



Killing Bugs and Saving Drugs Across a Health System: A Multi-Hospital Shared Antimicrobial Stewardship Program

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Disclosures

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

Learning Objectives

- Design an innovative plan to provide antimicrobial stewardship services within a single facility or across a multi-hospital network.
- Interpret clinical findings and key decision alerts to identify opportunities for intervention.
- Evaluate facility needs to target stewardship program activities for maximum results and program effectiveness.
- Assess the cost savings and clinical impact of a shared infectious disease pharmacist and integrated antimicrobial stewardship program.

Background

2007

- IDSA/SHEA - Guidelines for Developing an Institutional Program to Enhance Antimicrobial Stewardship

2010

- Antimicrobial Stewardship became clinical initiative in our health system.
- Clinical Decision Tool investment, minimal staff pharmacist training
- No dedicated pharmacist time, ID MD on call for questions

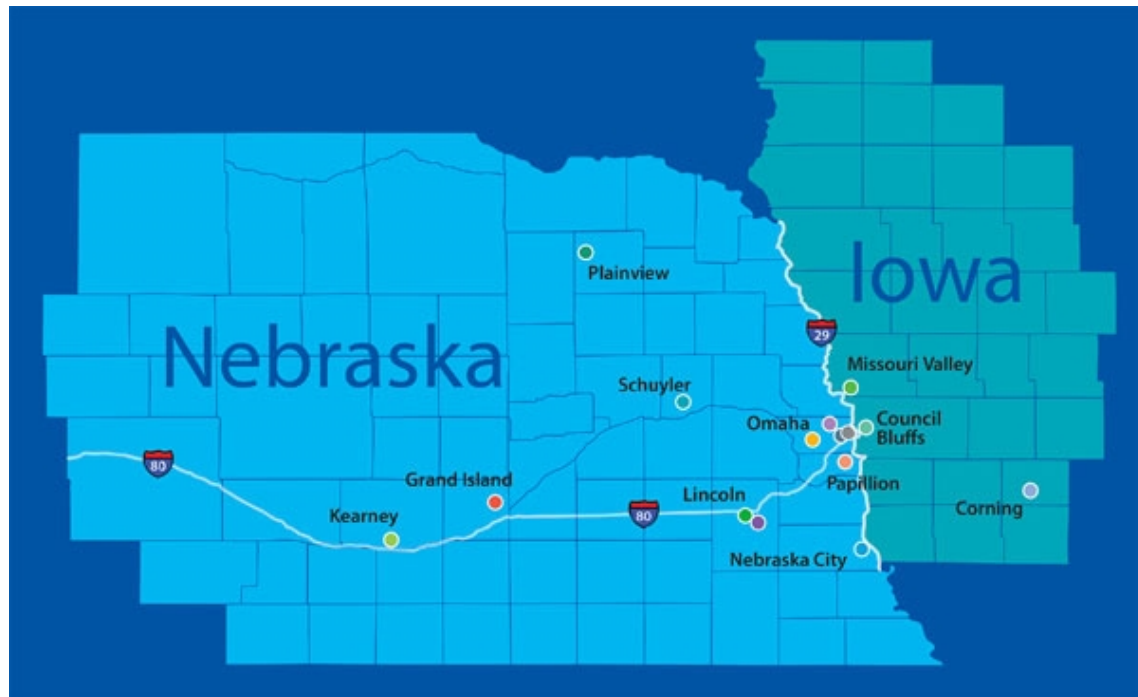
2012

- Creighton University Medical Center joined Alegant Health System
- Dedicated Antimicrobial Stewardship with ID provider and ID pharmacist
- Daily audit with feedback interventions



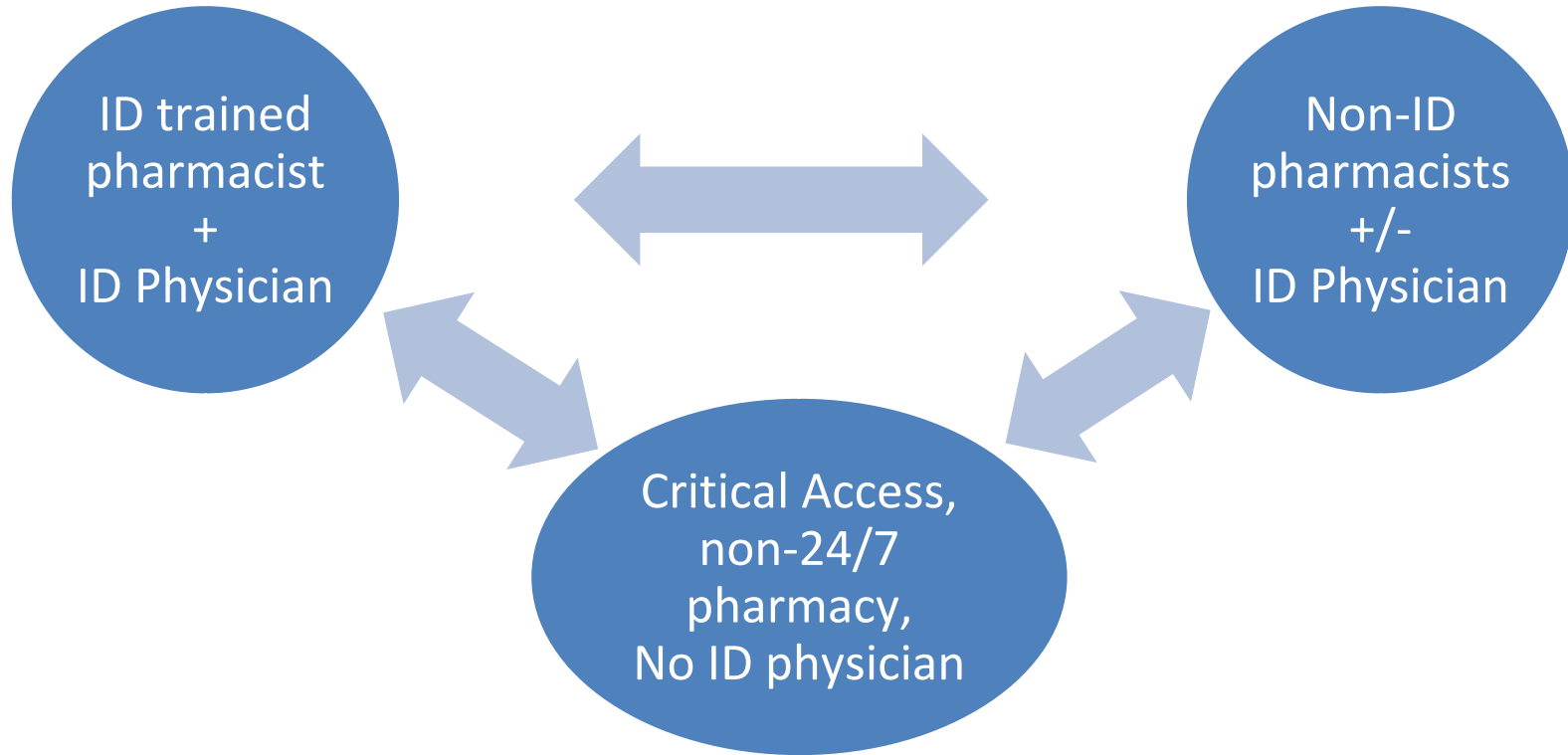
Imagine better health.SM

- 14 Hospital Facilities
- 913 combined ADC
- Urban, Suburban, Rural
- Academic, Community, Critical Access



