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Clinical Meeting & Exhibition

JACKPOT! Integration of Information Technology and Antimicrobial Stewardship

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VA HEALTH CARE Defining EXCELLENCE in the 21st Century

Disclosure

- The program chair and presenters for this continuing education activity have reported no relevant financial relationships.

…You want me to add on Antimicrobial Stewardship to my to-do list?

Describe the institution where you primarily practice

A. Large academic medical center (≥600 beds)
B. Medium-sized academic medical center (400-600 beds)
C. Community hospital, part of a health-system (200-400 beds)
D. Community hospital, not part of a health-system (200-400 beds)
E. Community hospital with ≤200 beds
F. Specialty Hospital
G. Government-based facility (i.e., Veterans Affairs)

Who is part of ASP at your institution?

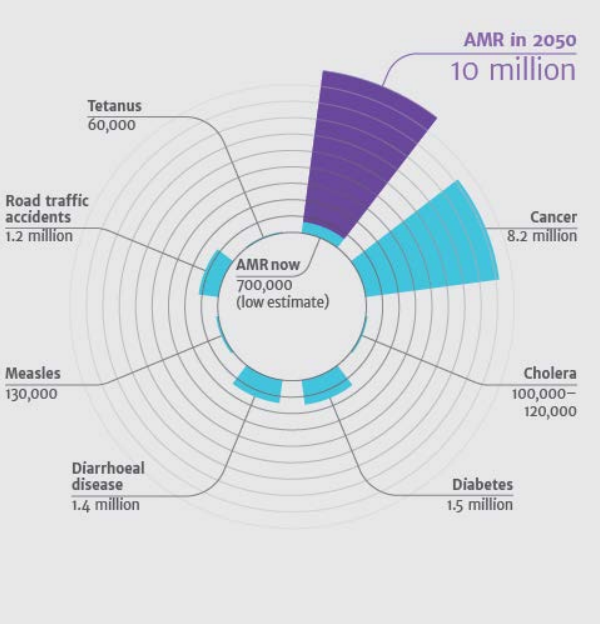
A. Infectious diseases-trained pharmacist only
B. Infectious diseases physician only
C. Infectious diseases physician **and** pharmacist
D. Non-infectious diseases trained pharmacist only
E. Non-infectious diseases trained physician only
F. Non-infectious diseases trained physician **and** pharmacist
G. Other
H. We do not have an ASP at this time

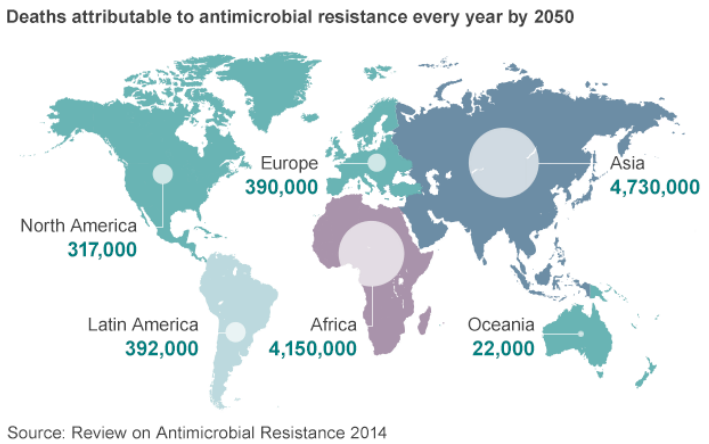
Learning Objectives

- Explain the importance of information technology in antimicrobial stewardship programs
- Evaluate three ways to integrate information technology into antimicrobial stewardship programs
- Describe methods of measuring antimicrobial outcomes using information technology

Antibiotic Resistance: An Ongoing Threat

- World Health Organization: 1 of 3 greatest threats to human health
- Centers for Disease Control and Prevention (2013):
  - >2 million illnesses, >23,000 deaths due to drug resistant bacteria





Antimicrobial resistance: tackling a crisis for the health and wealth of nations. [online]. Retrieved on 2016 March 25. from: http://amr-review.org

Dellit TH, et al. *Clin Infect Dis* 2007: 44 (15 January): 159-77
CDC: Antibiotic Resistance threats in the United States, 2013. [Online]. Retrieved on 26 Sept 2016 from, http://www.cdc.gov/drugresistance/pdf/ar-threats-2013-508.pdf

Antibiotic Resistance: An Ongoing Threat

- "There may be a danger, though, in underdosage. It is not difficult to make microbes resistant to penicillin in the laboratory…" – Sir Alexander Fleming, Nobel Lecture, 1945

- Today: Drug resistance + limited pipeline of antibiotics =

POST-ANTIBIOTIC ERA

UNLESS, we do something about it...

Alexander Fleming Nobel Lecture: Penicillin. [Online]. Retrieved on 26 Sept 2016 from, https://www.nobelprize.org/nobel_prizes/medicine/laureates/1945/fleming-lecture.pdf

Antimicrobial Stewardship Programs

- ~50% of prescribed antibiotics = unnecessary or inappropriate
- ASPs improve antibiotic use
  - ↑ patient outcomes, ↓ unintended consequences
- Cost savings of $200,000 - $900,000 at larger hospitals

File TM, et al. *Clin Infect Dis* 2014 (suppl 3): S93-S100
Barlam TF, et al. *Clin Infect Dis* 2016. 62(10): e51-77.

Antimicrobial Stewardship Programs

- Need for ASPs recognized nationally
  - National Action Plan for Combating Antibiotic Resistant Bacteria
  - Centers for Disease Control and Prevention
  - Joint Commission medication management standard
  - Centers for Medicare and Medicaid Services proposed conditions of participation

