

## Anti-Infective Clinical Decision Support Software

David Taber, PharmD, BCPS  
Clinical Coordinator, Critical Care  
Clinical Specialist, Solid Organ Transplant  
Medical University of South Carolina,  
Charleston, SC

## Learning Objectives

Upon completion of this program, the participants should be able to:

- List reasons why antimicrobial stewardship programs are important to implement as part of comprehensive clinical pharmacy services
- Describe methods to utilize in order to determine the most appropriate antimicrobials and medical services to initial target as part of a new antimicrobial stewardship program
- Describe strategies to develop initial reports or programs within clinical decision support software to optimize antimicrobial utilization
- Design an antimicrobial stewardship program using clinical decision support software that is seamlessly integrated in a clinical pharmacy services model
- List methods to document outcomes of a new antimicrobial stewardship program

## Outline

- Rationale for using clinical decisions support software for antibiotic utilization
- Developing an antimicrobial surveillance program - where to focus first
- Building reports
- Building a surveillance program with your current clinical staff model - how to integrate (MUSC perspective)
- Using the software for documentation
- Tracking Outcomes
- Lessons Learned

## Questions for the Audience

- Brief Audience Poll
  - How many people have an antimicrobial stewardship program?

## Questions for the Audience

- Brief Audience Poll
  - How many people utilize clinical decision support software as part of the ASP?

## Questions for the Audience

- Brief Audience Poll
  - How many people track resistance, clinical outcomes, and cost data with assistance from this software?

## Why target Antimicrobials?

- Quality Issues
  - Increased rates of microbe resistance linked to antimicrobial misuse<sup>1</sup>
  - Optimizing antimicrobial use has demonstrated improved patient outcomes and lower resistance<sup>2</sup>
  - Only class of drug where misuse in one patient can directly influence outcomes in another patient

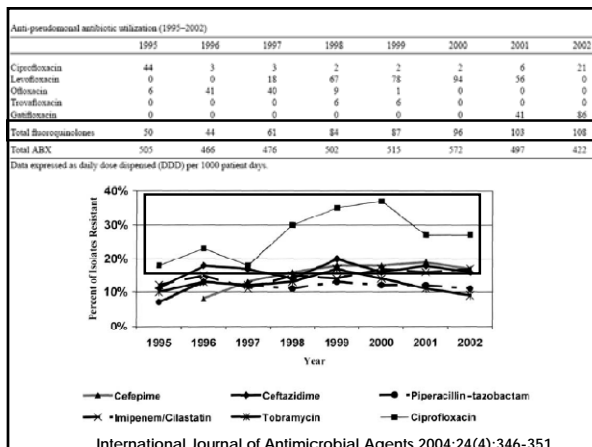
<sup>1</sup> CID 2007;44:159.

<sup>2</sup> ICHE 2003;24:699.

## Why target Antimicrobials?

- Quantity Issues
  - Abx estimated to be 30% of hospital pharmacy budget<sup>1</sup>
  - 50% of abx use may be inappropriate<sup>1</sup>
  - More use of a particular abx associated with increased resistance

<sup>1</sup> CID 2007;44:159.



## Why target Antimicrobials?

Improving Quality - ↓ Resistance

Organism/phenotypic resistance	Resistance rate, % (total no. of strains) <sup>a</sup>			
	Period 1: baseline	Period 2: initial intervention	Period 3: education phase	Period 4: active control
<i>Escherichia coli</i> /third-generation cephalosporins	0 (204)	7 (195)	12 (120)	8 (131)
<i>E. coli</i> /AMF-SUL	22 (204)	18 (195)	19 (128)	18 (131)
<i>Klebsiella</i> species/third-generation cephalosporins	45 (64)	53 (32)	21 (43) <sup>b</sup>	42 (50)
<i>Proteus mirabilis</i> /third-generation cephalosporins	40 (47)	45 (49)	30 (46)	27 (41)
<i>Enterobacter cloacae</i> /third-generation cephalosporins	50 (16)	50 (6)	29 (17)	16 (10)
<i>Pseudomonas aeruginosa</i> /imipenem	19 (99)	9 (62)	2 (100)	0 (66)
<i>P. aeruginosa</i> /cefepime	8 (98)	0 (62)	3 (100)	7 (56)
<i>Staphylococcus aureus</i> /methicillin	47 (165)	50 (150)	40 (199)	30 (101)

CID 2003;37:180.