ADC = Average Daily Census

Models of Antimicrobial Stewardship within Health System

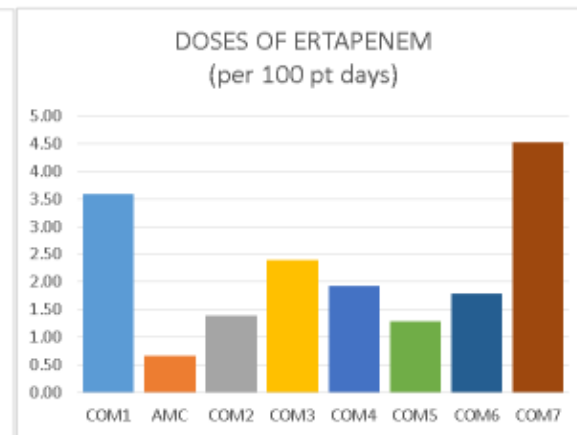
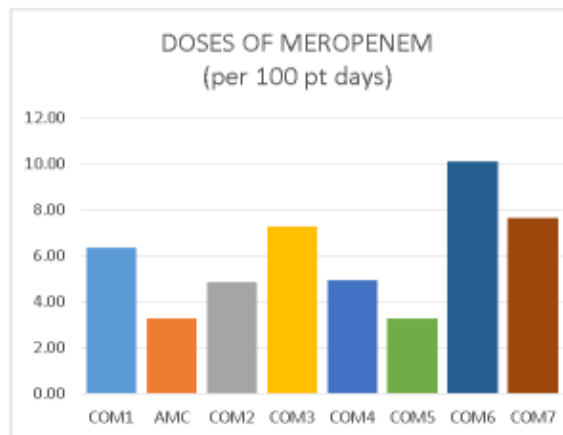
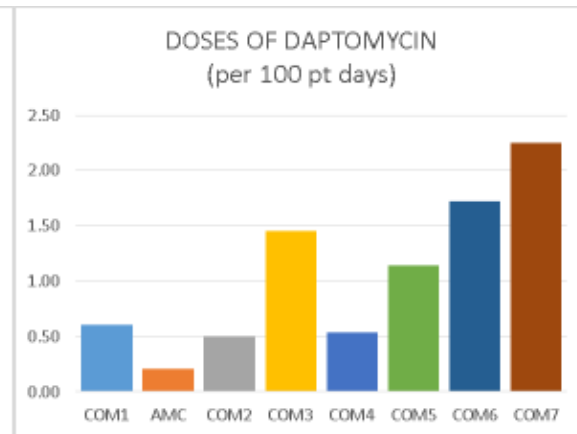
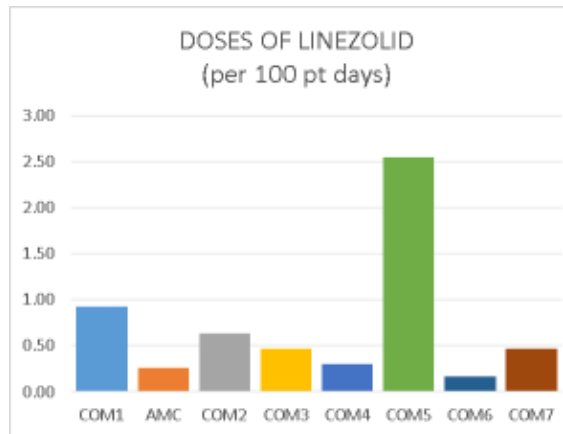


How were we doing?

\$58.7 M Drug Budget

Anti-infectives \$5.8M
(~10%)

AMC consistently out
performing community
hospitals



Model Development & Resource Needs

- Goal: Provide a robust ASP model across diverse Health System
- Meet TJC/CMS requirements of Antimicrobial Stewardship Program

CMS

- 0.1 FTE MD
- 0.25 FTE RP
- 0.05 FTE data
- /~124 beds

Echevarria et al.

- VA Hospitals
- 1.0 FTE RP
- /100 beds

Morris et al.

- 1 FTE MD
- 3 FTE RP
- 0.5 FTE Coord
- 0.4 FTE data
- /1000 beds

Doernburg et al.

- 0.56 FTE MD
- 1.69 FTE RP
- /501-1000

Medicare and Medicaid Programs; Hospital and Critical Access Hospital (CAH) Changes To Promote Innovation, Flexibility, and Improvement in Patient Care. (2016, June 16).

Echevarria, et al. *American Journal of Health-System Pharmacy*. 2017;74(21):1785-1790

Morris, et al. *Antimicrobial Resistance & Infection Control*. 2018;7(1)

Doernberg, et al. *Clinical Infectious Diseases*. 2018 Mar 26. [Epub ahead of print]

Model Development & Resource Needs

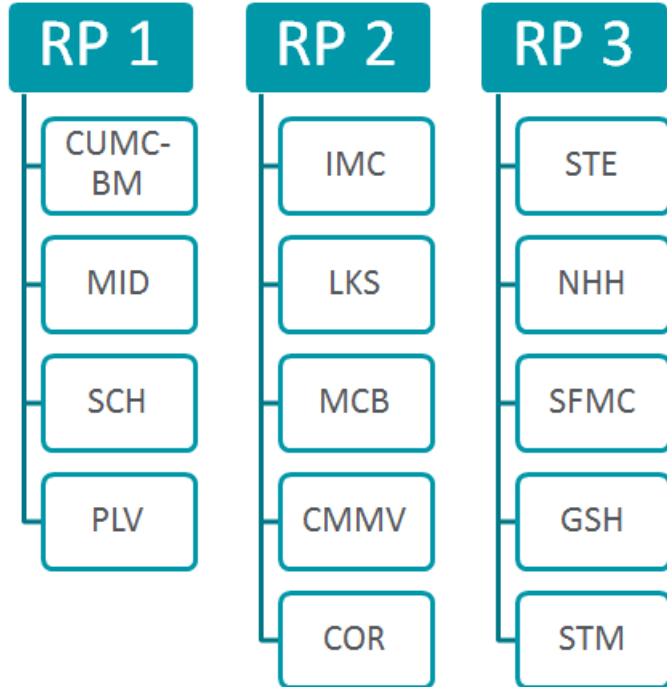
- Echevarria et al.
 - VA Health System staffing tool
 - Time breakdown - 70% Clinical & 30% program management activities
- Doernberg et al.
 - Each 0.50 increase in pharmacist and physician full-time equivalent support predicted a 1.48-fold increase in the odds of demonstrating effectiveness.
 - The effect was mediated by the ability to perform prospective audit and feedback.
 - Most programs noted significant barriers to success.