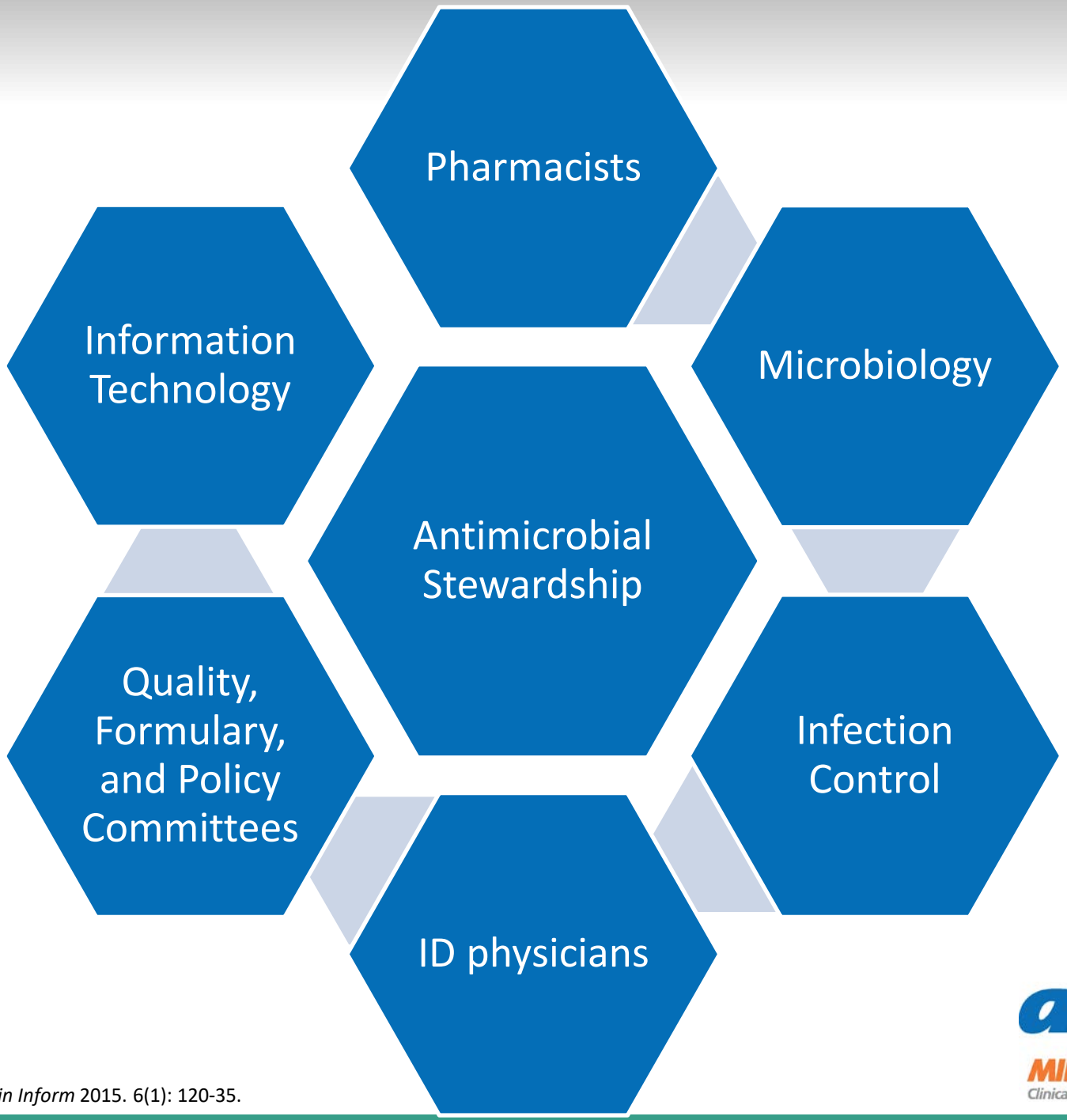
What are key components that make up an Antimicrobial Stewardship Program?

Antimicrobial Stewardship Programs

- Preauthorization or prospective audit with feedback intervention
- Antimicrobial restrictions
- Institutional guidelines
- Order sets
- Pharmacokinetic services
- Intravenous to oral conversions
- Allergy reconciliation
- Therapy duration limitation
- Antibiogram development
- Microbiology reporting optimization

Barlam TF, et al. *Clin Infect Dis* 2016. 62(10): e51-77.

Who are the core members that make up Antimicrobial Stewardship Program teams?



Evans RS, et al. *Appl Clin Inform* 2015. 6(1): 120-35.

“For ASPs to be optimized fully and truly make a viable long-term impact on patient outcomes, information technology (IT) must be employed.”

Kullar R, et al. *Clin Infect Dis* 2013. 57(7): 1005-13.

Information Technology

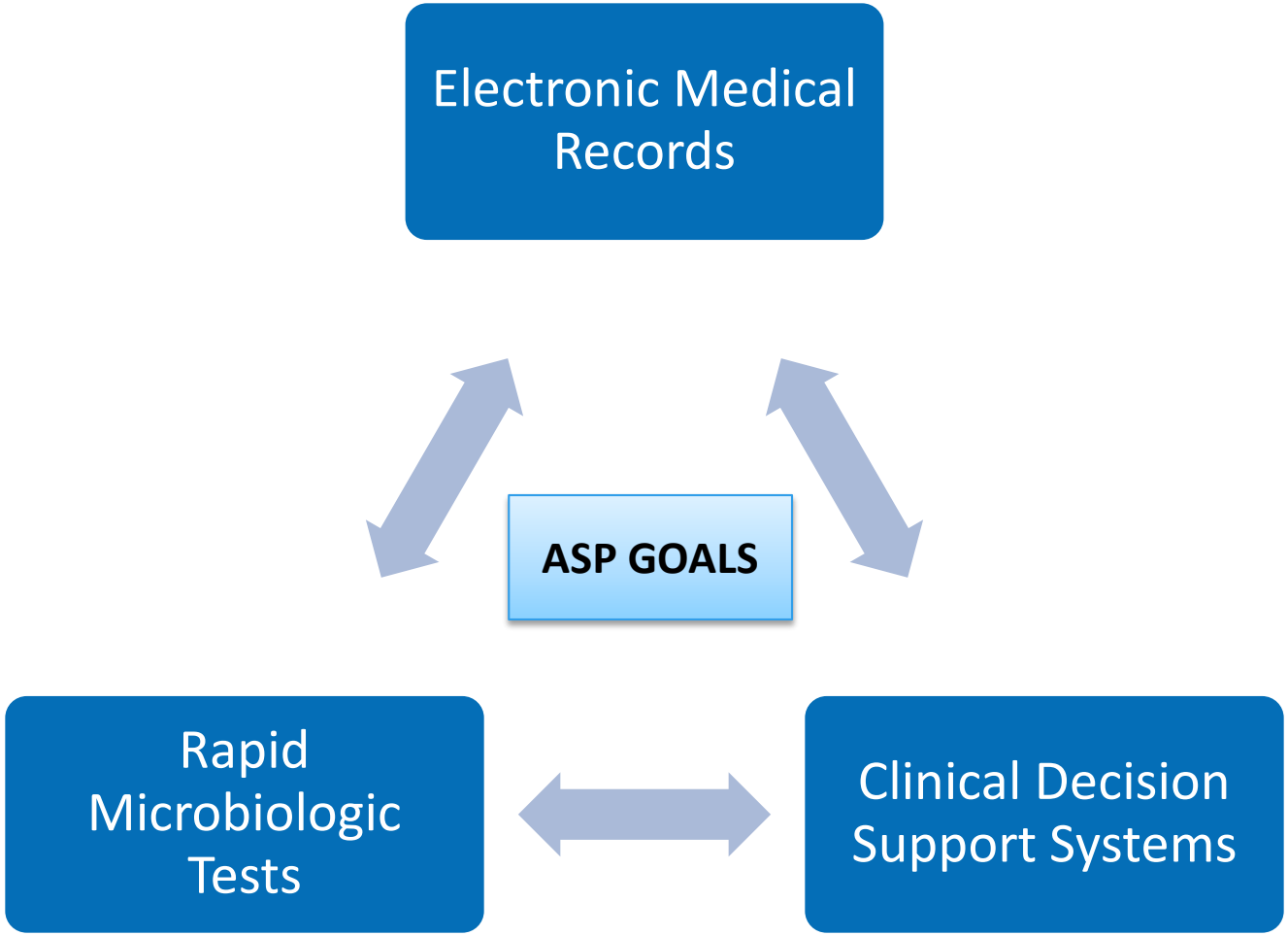
- Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009
  - Financial incentives to qualified institutions
- Institute of Medicine has identified electronic medical record functions needed to improve patient care

Forrest GN, et al. *Clin Infect Dis* 2014 (suppl 3): S122-S133.

What information technology does your Antimicrobial Stewardship Program have to support initiatives and goals?

A. Electronic Medical Records
B. Clinical Decision Support Systems
C. Rapid Microbiologic Tests
D. More than one form of technology
E. None at this time

Information Technology in ASPs



Electronic Medical Records (EMR)

Does your institution have an EMR?