## Why target Antimicrobials?

Improving Quantity – Cost Savings

Variable	Cost, US\$		Difference, %
	Before intervention	After intervention	
<b>All patients</b>			
Total	67,883	29,814	-56
Intravenous therapy	59,782	23,264	-60
Oral therapy	9101	6551	-28
<b>Per patient admitted<sup>a</sup></b>			
Mean total	126.8	59.6	-56
Intravenous therapy	117.5	46.3	-60
Oral therapy	18.2	13.1	-28
<b>Per patient treated<sup>b</sup></b>			
Mean total	292.6	201.5	-31
Intravenous therapy	253.4	187.2	-38
Oral therapy	39.2	44.3	+13
<b>Per 1000 hospital-days, all patients<sup>c</sup></b>			
Mean total	9818	4806	-51
Intravenous therapy	8502	3751	-56
Oral therapy	1316	1057	-20
<b>Per 1000 treatment-days<sup>d</sup></b>			
Mean total	17,446	11,616	-33
Intravenous therapy	15,109	9906	-48
Oral therapy	2339	2510	+9

CID 2004;38:348.

## Where to Focus First

- Important to understand your institutions quality outcomes for common infections
  - Pneumonia, bacteremia, UTI, cellulitis, FN, SSI, etc
- Important to understand your institutions abx utilization
  - Globally – which abx do you use the most and which are most expensive
  - Service specific – what services use which abx

### Where to Focus First

- Utilize benchmark data from consortiums, buying groups, etc
- Compare both quality and cost data
- Compare data across similar type and size hospitals
- Review both quarterly and yearly data

### MUSC Data - Quality

Pneumonia										
Hospital	Cases	Mean LOS (Obs)	Mean LOS (Exp)	LOS Index	% ICU Cases	Mean ICU Days	% With Comp's (2)	% Deaths (Obs)	% Deaths (Exp)	Mortality Index
MUSC	333	4.3	4.3	0.99	6.91	3.43	25	1.5	1.8	0.82

- 57<sup>th</sup> percentile for Mortality index
- 50<sup>th</sup> percentile for LOS index

[www.uhc.edu](http://www.uhc.edu)  
accessed 3/17/2009

### MUSC Data - Quality

Sepsis										
Hospital	Cases	Mean LOS (Obs)	Mean LOS (Exp)	LOS Index	% ICU Cases	Mean ICU Days	% With Comp's (2)	% Deaths (Obs)	% Deaths (Exp)	Mortality Index
MUSC	165	9.3	9.8	0.95	44%	6.7	38%	22.4	21.9	1.02

- 46<sup>th</sup> percentile for Mortality index
- 62<sup>th</sup> percentile for LOS index

[www.uhc.edu](http://www.uhc.edu)  
accessed 3/17/2009

### MUSC Data - Quantity

Hospital	Clinical Population Denominator Cases	Cases Receiving Resource	% Cases Receiving Resource	Mean Days Resource Used/Patient	Resource \$ per Patient/Day	Resource Total \$
MUSC	333	327	98.20	4.4	72	102,499

- 3<sup>rd</sup> percentile for Abx expenditures per patient day when treating pneumonia
- 71<sup>st</sup> percentile for mean days of abx used per patient for pneumonia

[www.uhc.edu](http://www.uhc.edu)  
accessed 3/17/2009

### MUSC Data - Quantity

Hospital	Clinical Population Denominator Cases	Cases Receiving Resource	% Cases Receiving Resource	Mean Days Resource Used/Patient	Resource \$ per Patient/Day	Resource Total \$
MUSC	165	164	99.4	9.1	124	184,533

- 1<sup>st</sup> percentile for Abx expenditures per patient day when treating sepsis
- 22<sup>nd</sup> percentile for mean days of abx used per patient for pneumonia

[www.uhc.edu](http://www.uhc.edu)  
accessed 3/17/2009

### MUSC Data – Abx Utilization

- Similar data for cellulitis, UTI, FN data
  - Decent for quality, high abx costs
- Overall antibiotic expenditures