Think-Pair-Share

- **How consistent is your health system at providing quality Antimicrobial Stewardship (Prospective Audit & Feedback) across all facilities regardless of size/resources?**
- **How consistent do you provide quality ASP within your facility, are all units included, challenges, areas for opportunity?**
- **How do your current staffing grids compare to those recommended in literature?**

ID MD

Program Structure (900-1000 Average Daily Census)



- 0.5 FTE – ID physician
- 2.5 FTE – ID trained pharmacists
- PRN - Research/education pharmacist
- Facilities grouped by size and electronic medical record

Overall Workflow

- Antimicrobial stewardship pharmacists utilize various methods to identify patients for ASP review
- Daily stewardship rounds with ID physician to discuss more complicated patients
- Interventions and recommendations communicated to both providers and pharmacists involved in the patient's care

Think – Pair – Share

- **How do you identify patients that may benefit from antimicrobial stewardship intervention?**
- **What kind of clinical decision support tools are available?**

How to Identify Patients for ASP Review

- Use of clinical decision support software and electronic medical record
- Through other members of the healthcare team
 - Microbiology notification
 - Infection preventionists
 - By request from providers, too!

Clinical Decision Support Alerts

Clinical Pharmacist

- Pharmacokinetics
- IV to PO
- Renal dose adjustments
- Alternative dosing interchanges
- Appropriate use criteria
- High risk of *C. difficile*

ASP Pharmacist

- Positive cultures
- Broad-spectrum antimicrobials
- Redundant therapy
- >72 hr antimicrobial therapy

Common Reasons for ASP Review

- Disease state and/or positive culture
 - All positive blood cultures
 - Positive *C. difficile* results
 - Influenza
- Multi-drug resistant organisms
 - MRSA, VRE, ESBL, CRE

Common Reasons for ASP Review

- Targeted antimicrobials
 - Those with established appropriate use criteria (e.g. ertapenem, daptomycin, aztreonam)
 - Broad spectrum antibiotics
 - High cost agents
- Prolonged duration of therapy
 - 72hr timeout review

Clinical Decision Support Patient Identification

Alert

EZ Alert: NE- Positive Verigene Admit Diagnosis: ADULTGEN

Age: 83 years Sex: F
 SCr: 1.26 (09/25/2018) Height: 63 in (160 cm)
 CrCl: 38 mL/min(Cockcroft-Gault; weight used=72 kg) Weight: 225.7 lb (102.6 kg)

This patient matches the EZ Alert criteria: 'EZ Alert: NE- Positive Verigene'

Order/Culture	Result	Source	Collected	Result Status (Date/Time)
BLOOD CULTURE	ANAEROBIC POSITIVE for ESCHERICHIA COLI	BLOOD VP	09/24/2018 05:30	F (09/24/2018 19:53)

Medications
Lab Review
Microbiology Review

Alert

EZ Alert: NE- Positive Verigene Admit Diagnosis: INF LT FOOT WOUND

Age: 64 years Sex: F
 SCr: 3.1 (09/25/2018) Height: 68 in (173 cm)
 CrCl: 29 mL/min(Cockcroft-Gault; weight used=99 kg) Weight: 335.3 lb (152.4 kg)

This patient matches the EZ Alert criteria: 'EZ Alert: NE- Positive Verigene'

Order/Culture	Result	Source	Collected	Result Status (Date/Time)
BLOOD CULTURE	ANAEROBIC POSITIVE for Coagulase Negative Staphylococcus species	BLOOD PICC LINE	09/24/2018 03:50	F (09/25/2018 09:48)

Medications
Lab Review
Microbiology Review

EMR Patient Identification

☆ IMC 6WEST 18 Patients		Refreshed just now 🔄 Search All Admitted...															
Patient Name/Age/Sex	MRN	Unit	Room/Bed	AMS Score	Level of Care	CrCl	Days of Therapy - All Antibiotics	Discharge order signed?	Bug-Drug Mismatch	Drug-Lab Mismatch	De-escalation Opportunity	Duplicate Coverage	Duplicate Antipseudomomo Coverage	Antimicrobial IV to PO	Diet and Nourishme Orders	Antibiotic Medications	Attend Prov
		IMC 6WEST	6615/6615-01	●	PCU	9.3 mL/min	8	---	---	---	---	---	---	---	---	bacitracin 500 unit/gram ointment TID ceFAZolin (ANCEF) injection 1 g Daily	HALAT, A
		IMC 6WEST	6612/6612-01		Medical	109.5 mL/min	---	●	---	---	---	---	---	---	---	---	KORIPALLI, V
		IMC 6WEST	6602/6602-01	●	PCU	18.8 mL/min	4	---	---	---	---	---	---	---	Nutritio... Suppleme Nutritional Suppleme	cefTRIAxone (ROCEPHIN) injection 2 g Q24H	GADIRAJU, R
		IMC 6WEST	6608/6608-01	●	PCU	78.2 mL/min	2	---	---	---	---	---	---	---	---	cefTRIAxone (ROCEPHIN) injection 1 g Daily	DORWART, W
		IMC 6WEST	6601/6601-01		PINS Tele	57.2 mL/min	---	---	---	---	---	---	---	---	---	---	BUMGARN... B
		IMC 6WEST	6610/6610-01		Med/Surg Tele	184.1 mL/min	---	---	---	---	---	---	---	---	---	---	SINGH, S
		IMC 6WEST	6609/6609-01	●	PCU	<Unk... ideal weight>	3	---	---	---	---	---	---	---	---	vancomycin (VANCOICIN) 500 mg in sodium chloride 0.9 % 100 mL IVPB Q24H	KORIPALLI, V
		IMC 6WEST	6614/6614-01	●	Medical	---	6	---	---	---	---	---	---	●	Nutritio... Suppleme	levofLOXacin (LEVAQUIN) 750 mg/150 mL IVPB 750 mg Q24H	HALAT, A
		IMC 6WEST	6613/6613-01		PCU	9.1 mL/min	---	---	---	---	---	---	---	---	Diet General	---	DADA, M
		IMC 6WEST	6621/6621-01	●	Medical	24.5 mL/min	2	---	---	---	---	---	---	---	---	piperacilin-tazobactam (ZOSYN) 4.5 grams/NS 100ml Q8H vancomycin (VANCOICIN) 500 mg in sodium chloride 0.9 % 100 mL IVPB Q24H	HALAT, A
		IMC 6WEST	6619/6619-01	●	Medical	70.2 mL/min	2	---	---	---	---	---	---	---	---	vancomycin (VANCOICIN) 1,000 mg in sodium chloride 0.9 % 250 mL IVPB Q24H cefTRIAxone (ROCEPHIN) injection 2 g Q24H	BUMGARN... B
		IMC 6WEST	6603/6603-01		PCU	140.1 mL/min	---	---	---	---	---	---	---	---	---	azithromycin (ZITHROMAX) tablet Daily	RAPP JR, J
		IMC 6WEST	6607/6607-01		PCU	38.1 mL/min	---	---	---	---	---	---	---	---	---	---	RAPP JR, J
		IMC 6WEST	6616/6616-01		PCU	---	---	---	---	---	---	---	---	---	Nutritio... Suppleme	---	STEIER, N
		IMC 6WEST	6606/6606-01		Medical	75.5 mL/min	---	---	---	---	---	---	---	---	Nutritio... Suppleme	---	BUMGARN... B