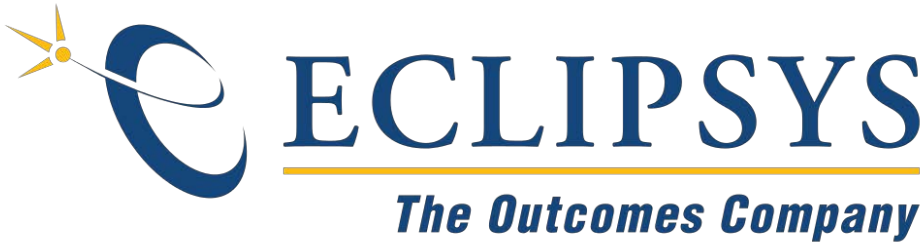
A. Yes
B. No

Which EMR System Does Your Facility Use?

A. Cerner®
B. Epic®
C. All Scripts™
D. CPRS®
E. Other
F. We are still using paper charts

Various EMR Systems

Empowering Healthcare



Importance of EMR

- Promote appropriate antimicrobial use
- Efficient review of all patient data
  - Helps provide greater impact on inappropriate use
- Facilitates promotion of patient care
- Limited data on clinical outcomes and antimicrobial use with EMR alone
  - Coupled with CDSS ➔ improved clinical care and patient outcomes

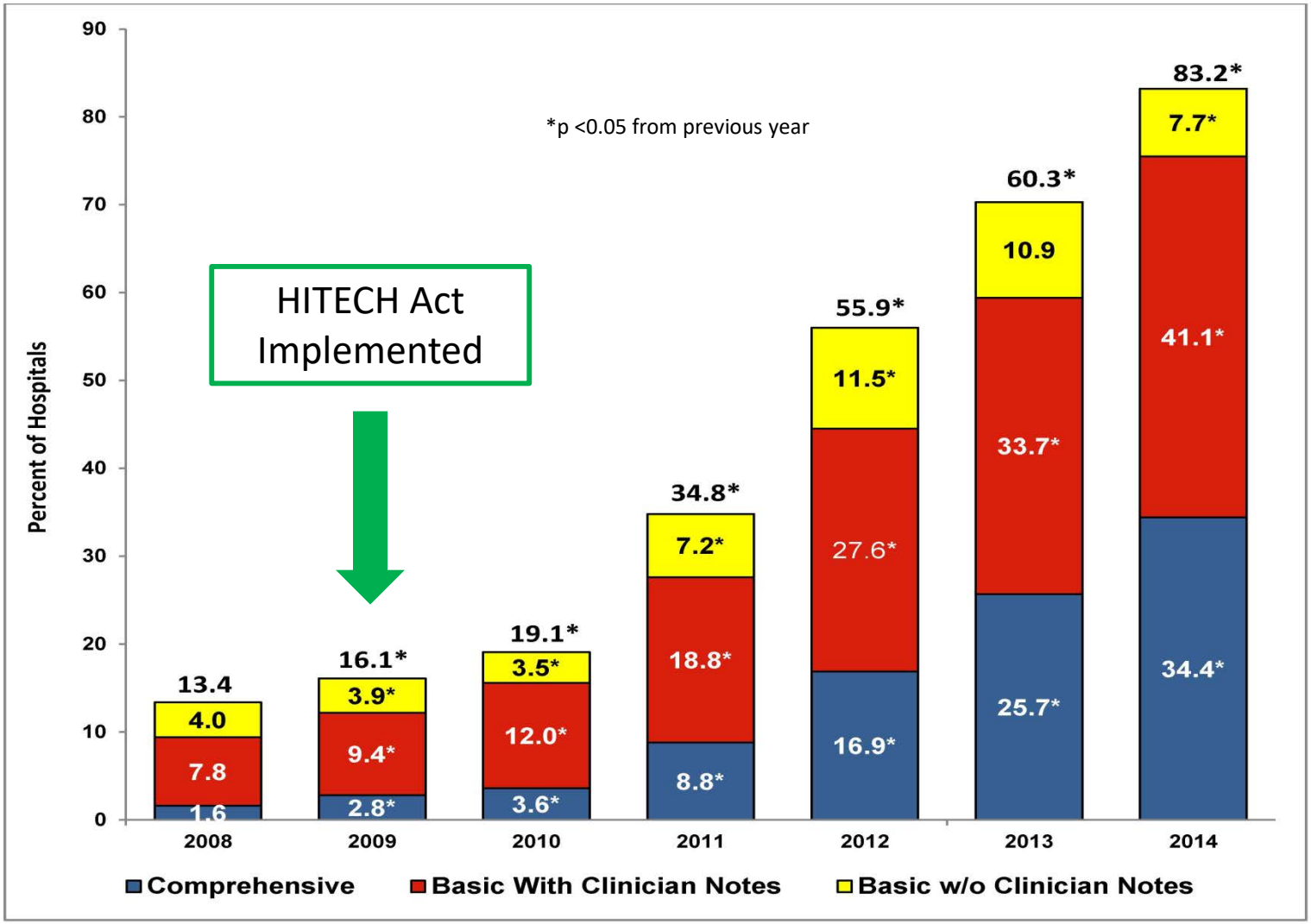
Kullar R et al. *Clin Infect Dis* 2013;57(7):1005-13
Forrest GN et al. *Clin Infect Dis* 2014;59(S3):S122-33

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

- Through the use of EMRs, ASP can aid in:
  - Prospective audit and feedback
  - Antibiotic preauthorization/formulary restrictions
  - Guidelines and clinical pathways
  - De-escalation of therapy

Trends in Adoption of EMR



Adoption of electronic health records systems among US Non-Federal Acute Acre Hospitals: 2008-2014. [Online]. Retrieved 1 Sept 2016 from, https://www.healthit.gov/sites/default/files/data-brief/2014HospitalAdoptionDataBrief.pdf

ASP Activities in EMRs

- Antibiotic order forms

	Prompt	Answer
1.	[DAPTOmycin] Indication	Prophylaxis-Surgical | Prophylaxis- Medical | Non-infectious | Infection-Documented | Infection-Suspected
2.	[DAPTOmycin] Site (select all that apply)	Abdominal/Pelvic | Bloodstream | Burn | Cellulitis | HEENT | IV Line | Lower RTI | Meningitis | Musculoskeletal | Neutropenic Fever | Surgical Wound | URI | UTI | Non-infectious | Transplanted Organ
3.	[DAPTOmycin] Cultures Ordered (Y/N)	Yes | No
4.	[DAPTOmycin] Type of Therapy	New Therapy | Modification of Therapy | Change Route of Therapy | Continuation of Therapy
5.	[DAPTOmycin] Coverage (select all that apply)	Anaerobes | Enteric GNR | Enterococcus, Not VRE | Enterococcus VRE | Mycobacteria | Pseudomonas aeruginosa | Staph, Beta-Lactam Susceptible | Staph, Methicillin Resistant | Streptococcus-Penicillin Susceptible | Streptococcus-Penicillin Resistant | Non-infectious | Methicillin-resistant CoNS | Organism NOS
6.	[DAPTOmycin] Authorizing ID provider/protocol. (From 23-07, the pharmacy may dispense a bridging quantity to initiate therapy until 1200)	

- Dosing alerts

Type/Significance	Description	Override Reason/Comment
N/A		New (1)
Dose Single	vancomycin, 10,000 mg, Intravenous, ONCE Single dose 10,000 mg. OVERDOSE (max. 3,267 mg) vancomycin (VANCOCIN) 10,000 mg in dextrose 5 % 500 mL bag Remove	