Year	Resource \$ per Patient Day	Overall Expenditures	Percentile
2006	\$46	\$3,647,231	39 <sup>th</sup>
2007	\$48	\$3,804,096	42 <sup>nd</sup>
2008	\$55	\$4,862,805	21 <sup>st</sup>

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accessed 3/17/2009

### MUSC Data – Abx Utilization

Antibiotic	% Admissions Receiving Abx	Mean Days Resource Used/Patient	Resource \$/Patient/Day	Percentile
Anti-Pseudomonal PCN	9%	5.3	\$69	34th
Carbapenem	3%	7.8	\$76	17th
Cefepime	2%	5.9	\$39	79th
Daptomycin	0.3%	7.8	\$98	58th
Linezolid	1%	5.9	\$143	46th
Vancomycin	15%	4.3	\$12	49th

- High user of carbapenems and anti-pseudomonal PCNs (high cost)
- Low user of cefepime (lower cost)
- Room for gram positive abx optimization

[www.uhc.edu](http://www.uhc.edu)  
accessed 3/17/2009

### Where to Focus Efforts

- Know your data and find your low hanging fruit
- MUSC
  - Quality outcomes were decent for common infections
  - Costs were high for common infections
    - High users of carbapenems and anti-pseudomonal PCNs
    - Improve gram positive de-escalation

### Specific Software and Capabilities

- SafetySurveillor™
  - Web-based application
  - Interfaces between ADT, Microbiology, and Pharmacy
  - Allows users to build reports to help identify patients warranting further review
    - IC and Pharmacy components

<https://ss.premierinc.com>

### Specific Software and Capabilities

- SafetySurveillor™
  - Pharmacy Reports
    - Built around drug utilization and microbiology data or both
    - Examples
      - Patients on meropenem >3 days
      - Patients on Pip/Tazo without a positive pseudomonas culture
      - Bug/drug mismatches

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### Screen shot of reports

Report Name	Details	Edit	Copy	Delete	No	Yes	No	Edit
Daptomycin - Adult University Hospital					No	Yes	No	Edit
Daptomycin - ART					No	Yes	No	Edit
Daptomycin - Childrens Hospital					No	No	No	Edit
Echinocandins with positive culture that is NOT Candida Adult University Hospital					No	Yes	No	Edit
Echinocandins with positive culture that is NOT Candida ART					No	Yes	No	Edit
Echinocandins with positive culture that is NOT Candida Childrens Hospital					No	No	No	Edit
IV to PO switch					No	Yes	No	Edit
Linezolid greater than 9 days Adult University Hospital					No	Yes	No	Edit
Linezolid greater than 9 days ART					No	Yes	No	Edit
Linezolid greater than 9 days Childrens Hospital					No	No	No	Edit
Meropenem Use greater than 3 days - Adult University Hospitals					No	Yes	No	Edit
Meropenem Use greater than 3 days - ART					No	Yes	No	Edit
Meropenem Use greater than 3 days - Childrens Hospital					No	No	No	Edit

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### How to build reports

- Utilize center specific data to determine which abx to target first
- Keep the number of initial reports low at first
  - Focus efforts on several key abx first
- How to target patients
  - All patients receiving abx >3 days
  - Target double coverage
  - All patients receiving abx without a positive culture
  - Target patients for streamlining, de-escalation or on prolonged therapy

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## How to build reports

**Select Rx(s):**

Select (one or more)

- abacavir
- abacavir/famivudine
- abacavir/famivudine/zidovudine
- acellular pertussis vaccine
- acyclovir
- amantadine
- amikacin
- Aminocillin
- amoxicillin
- amoxicillin-clavulanic acid (single)

Select Group

Aminoglycosides

[ View Group Members ]

Detection Logic (list only):

Use AND Logic  Use OR Logic

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## How to build reports

**Select Rx Route(s):**

Select (one or more)

- apply externally
- automated dispense
- buccal
- chew
- dental
- endocervical
- endotracheal tube
- enteric tube (various)
- epidural
- immerse (soak) body part