EMR Patient Identification

Search Medication Orders Report ? Close X

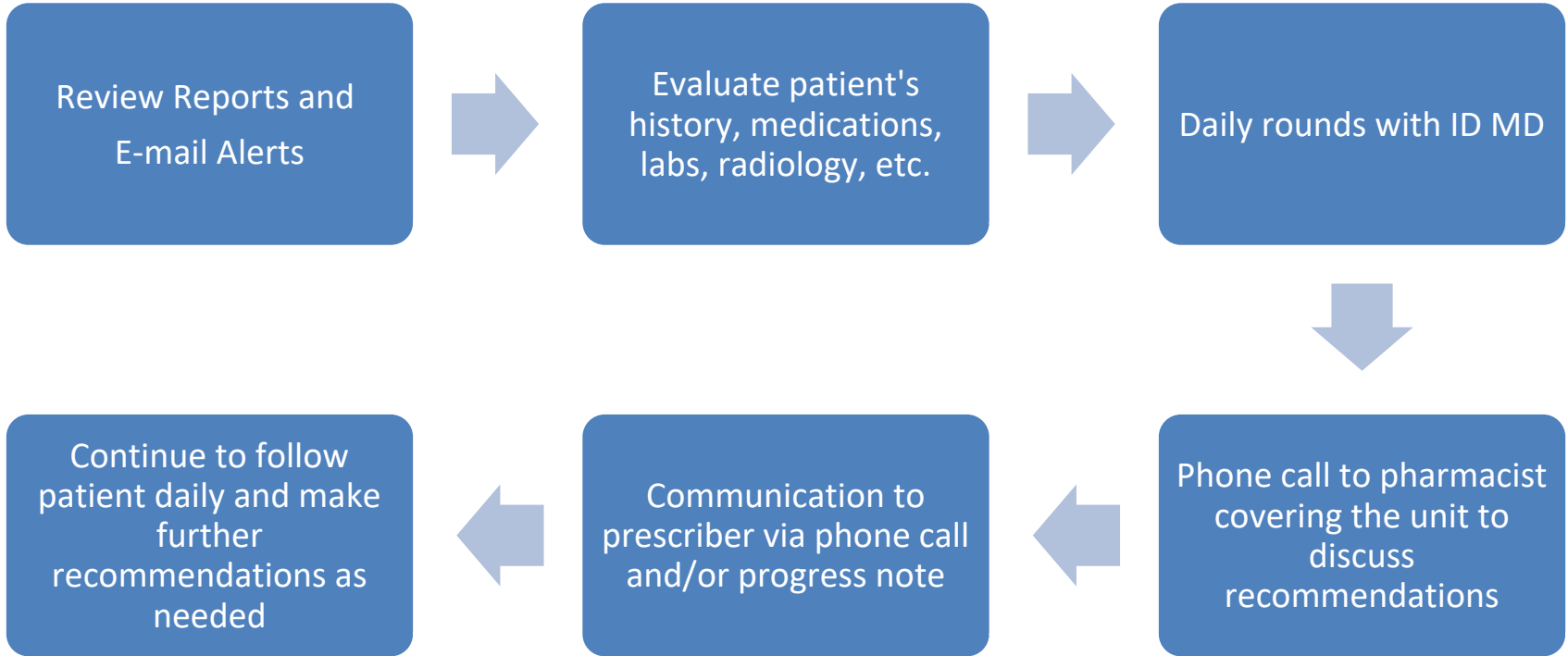
Patients on any of the following medications: Showing active orders only

ERTAPENEM 1 GRAM/NS 50 ML
 DAPTOMYCIN I/PB
 DAPTOMYCIN 500 MG INTRAVENOUS SOLUTION
 DAPTOMYCIN 500 MG INTRAVENOUS SOLUTION
 LINEZOLID 600 MG TABLET
 LINEZOLID IN 5% DEXTROSE IN WATER 600 MG/300 ML INTRAVENOUS PIGGYBACK
 MEROPENEM (MERREM) I/PB IN 50 ML NS
 MEROPENEM 1 G IN NS 100 ML - P/YX5
 GENTAMICIN 40 MG/ML INJECTION SOLUTION
 CEFTOLOXANE-TAZOBACTAM 1.5 GRAM INTRAVENOUS SOLUTION
 MICAFUNGIN I/PB
 FLUCONAZOLE 200 MG TABLET
 CEFTAROLINE I/PB ACH
 POSACONAZOLE 300 MG/16.7 ML INTRAVENOUS SOLUTION
 POSACONAZOLE 100 MG TABLET DELAYED RELEASE
 POSACONAZOLE 200 MG/5 ML (40 MG/ML) ORAL SUSPENSION
 AZTREONAM 1 GRAM SOLUTION FOR INJECTION
 AZTREONAM 2 GRAM SOLUTION FOR INJECTION
 VORICONAZOLE 200 MG TABLET
 VORICONAZOLE 100 MG TABLET
 VORICONAZOLE 50 MG TABLET
 ADI/CLOVIR SODIUM 50 MG/ML INTRAVENOUS SOLUTION
 AMPHOTERICIN B 50 MG SOLUTION FOR INJECTION
 AMPHOTERICIN B LIPOSOME 50 MG INTRAVENOUS SUSPENSION
 ERTAPENEM 1 GRAM SOLUTION FOR INJECTION
 MEROPENEM 500 MG INTRAVENOUS SOLUTION
 OSELTAMIVIR 75 MG CAPSULE
 OSELTAMIVIR 45 MG CAPSULE
 OSELTAMIVIR 30 MG CAPSULE
 OSELTAMIVIR 6 MG/ML ORAL SUSPENSION
 GANCICLOVIR SODIUM 500 MG INTRAVENOUS SOLUTION
 FLUCONAZOLE 400 MG/200 ML IN DEXTROSE (50-OSM) INTRAVENOUS PIGGYBACK
 FLUCONAZOLE 200 MG/100 ML IN SOD. CHLORIDE(ISO) INTRAVENOUS PIGGYBACK
 FLUCONAZOLE 40 MG/ML ORAL SUSPENSION
 PERAMIVIR (PF) 200 MG/20 ML (10 MG/ML) INTRAVENOUS SOLUTION
 MEROPENEM 500 MG/50 ML IN 0.9% SODIUM CHLORIDE INTRAVENOUS PIGGYBACK
 MEROPENEM 2 GRAM IN NS 100 ML ACH
 FIDAXOMICIN 200 MG TABLET
 FLUCONAZOLE 100 MG TABLET