Kullar R et al. *Clin Infect Dis* 2013;57(7):1005-13

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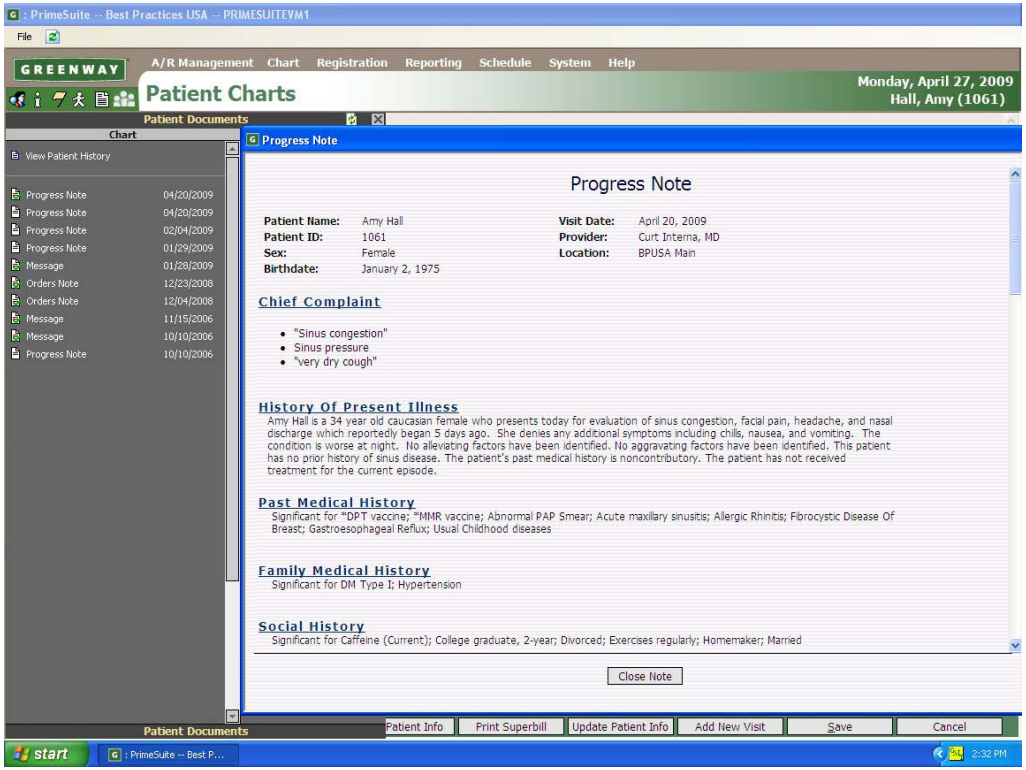
ASP Activities in EMRs

- Pharmacokinetic dosing
- Care pathways
- Order sets
- IV-to-PO interchange
- Best practice alerts
- Progress notes
- iVents*

*specific to Epic®



Dellit TH et al. *Clin Infect Dis* 2007;44:159-77

Kullar R et al. *Clin Infect Dis* 2013;57(7):1005-13

Image retrieved on 28 Sept 2016 from, http://www.mdsmedicalsoftware.com/wp-content/uploads/2012/12/progress-note.jpg

EMR is Just the Beginning…

- EMR primary focus is clinical, patient care functions (ex: EPIC®)
  - Limited decision support functions
    - Medication safety, patient/medication list, etc.
- Additional clinical decision support software (CDSS) can improve ASP functionality
- Major barrier to CDSS implementation => $$$

Dellit TH et al. *Clin Infect Dis* 2007;44:159-77
Kullar R et al. *Clin Infect Dis* 2013;57(7):1005-13

Open Discussion

- What ASP efforts have you implemented within your EMR?
- Name barriers to building ASP-related EMR initiatives. How did you successfully overcome these barriers?

ADD-ON CLINICAL DECISION SUPPORT SYSTEMS (CDSS)

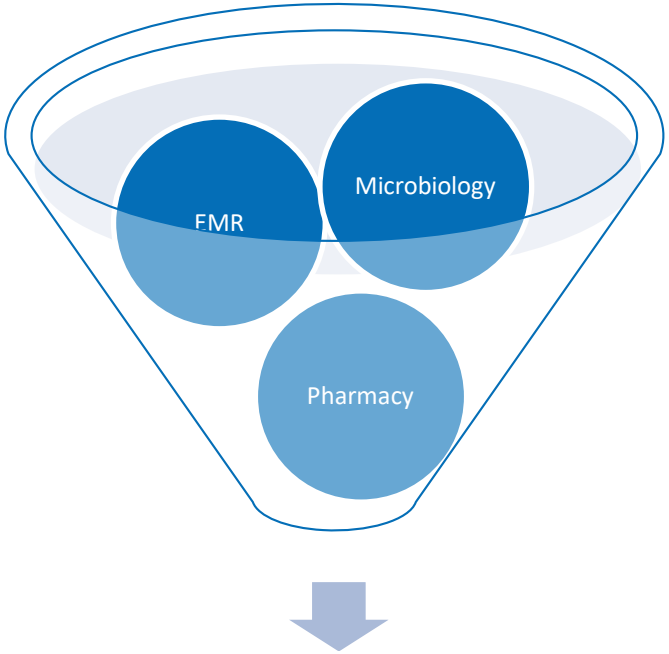
CDSS in ASP

- Patient data + population statistics + clinical guidance
- CDSS embedded in EMRs
  - Limited capabilities
- Add-on CDSS
  - "Software as a service" programs
  - Data collected from multiple sources
    - Pharmacy, microbiology
  - Robust case-finding and logic capabilities

Forrest GN, et al. *Clin Infect Dis* 2014 (suppl 3): S122-S133.

CDSS in ASP

- Automated, near real-time surveillance, alerting, analysis, reporting
- Integrates electronic and medical administration records
- Identify opportunities to decrease risk of adverse drug events, de-escalate, and optimize therapy



IDSA guidelines

- "We suggest incorporation of computerized clinical decision support at the time of prescribing into ASPs"
  (weak recommendation, moderate-quality evidence)

- CDSS can streamline work of ASPs, identifying opportunities for interventions

Barlam TF, et al. *Clin Infect Dis* 2016. 62(10): e51-77.

Capabilities of CDSS

- EMR integration
  - Clinical information
- Treatment guidelines
- Infection control software
- Institutional antibiograms
- Prescriber metrics
- Real-time, customizable alerts

Forrest GN, et al. *Clin Infect Dis* 2014 (suppl 3): S122-S133.

Third-Party CDSS Vendors

CDSS					
Vendor/ Features	TheraDoc®	SafetySurveillor®	QC PathFinder®	Sentri7®	MedMined®
EMR integration	✓		✓	✓	
Real-time alerts	✓	✓	✓	✓	✓
Delayed alerts		✓	✓	✓	✓
Customizable alerts	✓	✓	✓	✓	✓
Clinical information	✓	✓		✓	✓
Infection control	✓	✓	✓	✓	✓
Unit antibiogram	✓		✓	✓	✓
Prescriber metrics	✓	✓			✓
Other features	**Antibiotic assistant, pager/ email alerts**	**Training modules, cost justification letters**	**Pager/email alerts, pre-programmed customizable alerts**	**User-specific reports**	**E-mail alerts, clinical experts support team**

Forrest GN, et al. *Clin Infect Dis* 2014 (suppl 3): S122-S133.
Kullar R, et al. *Infect Dis Clin North Am* 2014. 28(2): 290-300.

Benefits of CDSS

Reductions in:

- Broad spectrum antibiotics
- Antibiotic resistance
- Prescribing errors
- Adverse events
- Mortality
- Antibiotic costs

Improvements in:

- Antibiotic dosing
- Appropriate antibiotic selection
- Efficiency of ASP initiatives

Barlam TF, et al. *Clin Infect Dis* 2016. 62(10): e51-77.
Calloway S, et al. *Hosp Pharm* 2013; 48(0): 1-9.