Any Rx Route

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## How to build reports

Select (one or more)

- <100,000 CFU/mL - See drill down
- >=100,000 CFU/mL
- Acid fast bacilli
- Acid fast bacilli isolated
- Acid fast bacilli seen
- Acinetobacter baumannii
- Adenovirus isolated
- Anaerobes
- Aspergillus AD positive
- Aspergillus fumigatus

[ Global List ] [ Institution List ]

Select Group

Acinetobacter species (inclusive)

[ View Group Members ]

No Organism Selected

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## How to build reports

**Select Drug Resistance:**

Select (one or more)

- acyclovir
- amikacin
- amikacin/ceftazidime
- amikacin/empenem
- amoxicillin
- amoxicillin
- amoxicillin-clavulanic acid
- amphotericin b
- ampicillin

[ Global List ] [ Institution List ]

Detection Logic (list only):

Use AND Logic  Use OR Logic

Select Group

Antistaphylococcal penicillins

[ View Group Members ]

No Drug Resistance Selected

**Categorize Intermediate Susceptibility As:**

Susceptible (I treated as S)

Resistant (I treated as R)

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## How to build reports

- Select specimen source
  - All or blood or BAL...
- Select unit or ward
  - Specific floor, group of floors, hospital, or service
- Select alert days delay
  - 0 or 3 or 7
- Select name, sign up preference, and email preference
- Select event suppression rule
  - Default to 7 days

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## How to build reports

- Reports utilized currently at MUSC
  - Bug/drug mismatch
  - Meropenem >3 days of therapy
  - Pip/Tazo >8 days of therapy
  - Pip/Tazo with a positive culture that is NOT Pseudomonas
  - Vancomycin with a positive culture that is MSSA
  - Vancomycin >8 days of therapy
  - Linezolid >8 days of therapy
  - All daptomycin therapy
  - Caspofungin with a positive fungal culture that is NOT Candida
  - Double coverage for anaerobes and viruses

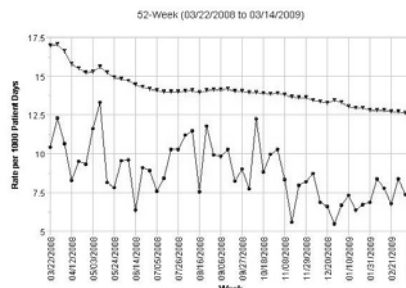
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### Additional Capabilities

- Control charts
  - Allows you to track resistance rates over time
  - Fires off warning when resistant rate falls above threshold limit
  - Future capabilities to have similar functionality with antimicrobials

### Additional Capabilities

MRSA Rates at MUSC 3/08 to 3/09



### Specific Software and Capabilities

- SafetySurveillor™
  - Future upgrades
    - Track abx utilization graphically over time and correlate to resistance patterns
    - Pull in other pharmacy and lab data
      - Anticoagulation monitoring, TDM, renal function monitoring, etc.

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### Using the Software – How to Integrate

- Build specific reports that meet your goals
  - Meropenem, Pip/Tazo
  - Vanc, Linezolid, Daptomycin
- Use software to do back end review, consultation, and recommendation
- Target patients on therapy >48 hours

### How to Integrate

- Brief Audience Poll
  - How many people work at an institution with clinical pharmacy specialists?

### How to Integrate

- Brief Audience Poll
  - How many people work at an institution with full time clinical pharmacy staff?

## How to Integrate

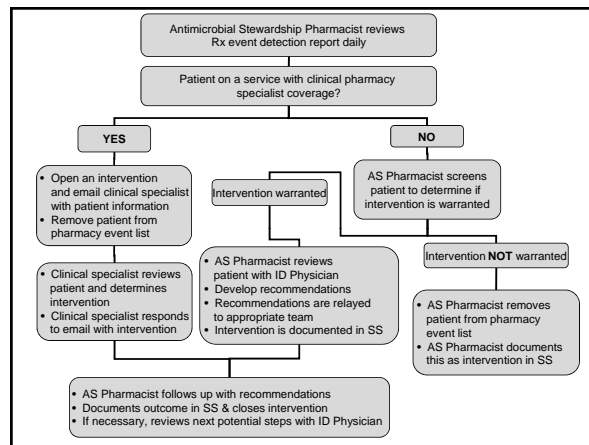
- Brief Audience Poll
  - How many people work at an institution where all clinical pharmacy duties are integrated into the staffing model?