IMC 1REHAB					IMC1REH-IMC1R17-1R17-01
	fluconazole (DIFLUGAN) tablet [164520667]	100 mg, Oral, Daily, starting 09/26/18 0900, ending after 14 doses, ending 10/10/18 0559	Active		⁵ Order Hx
IMC 4ICU					IMC4ICU-IMC4455-4455-01
	ertapenem (IRVance) 1 g in 50 mL NS [164623595]	1 g, Intra/VEous, Every 24 hours interval, 100 mL/hr over 30 Minutes, starting 09/24/18 1300	Active		⁵ Order Hx
IMC 6WEST					IMC6W-IMC6617-6617-01
	meropenem (MERREM) injection 0.5 g [164697777]	0.5 g, Intra/VEous, Every 6 hours interval, starting 09/24/18 1000	Active		⁵ Order Hx
IMC 7EAST					IMC7E-IMC7739-7739-01
	daptomycin (CUBICIN) 700 mg in sodium chloride 114 mL I/PB [164737223]	700 mg, Intra/VEous, Every 24 hours interval, 228 mL/hr over 30 Minutes, starting 09/24/18 1200	Active		⁵ Order Hx

Settings Close

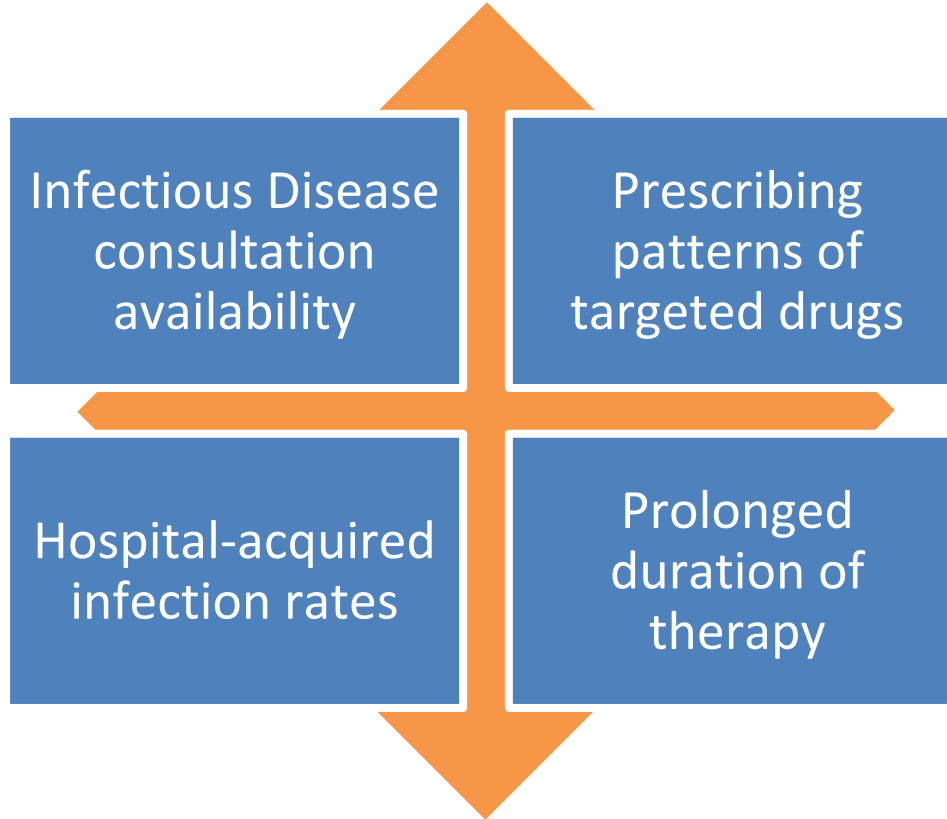
Workflow Example



How Do Our Daily Activities Help Meet The Joint Commission Requirements?

- Leaders establish ASP as an organizational priority
- Education of providers
- Multidisciplinary team
- Core elements
- Organization approved multidisciplinary protocols
- Collect, analyze, and report data
- Take action on improvement opportunities

Identifying Facility-Specific Needs



Hospital# 1

- No ID consultation available
- ASP reviews most complicated disease states and follows daily to provide recommendations

Hospital#2

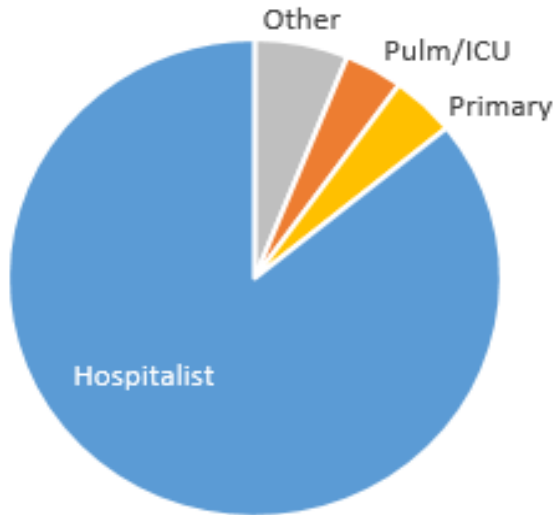
- Highest rate of hospital-acquired *C. difficile* in the division
- ASP focused efforts to reduce the use of unnecessary empiric broad-spectrum antibiotics

Hospital#3

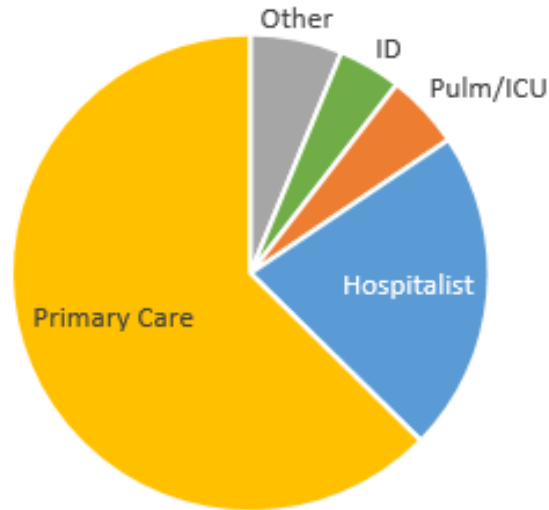
- Often de-escalated appropriately, but continued for prolonged duration
- Educating providers about guideline recommendations for DOT and following up on antibiotic stop-dates