CDSS in ASP

- Nebraska Medical Center
- Post-implementation:

Influenza vaccination
Pneumococcal vaccination
Polyantimicrobials (3+ antibacterials)
Redundant anaerobic coverage
Drug-bug mismatch
Vancomycin for CoNS
Vancomycin for MSSA
No positive cultures

- 10,545 alerts, 30% of alerts actionable
- Increase in intervention attempts
  - 88% intervention acceptance rate

Hermsen ED, et al. *Infect Control Hosp Epidemiol* 2012. 33(4): 412-5.

CDSS in ASP

- Good Shepherd Medical Center, Texas
- Alerts sent via pager, e-mail

IV to PO conversion
ADR alert
Targeted drugs (i.e., piperacillin-tazobactam, daptomycin)
TAM: Susceptibility known, inpatient
TAM: No positive bacterial cultures
TAM: No positive fungal cultures
Renal function alert
Antibiotic level
Targeted organisms (*Pseudomonas*, quinolone-resistant; *Staphylococcus aureus*, resistant; *Enterococcus*, vancomycin resistant)

- Interventions documented within system
- Antibiogram development

Calloway S, et al. *Hosp Pharm* 2013; 48(0): 1-9.

CDSS in ASP

- Good Shepherd Medical Center, Texas
- 99% intervention acceptance rate
  - Increased from 1986 per month to 4065 per month
- Intervention cost calculator model:
  - Cost savings increased by 96% to $249,959/month

Calloway S, et al. *Hosp Pharm* 2013; 48(0): 1-9.

5 “Rights” of CDSS

- CDSS is not meant to replace clinical judgement, but to assist

RIGHT information

RIGHT people

RIGHT channels

RIGHT intervention formats

RIGHT points in workflow

Ehealth University: Centers for Medicare & Medicaid - Clinical Decision Support. [Online]. Retrieved from on 26 Sept 2016 from, https://www.cms.gov/regulations-and-guidance/legislation/EHRincentiveprograms/downloads/clinicaldecisionsupport_tipsheet-.pdf

Building Alerts

- Pre-built alerts vs. custom-built alerts
- Base alerts on institutional needs, available resources
  - Flexibility of ASP and alerts is key
- Alerts with high actionable intervention potential (pilot phase)
- Supportive of CDC, IDSA guidelines, and recommendations

Preauthorization: Does you institution restrict or regularly monitor use of antibiotics?

A. YES, all antimicrobials are restricted, none are monitored
B. YES, some antimicrobials are restricted, others are monitored
C. YES, no restricted antimicrobials, some are monitored
D. NO, we do not currently have antimicrobials restricted or monitored for use at our institution

Preauthorization: How do you ensure that restrictions are enforced and followed?

A. Daily antibiotic report print out/review
B. Customized Clinical Decision Support System alert
C. We currently do not track process compliance for restricted antimicrobials

Preauthorization

- CDSS with customizable **real-time** alerts when restricted or monitored antimicrobial ordered
  - Allows for active discussion by ASP member
    - Approval by ASP member was more effective than off-hour approval by ID fellows in:
      - Recommendation appropriateness
      - Cure rate
- Pertinent patient-related information found in CDSS summary

Barlam TF, et al. *Clin Infect Dis* 2016. 62(10): e51-77.

Prospective Audit and Feedback (PAF)

- Pre-built alerts
  - De-escalation of therapy after pre-specified duration
  - Reported (+)-cultures without antibiotics prescribed
  - Redundant antimicrobials (i.e., dual anti-anaerobic coverage)

- Customizable alerts
  - Microbe-drug mismatch
  - Specific de-escalation opportunities
  - Multi-drug resistant organisms on inappropriate therapy
  - Optimizing therapy (escalation of therapy)

Open Discussion

1) What de-escalation specific alerts have you built at your institution?

2) What other alerts have you built that would allow for PAF?

3) Name barriers you have encounter in using CDSS at your institution for ASP efforts. How did you successfully overcome these barriers?

Rapid Microbiologic Tests

Does Your Hospital Have Rapid Microbiologic Tests ?

A. Yes
B. No

Which Rapid Microbiologic Tests Does Your Hospital Use?

A. Verigene®
B. Gene Xpert®
C. MALDI-TOF
D. PNA-FISH® or *Quick*FISH™
E. FilmArray®
F. Light Cycler®
G. T2 *Candida*®
H. My hospital uses >1 of these tests
I. None at this time

Rapid Microbiologic Tests for Identification of Bloodstream Pathogens

Rapid Test	Pathogens Detected	Resistance Marker	Time
Verigene®	*S. aureus,* CoNS, *Streptococcus* spp., *Enterococcus* spp. (including VRE) Enterobacteriaceae, *P. aeruginosa*, *Acinetobacter* spp., *Listeria* spp.	*mecA, Van A, Van B* KPC, NDM, CTX-M, VIM, IMP, OXA	2 – 2.5 hr
Gene Xpert®	*S. aureus*	*mecA*	<1 hr
MALDI-TOF	Gram (+), Gram (-), yeast, fungi, mycobacteria	Under development	10-30 min

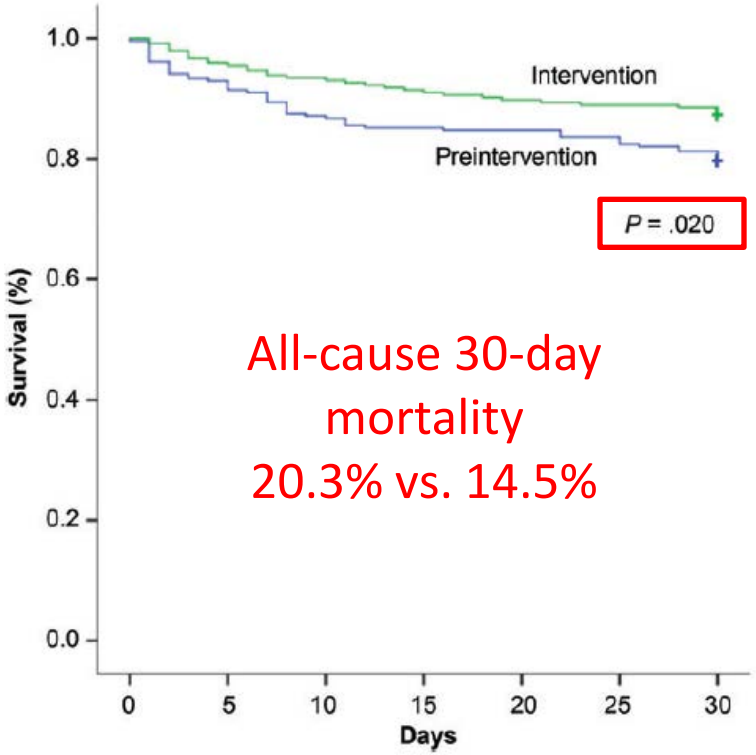
Kothari A, et al. *Clin Infect Dis* 2014;59(2):272-8

Rapid Microbiologic Tests for Identification of Bloodstream Pathogens

Rapid Test	Pathogens Detected	Resistance Marker	Time
PNA FISH®	*S. aureus*, CoNS, *Enterococcus* spp., *E. coli*, *K. pneumoniae*, *P. aeruginosa*, *Candida* spp.	No	1.5-3 hr
*QUICK*FISH™	*S. aureus*, CoNS, *Enterococcus* spp., *E. coli*, *K. pneumoniae*, *P. aeruginosa*	No	<30 min
FilmArray®	*S. aureus* and CoNS, *Streptococcus* spp., *Enterococcus* spp., *P. aeruginosa,* Enterobacteriaceae, *A. baumannii, Candida* spp.	*mecA, Van A, Van B*	1 hr
Light Cycler®	*S. aureus*, CoNS, *Streptococcus* spp., *Enterococcus* spp., Enterobacteriaceae, *S. maltophilia*, *Candida* spp.	No	6 hr

