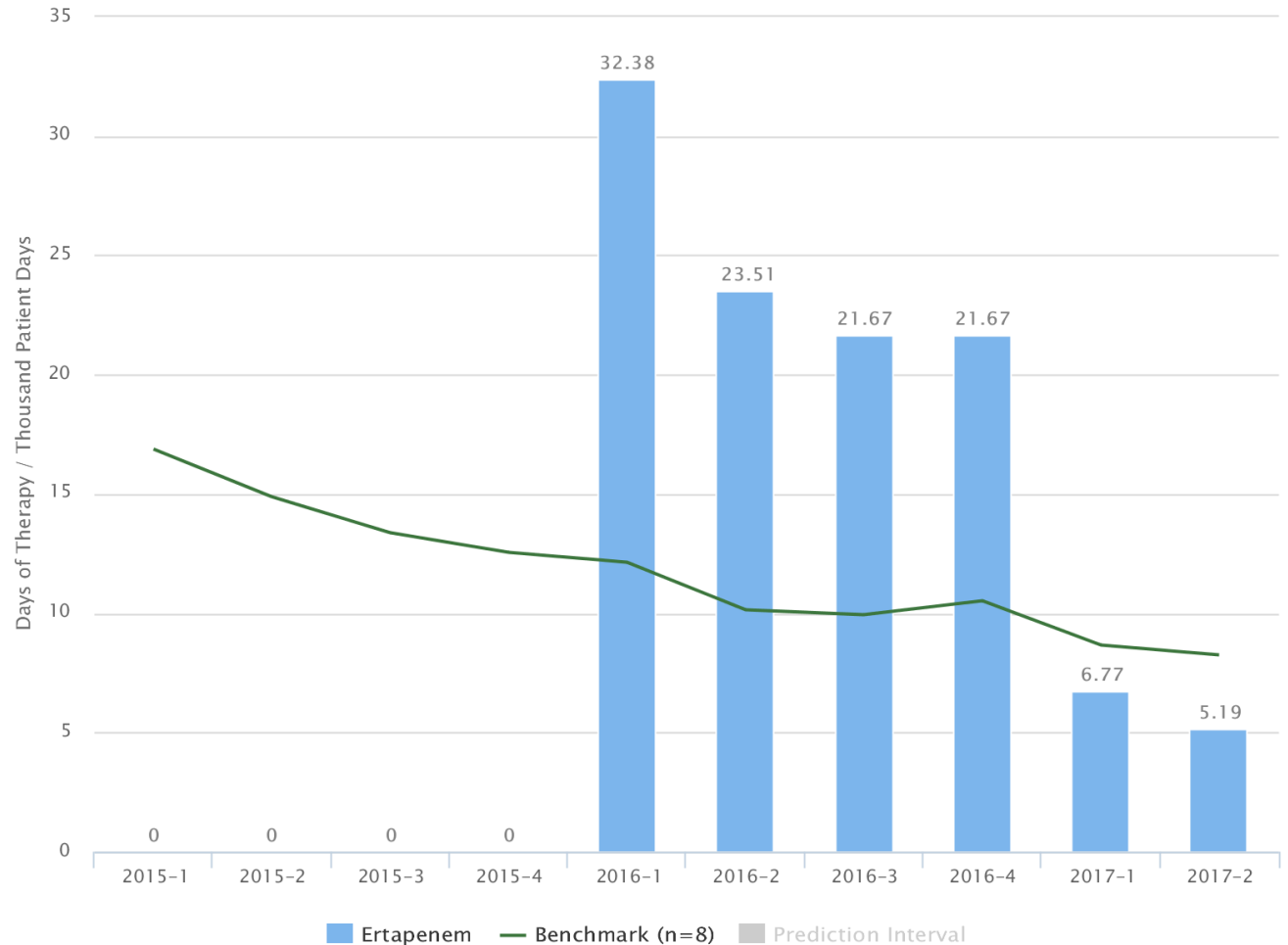
No changes in median length of therapy for any antimicrobial during the evaluated time period (November – December 2017)

Agent	Median Length of Therapy, days
Amoxicillin-clavulanate	10
Amoxicillin	10
Azithromycin	5
Cephalexin	7
Ciprofloxacin	10
Clindamycin	10
Doxycycline	10

Agent	Median Length of Therapy, days
Fluconazole	1
Levofloxacin	7
Metronidazole	7
Nitrofurantoin	7
Oseltamivir	5
Penicillin VK	10
Sulfamethoxazole-trimethoprim	7

# The biggest data to drive change!

Show  
Them  
Success!




# Making the Data Actionable

Data alone will not answer all the questions, but it allows more refined reviews

- Who?- Who is writing for the antibiotics?
- What?- What is the most frequently used antibiotic?
- Where?- Are there units that tend to use the most antibiotics?
- When?- Are there times when antibiotics are most likely to be prescribed?
- Why? - What is the most common reason antibiotics are used?

## From there

- Conversations become more productive
  - Guidelines for use can be created with provider input
  - Remember- always ask why- the reasons behind the use might not be what you had guessed!
- 

# Audience Participation

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What is a major limitation of using eprescribing data to determine total antibiotic duration?

- a) It does not account for co-pays
- b) It does not account for what was actually taken
- c) It does not assess whether or not the prescription was filled
- d) B and C

# Audience Participation

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When you use data examples from the literature for your local stewardship efforts, you always need to repeat the statistical analyses.

- a) True
- b) False