Different Provider Mix

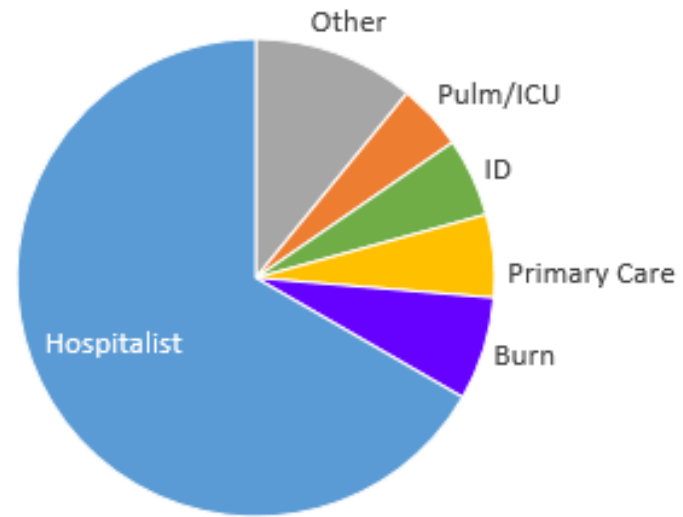
Hospital #1



Hospital #2



Hospital #3



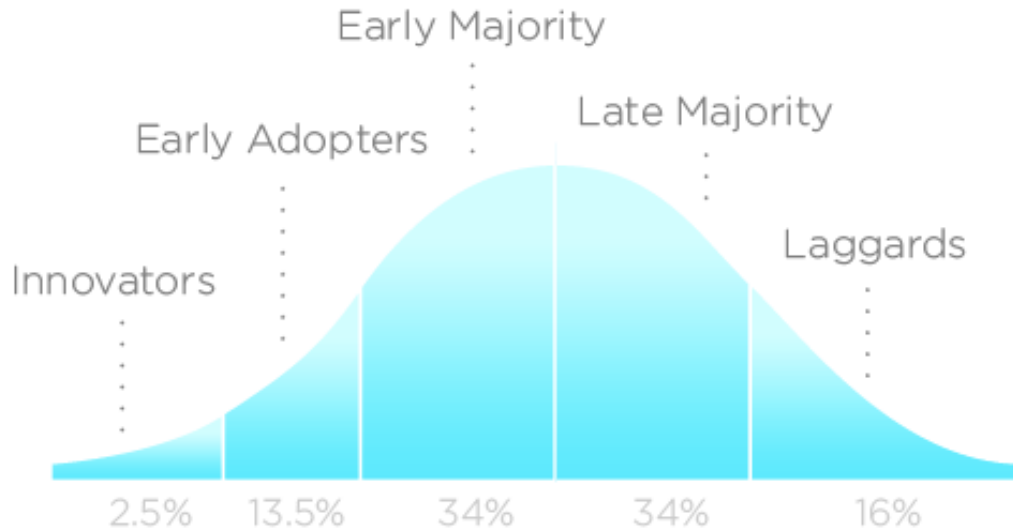
Think – Pair – Share

- **What are some of the challenges of implementing programs at remote sites which you may visit rarely/ever?**
- **What are some strategies that have made (or you believe would make) you successful in accomplishing this?**

Overcoming the Distance

- Keep communication open and visit often!
- Designate local physician and pharmacy champions
- Share ongoing antimicrobial stewardship initiatives at the local level
- Prepare regular reports to share with key stakeholders
- Provide educational presentations

Behavior Change Methodology as a Core Competency for ASP Programs



INNOVATION ADOPTION LIFECYCLE

Rare - Theory of Change

- 350 conservation "Pride campaigns" in 56 countries, having impacted 10 million people
- Solutions that are local and create a collective will in favor of conservation

KNOWLEDGE

What knowledge is needed to increase awareness and help shift attitudes?



ATTITUDE

What attitudes must shift for these conversations to happen?



INTERPERSONAL COMMUNICATION

What conversations are needed to encourage people to adopt the new behavior?



BARRIER REMOVAL

What are the barriers to adoption of the new behavior we want to see, and how can we remove them?



BEHAVIOR CHANGE

What behaviors for which group(s) must change in order to reduce this threat?



THREAT REDUCTION

What threat needs to be reduced in order to achieve your conservation result?



CONSERVATION RESULT

What is the desired conservation result, and when will it be achieved?



Provider Approaches Must be Adaptive

- Antimicrobials are the "drugs of fear"
- Providers need to emotionally connect with global ASP objectives
- Varied root causes for overprescribing
 - Uncomfortable with ID problems and antimicrobials
 - Inattentive to daily process of de-escalation/discontinuation
 - Reference their "long clinical experience" or prior institutional practices often
 - Disengaged or belligerent towards stewardship goals and personnel
- Be self-reflective in your communications

Think – Pair – Share

"How can I ensure that you don't make any recommendations on my patients in the future?"

CHI Health Criteria for Appropriate Use Policy

- Criteria for use developed for: aztreonam, ceftazidime/avibactam, ceftolozane/tazobactam, daptomycin, and ertapenem
- 24/7 enforcement across all CHI Health facilities
- These antibiotics were chosen:
 - Known suboptimal prescribing practices
 - Pre-existing criteria not being enforced
 - Definable criteria for use relatively straightforward
 - High-risk for impactful resistance development and superinfection
- Our goals:
 - Establish a process for appropriate use that can be expanded in the future
 - Develop a collective ownership of stewardship goals amongst all providers and clinical pharmacists

CHI Health Criteria for Appropriate Use Policy

- Procedure
 - Pharmacist closest to the bedside is responsible for evaluating appropriateness and contacting provider, if outside scope
 - Order is not processed until criteria have been assessed and documented. ASP pharmacists available for assistance once initial review is completed.
- Pharmacist Education
 - Provide criteria for use with specific clinical examples, common alternatives, scripting for provider communications, and documentation templates
 - Live in-service presentations for each site with Q&A opportunity
 - Prior to go-live, online competency assessment
 - Emphasize empowerment, available support from ASP, and accountability

CHI Health Criteria for Appropriate Use Policy

- Implementation
 - Requests frequent initially
 - E-mail reminders for missed evaluation and/or documentation
 - Focus of post-prescription review
- Initial Results (Omaha)
 - 2nd to 3rd Quarter of full ASP implementation
 - Aztreonam usage down **57%-94%**
 - Attention to PCN allergy evaluation
 - Cost savings - \$12,200
 - Single quarter for four hospitals

Clinical pharmacists developing collective ownership and pride for a stewardship process and outcome

AHRQ Safety Program for Improving Antibiotic Use

PREVENT HAIs
Healthcare Associated Infections

AHRQ
Agency for Healthcare Research and Quality

CUSP

Home FAQ Contact Us Join the Program Login

AHRQ Safety Program for Improving Antibiotic Use

Follow a Comprehensive Safety Approach to Reduce Harm Associated with Antibiotic Use

[Join the Program](#)

The AHRQ Safety Program for Improving Antibiotic Use: A National Program for Antibiotic Stewardship

The Agency for Healthcare Research and Quality (AHRQ), in conjunction with the Johns Hopkins Medicine Armstrong Institute for Patient Safety and Quality and NORC at The University of Chicago, created the AHRQ Safety Program for Improving Antibiotic Use to develop and implement a bundle of interventions designed to improve antibiotic stewardship and antibiotic prescribing practices across acute care, long-term care, and ambulatory care facilities across the United States.