Impact of RMTs + ASPs

- Pre/post quasi-experimental
  - MALDI-TOF vs. historical control
  - ~500 pts with bacteremia/ candidemia
- Real time notification of all (+) blood cultures + ASP
- Time to organism identification
  - 84.0 vs. 55.9 hrs, p <0.001
- Time to effective antibiotics
  - 30.1 vs. 20.4 hrs, p =0.02
- Time to optimal antibiotics
  - 90.3 vs. 47.3 hrs, p <0.001

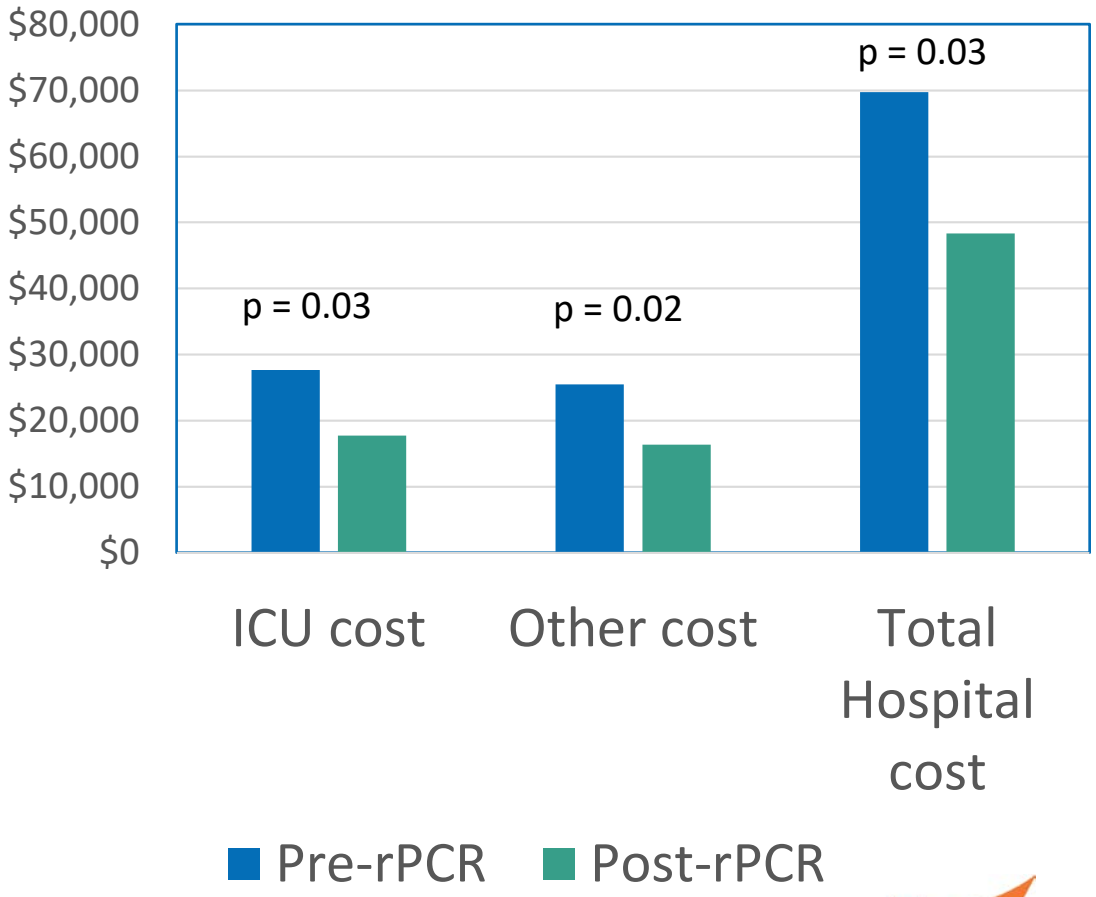


All-cause 30-day mortality
20.3% vs. 14.5%

Huang AM, et al. *Clin Infect Dis* 2013;57(9):1237-45

Impact of Rapid Microbiologic Tests + ASP: Cost Savings

- Pre/post comparative study
  - Rapid PCR MRSA/SA
  - 156 bacteremic patients
- Real time notification of all (+) blood cultures + ASP



Bauer KA et al. *Clin Infect Dis* 2010;51(9):1074-1080

Open Discussion

1) In what capacity is pharmacy/ASP involved in results from rapid microbiologic tests at your institution?

2) Are the services 24 hrs vs. business hours?

3) What is the process?

4) What barriers have you encountered in involving pharmacy/ASP in the process related to results from rapid microbiologic tests?

Measuring ASP-Related Outcomes

The Why

- Measurement allows comparison, highlighting differences in approach to reveal opportunities for improvement

- "It is widely believed that you cannot manage what you cannot measure. It is also true that you cannot measure what you cannot define."

  - Richard Platt, MD, MSc

Berrington A. *J Antimicrob Chemother* 2010; 65: 163-68.

Open Discussion

1) What ASP-related metrics are used at your institution?

2) How is this data obtained?

3) Who is responsible for obtaining, analyzing and reporting this data?

4) How and where do you document ASP-related interventions?

Sources of Data

- Purchased
  - Easy to obtain, but least accurate
- Dispensed
  - More accurate than purchased but can still overestimate usage
- Administered
  - Most accurate, best achieved with electronic medical records

Antimicrobial Stewardship Toolkit. [Online]. Retrieved on 10 Sept 2016 from, http://www.jcrinc.com/antimicrobial-stewardship-toolkit/

Definitions

- Defined daily dose (DDD)
- Days of therapy (DOT)
- Length of therapy (LOT)
- Standardized antimicrobial administration ratio (SSAR)

- Simply a numerator (DOT, DDD, LOT) & a denominator (patient days, admissions, days present)

Ibrahim O, et al. *Infect Dis Clin N Am* 2014. 28: 195–214.

Defined Daily Dose (DDD)

- The assumed average maintenance dose per day for a drug used for its main indication in adults
  - WHO standards
- Pros
  - Relatively easy to calculate
- Cons
  - May underestimate antibiotic exposure
  - Not applicable in pediatrics
  - Number of days of therapy may be inaccurate at times

WHO standards:
Piperacillin/tazobactam = 14g
Vancomycin= 2g

Drug	Day 1	Day 2	Day 3	This patient	Use/WHO standard
Piperacillin/tazobactam (3.375g q6H)	✓	✓	✓	12g x3 days= 36	36/14= 2.57
Vancomycin (1g q8H)		✓	✓	3g x 2 days = 6	6/2=3

Polk RE. *Clin Infect Dis* 2007. 44: 664-70.

Days of Therapy (DOT)

- Pros
  - Not impacted by dose changes
  - Can be used in adults and pediatrics
- Cons
  - Patient-level antibiotic use data needed

Drug	Day 1	Day 2	Day 3	This patient	D0T
Piperacillin/tazobactam (3.375g q6H)	✓	✓	✓	3 DOT	3+2= 5
Vancomycin (1g q8H)		✓	✓	2 DOT	

Polk RE. *Clin Infect Dis* 2007. 44: 664-70
Barlam TF, et al. *Clin Infect Dis* 2016. 62(10) e51-77.