## Using the Software – How to Integrate

- MUSC Clinical Model
  - Clinical Specialists
    - Follow patients on certain service(s)
  - Clinical Pharmacists
    - Order entry, follow patients for a particular floor that are not followed by clin spec
  - Central Pharmacists
    - Operations experts

## Using the Software – How to Integrate

- Primary person responsible for building reports and reviewing real-time data on a daily basis
- Disseminate data to clinical specialists covering their respective services
- Reviews patients on all non-covered services
- Requires approx. 2 hours per day
- Work flow diagram...



## Patient View

Real Time Drug Usage Events : [ View RT Drug Usage Events Log ]

There were no Real Time Drug Usage Event alerts since your last session.

Event Name	Patient ID	Patient Name	Location	Drug	Event Date	Patient Viewed
RT Double Coverage-Anerobe. Hydromorphone + Ampicillin/Sulbactam	<a href="#">Details</a> 0123456	Doe, John	N00-D769A	ampicillin-sulbactam (single)	03/18/2009	Yes

[Remove](#) Remove all Viewed items (Items with Alert Viewed = Yes)  
[Remove](#) Remove all items.

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## Patient View

- Once click on patient, 3 pieces of data
  - ADT information
  - Microbiological information
    - Hyperlink to positive culture sensitivities
  - Antimicrobial information
    - Chronologically listed, active first
    - Start and stop time
    - Hyperlinked to administration times (AdminRx)

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## Using the software for documentation

- Interventions and notes can be entered for specific patients
- Interventions can be assigned to people for follow-up
- Recommendations can be tracked for acceptance
- Reports to summarize data

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## Using the software for documentation

Date Created (date to Interventions)	Follow-up Date	Problem	Note	Review?	Change Status	Status	Follow-up Reason	Primary Consult?	Secondary Consult?
[A Z]	[A Z]	[A Z]	[A Z]	[A Z]	[A Z]	[A Z]	[A Z]	[A Z]	[A Z]
03/08/2009	03/08/2009	Antimicrobial with a narrower spectrum indicated	patient on zosyn, consider narrowing coverage with culture results to uranyl	No	No change occur		Change still needed	No	No
03/02/2009	03/02/2009	Organism resistant to current antimicrobial therapy	is still in urine, only on zosyn	Yes	Recommendation accepted		Change still needed	No	No
03/03/2009	03/03/2009	Double coverage of antimicrobial therapy	patient on both zosyn and cefepime	No	Recommendation		Change still needed	No	No
03/05/2009	03/05/2009	Antimicrobial with a narrower spectrum indicated	patient on broad spectrum antibiotic with no positive culture for pseudomonas	No	Different change made		Change still needed	No	No

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## Tracking Outcomes

- Utilize software to track
  - Number of interventions
  - Type of interventions
  - Acceptance rates
  - Resistance rates over time
  - Antibiotic utilization over time (??)
- Utilize benchmark data (UHC) to track
  - Quality outcome measures (LOS, complications, mortality index)
  - Global antibiotic utilization
  - Antibiotic utilization and expenses

## Lessons Learned

- Choose software based on your specific institutional needs
- Build interfaces to support optimal use of software
  - AdminRx was used for SafetySurveillor™ at MUSC, but only available in certain units

## Lessons Learned

- This software is only a tool which allows you to improve efficiencies in clinical programs
  - Without a model that can support and optimize use of this software, the software is useless
  - Harder to change your model than to choose the right type of software

## Lessons Learned

- Get buy in from administration, IS, and clinicians before purchasing this software
- Use a multidisciplinary team to decide how to optimize this software

## Conclusions

- Antimicrobial optimization programs are an important part of clinical pharmacy services
- Use of clinical decision support software lends itself very nicely to these programs
- Clinical decision support software is a wonderful tool, but not the panacea to antimicrobial stewardship programs
- Early planning and thorough research is pivotal to ensuring optimal use of CDS software