Antibiotics are a precious resource and can be critical for improving the outcomes of patients with serious infections. However, antibiotics also have the potential to cause patient harm, including allergic reactions, *Clostridium difficile* infections, and antibiotic resistance both at the individual patient level and for society as a whole. We want antibiotics to be effective for future generations, and that is only possible if we use antibiotics judiciously.

Long-term Care Facilities

- [Learn About Participating](#)
- [Program Team](#)
- [Coming soon... Continuing Education Credits](#)
- [Science of Safety Video](#)
- [AHRQ Privacy Policy Notice](#)

AHRQ Safety Program for Improving Antibiotic Use

- Statement of administrative/institutional support
- Structured daily patient review
- Monthly webinars on practical and clinical ASP topics
- Monthly "office hours" conference calls with clinical leads
- Monthly check-in calls with program coordinators
- Clinical templates, brief topic reviews, and promotional materials
- Quarterly antimicrobial usage and *C. difficile* incidence data evaluation

AHRQ Safety Program for Improving Antibiotic Use

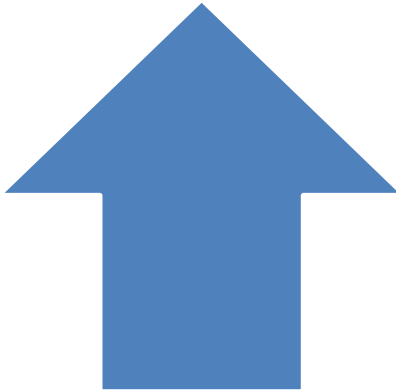
- Enrolled the Hospitalist service at a single CHI Health hospital
 - Visibility for new stewardship program within the institution
 - Set rounding expectations and formalize ASP clinical evaluation process
 - Improve provider topic area clinical knowledge
 - Obtain preliminary benchmarking data on antimicrobial use

**Providers developing collective ownership and pride
for a stewardship process and outcome**

Behavior Change is an Ongoing (Never-ending!) Process

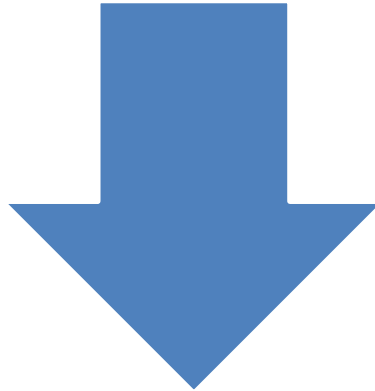
- Reversion to "wild type" applies with clinicians as well as microbes...
- Implementation of an ASP program in 2001, and was active 2002-2008
 - Yearly antimicrobial expenditures averaged a 31% decrease from baseline (\$2.4 million)
- ASP program was terminated in 2009
 - Within 2 years antimicrobial expenditures had **increased by \$1.5 million**

Program Results



Total Drug Budget

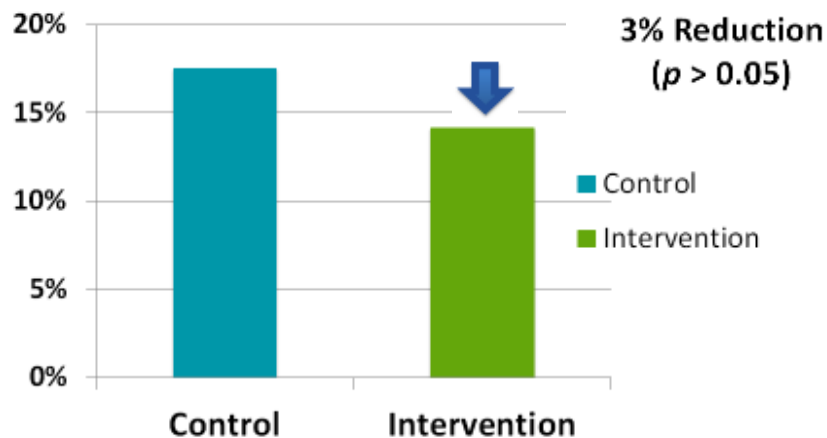
- \$58.7M → \$61.7 M → \$66.5 M



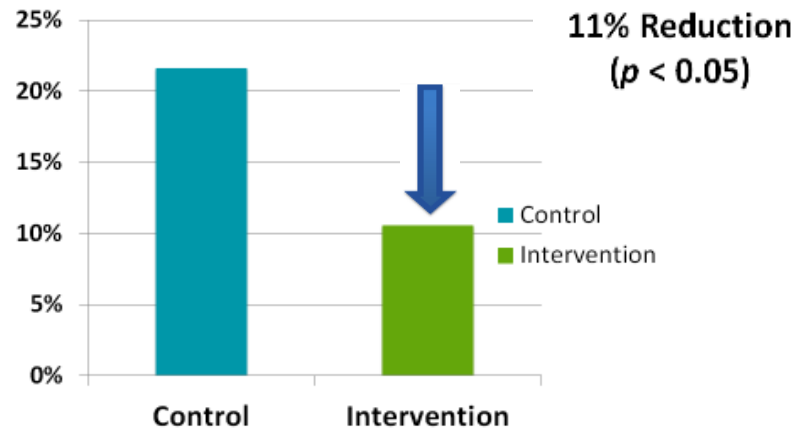
Anti-infective Spend

- \$5.9M → \$5.6M → \$4.4 M
- 21% reduction in year 1

Clostridium Difficile Infection 30-Day Readmission

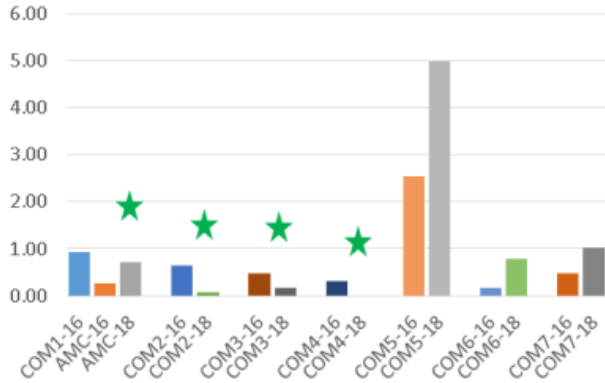


30-Day CDR Rates for
Healthcare System

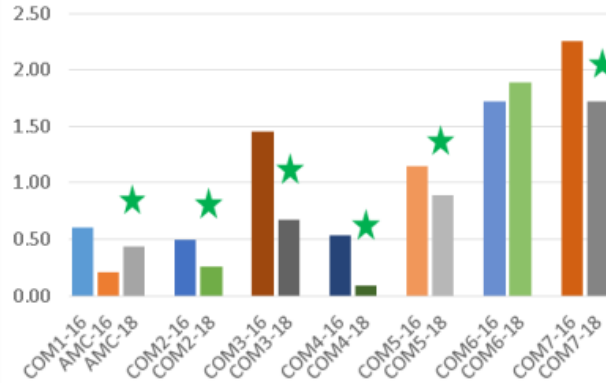


30-Day CDR Rate for AMC

DOSES OF LINEZOLID
(per 100 pt days)