Length of Therapy (LOT)

- Number of antimicrobials dispensed/utilized is irrelevant
- Pros
  - Accounts for dosing intervals beyond 1 day (e.g. patients on q48H vancomycin)
- Cons
  - Does not differentiate between monotherapy or combination therapy

Drug	Day 1	Day 2	Day 3	LOT
Piperacillin/tazobactam (3,375g q6H)	✓	✓	✓	3
Vancomycin (1g q8H)		✓	✓	

Morris AM. *Curr Treat Options Infect Dis* 2014. 6: 101-12.
Ibrahim OM, et al. *Infect Dis Clin D Am 2014*. 28:195-214.

Standardized Antimicrobial Administration Ratio (SSAR)

- Developed by the CDC
- Definitions:
  - Antimicrobial day: aggregate sum of days for any amount of antimicrobial administered to a patient
  - Observed antimicrobial use (O): # of days of therapy
  - Predicted antimicrobial use (P): calculated using predictive modules developed by CDC
    - Five specific categories

Antimicrobial Use and Resistance Module. [Online]. Retrieved on 10 Sept 2016 from, http://www.cdc.gov/nhsn/pdfs/pscmanual/11pscaurcurrent.pdf

IDSA Recommendation

- Every ASP must measure antibiotic use, stratified by antibiotic (*weak recommendation, low-quality evidence*)
- DOT is preferred
  - Not impacted by dose adjustments, patient population
  - CDC's National Healthcare Safety Network requirement

Barlam TF, et al. *Clin Infect Dis* 2016; 62(10): e51-77.

Manual Reporting

- Excel®
- Google docs®

- Free Resource
  - Joint Commision Toolkit

Requirements for Manual Calculation

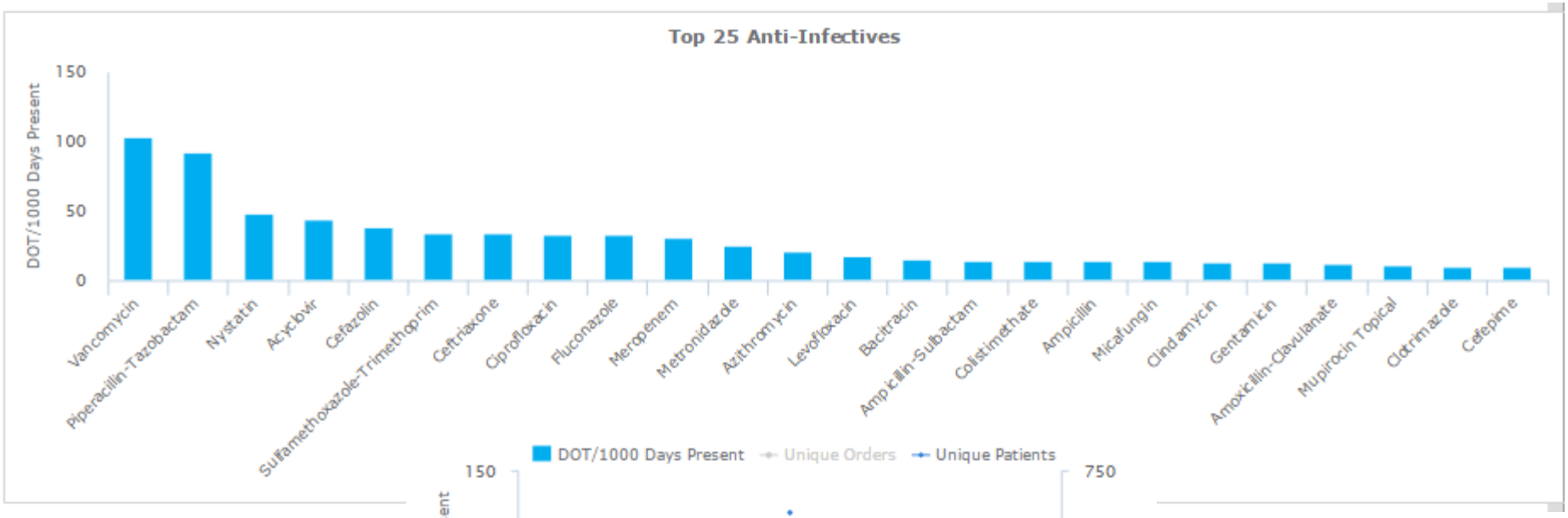
- Date of administration
- Patient account number or medical record number (MRN)
- Note: only valid for antimicrobials given at least once daily
  - May be inaccurate for q48H or q72H dosing

Antimicrobial Stewardship Toolkit. [Online]. Retrieved on 10 Sept 2016 from, http://www.jcrinc.com/antimicrobial-stewardship-toolkit/

CDSS Reports: SafetySurveillor®

Ward/Unit	Census	Drug	DDD	Patient Days of Use (per DDD)				DDD/1000 Patient Days				Actual Days of Therapy (DOT)				DOT/1000 Patient Days			
				Curr	Avg	Hi	Lo	Curr	Avg	Hi	Lo	Curr	Avg	Hi	Lo	Curr	Avg	Hi	Lo
CICU	*505*	acyclovir	4.0 gm		0.3	2.5	0.2		0.5	4.8	0.5		0.8	6.0	1.0		1.7	11.5	1.9
CICU	*505*	amphotericin B liposomal	350.0 mg		0.3	3.3	3.3		0.5	6.4	6.4		0.3	4.0	4.0		0.6	7.8	7.8
CICU	*505*	ampicillin	2.0 gm		12.9	51.0	1.0		24.6	97.9	1.9		3.8	17.0	1.0		7.3	31.7	1.9
CICU	*505*	ampicillin-sulbactam (single)	2.0 gm	3.0	14.2	54.0	1.5	5.9	26.7	95.6	2.9	2.0	4.1	13.0	1.0	4.0	7.7	24.2	1.9
CICU	*505*	azithromycin	500.0 mg	11.0	15.7	27.5	4.0	21.8	30.0	53.0	7.6	12.0	16.0	29.0	4.0	23.8	30.5	55.9	7.6
CICU	*505*	aztreonam	4.0 gm	0.4	5.8	9.8	0.4	0.7	11.1	17.3	0.7	1.0	9.3	16.0	1.0	2.0	17.8	31.1	2.0
CICU	*505*	cefazolin	3.0 gm	1.0	7.2	22.0	1.0	2.0	13.9	42.4	2.0	2.0	8.9	19.0	2.0	4.0	17.1	36.6	3.8

CDSS Reports: TheraDoc®



	Monthly Average	Period Total
DOT/1000 Days Present	103.25	103.25
DOT	2966.00	2966.00
Unique Orders	1390.00	1390.00
Unique Patients	615.00	615.00
Order Length (Days)	2.35	---

DOT Reports: TheraDoc®

DOT per 1000 (Days Present)

Therapeutic Class	Medication / Class	Jul 16	TOTAL	Average
anti-infectives	acyclovir	49.13	49.13	49.13
anti-infectives	amoxicillin-clavulanate	49.13	49.13	49.13
anti-infectives	azithromycin	20.23	20.23	20.23
anti-infectives	bacitracin	26.01	26.01	26.01
anti-infectives	cefazolin	8.67	8.67	8.67
anti-infectives	ceftriaxone	15.90	15.90	15.90
anti-infectives	cefuroxime	114.16	114.16	114.16

DOT

Therapeutic Class	Medication / Class	Jul 16	TOTAL	Average
anti-infectives	acyclovir	34.00	34.00	34.00
anti-infectives	amoxicillin-clavulanate	34.00	34.00	34.00
anti-infectives	azithromycin	14.00	14.00	14.00
anti-infectives	bacitracin	18.00	18.00	18.00
anti-infectives	cefazolin	6.00	6.00	6.00
anti-infectives	ceftriaxone	11.00	11.00	11.00
anti-infectives	cefuroxime	79.00	79.00	79.00

Goals of Measuring Outcomes of ASP

Improve patient outcomes

- Maximize clinical cure by optimizing antibiotic choice, dose, duration

Improve patient safety

- Minimize unintended consequences

Reduce resistance

- Preserve the utility of available agents

Reduce cost

- Less antimicrobial use and shorter durations

Mcgowan JE. *Infect Control Hosp Epidemiol* 2012; 33 (4): 331-37.

Process vs. Outcome Measures

Process

- Excess days of therapy
- Duration of therapy
- Compliance with guidelines or treatment algorithm
- Change in antibiotics based on microbiology results
- Conversion of IV-to-PO

Outcome

- Hospital length of stay
- 30-day mortality
- Unplanned hospital readmission within 30 days
- *Clostridium difficile* infection or other adverse event related to antibiotics
- Clinical failure

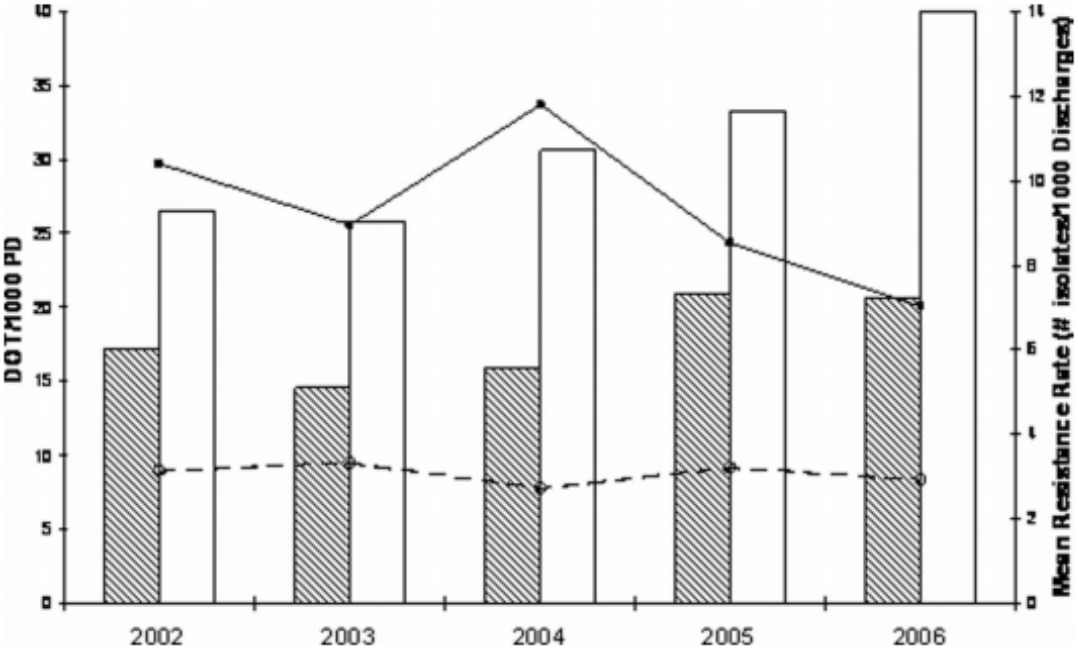
Barlam TF, et al. *Clin Infect Dis 2016*; 62(10): e51-77.

Moving from Process to Clinical Outcomes

- Historically, ASP outcomes have focused on cost reduction
- Measuring clinical outcomes such as antimicrobial resistance is more difficult
  - Changes in patterns of organisms prevalent in a setting
  - Changes in infection control measures

Ibrahim OM, et al. *Infect Dis Clin D Am 2014*. 28:195-214..

Decreased Resistance with Antimicrobial Restriction of Carbapenems

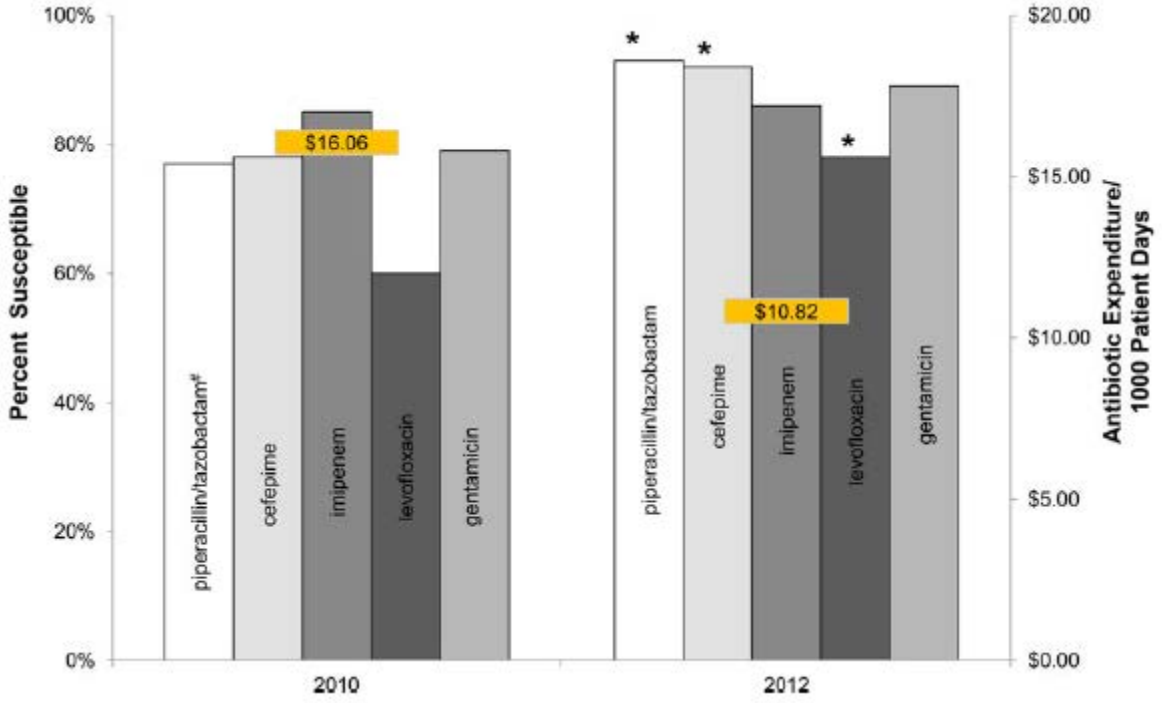


Shaded Bars: restricted
Open Bars: not restricted

Pakyz AL, et al. *Antimicrob Agents Chemother* 2009. 53(5):1983-6.

Susceptibilities and Stewardship

- *Pseudomonas aeruginosa* susceptibility increased after the initiation of ASP in a 70-bed rural community hospital



Day SR, et al. *Open Forum Infect Dis* 2015. 2(2): ofv064

Incorporating IT into your Ideal ASP

1) What ASP-related EMR initiatives will you take back and build at your institution?

2) What de-escalation alerts will you incorporate into your ASP with the available IT support/resources?

3) What additional PAF alerts will you build at your institution?

4) How will you incorporate rapid microbiologic tests into your ASP?

Key Takeaways

- Resistance continues to be a global health threat
- Antimicrobial Stewardship Programs can help preserve the power of our currently available antimicrobials
- As the demand of ASP initiatives continues to increase, the incorporation of information technology is of vital importance in assisting with streamlining ASP efforts