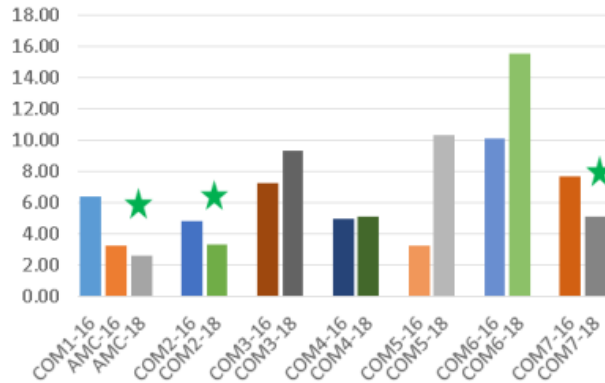


DOSES OF DAPTOMYCIN
(per 100 pt days)

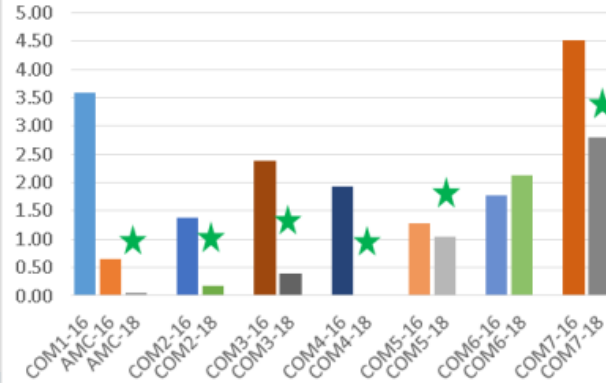


★ Shows FY18 improved over FY16 baseline

DOSES OF MEROPENEM
(per 100 pt days)

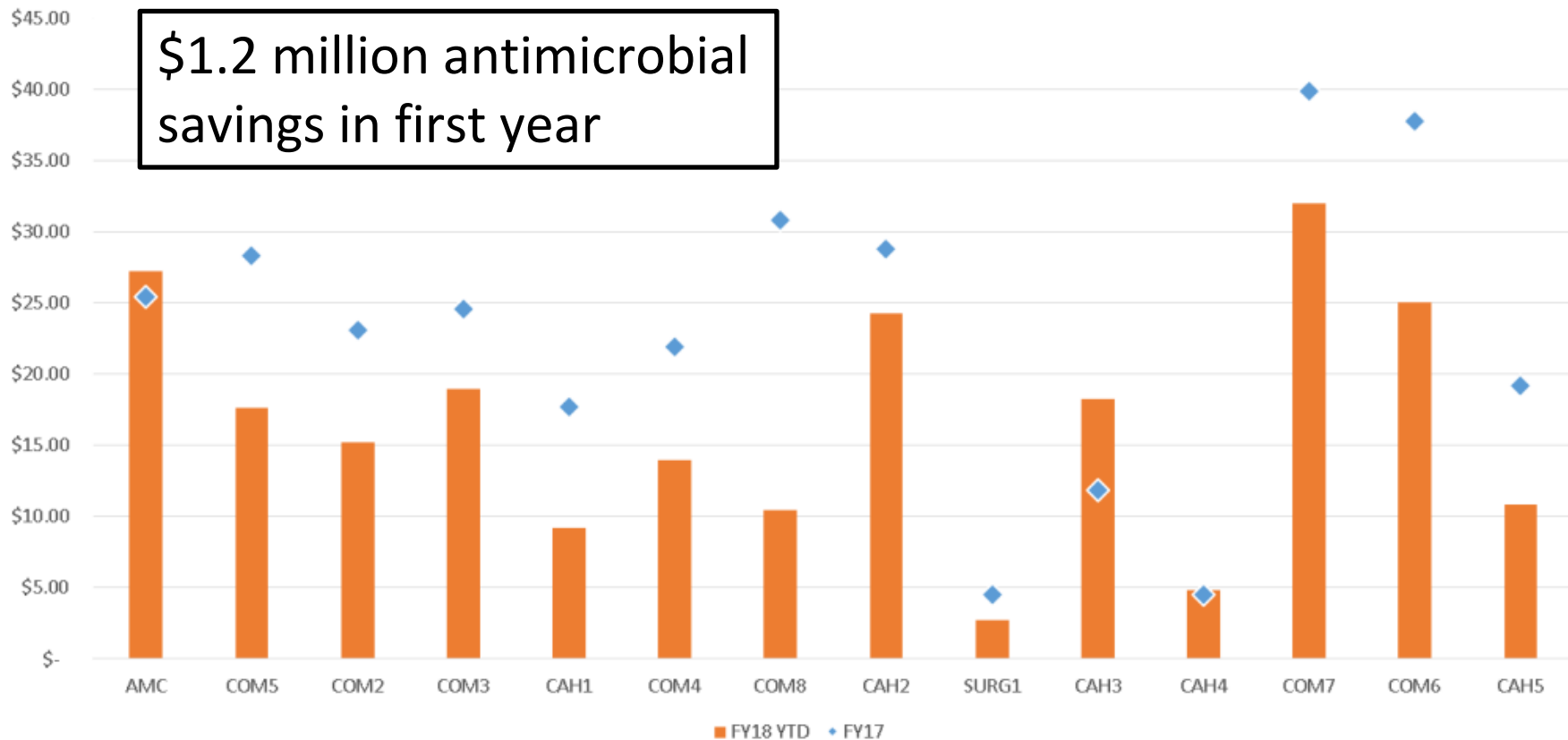


DOSES OF ERTAPENEM
(per 100 pt days)



Antibiotic Spend per CMI Adjusted Admission

\$1.2 million antimicrobial savings in first year



KEY TAKEAWAYS

- 1) DEDICATED ANTIMICROBIAL STEWARDSHIP RESOURCES DEPLOYED ACROSS MULTIPLE FACILITIES CAN IMPROVE PROGRAM OUTCOMES**
- 2) CLINICAL DECISION SUPPORT ALERTS COMBINED WITH PROSPECTIVE AUDIT WITH FEEDBACK INTERVENTIONS CAN OPTIMIZE PATIENT OUTCOMES AND REDUCE ANTIMICROBIAL EXPENDITURES**
- 3) COLLECT AVAILABLE DATA ENDPOINTS TO DETERMINE PROGRAM EFFECTIVENESS AND SPECIFIC FACILITY NEEDS**

Antimicrobial Stewardship Team



ACKNOWLEDGEMENTS & CONTACT INFO

ASP TEAM MEMBERS

- Renuga Vivekanandan, MD
- Jennifer Anthone, Pharm.D.
- Christopher Destache, Pharm.D.

LEADERSHIP TEAM

- Michael Tiesi, RP, VP Pharmacy
- Gary Gorby, MD, ID-Chair
- Cary Ward, MD, CMO
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