



MASSACHUSETTS  
GENERAL HOSPITAL  
**ACADEMY**



MASSACHUSETTS  
GENERAL HOSPITAL

**DIVISION  
of INFECTIOUS DISEASES**

**Improving the Use of Antimicrobials to Treat  
Gram-Positive Infections: Encouraging Appropriate  
Use and Minimizing Antimicrobial Resistance**

January 2013 – July 2015

[www.mghacademy.org](http://www.mghacademy.org)

sponsored by



---

FOUNDED BY BRIGHAM AND WOMEN'S HOSPITAL  
AND MASSACHUSETTS GENERAL HOSPITAL

## **C. Main Section of the Proposal**

**1) Overall Goal & Objectives:** *Describe the overall aim for this initiative. List the key objectives and how they are intended to address the established need for this initiative.*

Under the auspices of the MGH Antimicrobial Stewardship Program (ASP), this inpatient-based quality improvement initiative will target inappropriate prescribing of daptomycin and linezolid, two powerful antibiotics increasingly used in the inpatient setting. Specifically, a multidisciplinary team will identify current inpatients receiving greater than 72 hours of treatment with daptomycin or linezolid and assess treatment appropriateness; for cases without microbiological data supporting continued use of these antibiotics, clinicians will receive targeted, evidence-based educational feedback about de-escalation strategies. The primary goal of reducing inappropriate prescribing of daptomycin and linezolid will be measured by comparing days of therapy (DOT) / 1000 patient days pre- and post- intervention. In parallel, a case-based clinician education program will be developed and deployed, with impact of both interventions measured through pre- and post-surveys of clinicians.

**2) Technical Approach:** *Describe how this initiative will meet the aim of the specific area of interest for the RFP.*

### **A: Current Assessment of Need in Target Area**

#### ***i. Baseline Data, Initial Metrics, Gap Analysis***

Prior work has demonstrated physicians' deviation from national guideline-based antimicrobial therapy.<sup>1</sup> Educational materials, such as the Joint Commission Resources Antibiotic Resistance Toolkit, are widely available, and studies have shown that clinicians are receptive to antimicrobial prescribing recommendations. However, there are few data demonstrating the impact of quality-improvement interventions on physician knowledge, prescribing practices and on total antimicrobial use.<sup>2</sup>

The proposed intervention is built upon preliminary work of the ASP. In the last several years, increased utilization of carbapenems was noted by the ASP. In response to an assessment, a team was created to undertake daily review of existing carbapenem orders, including chart and microbiological review, and provide direct feedback to teams regarding the appropriateness of the use of meropenem, ertapenem and imipenem. An analysis of the impact of this intervention in 2011 demonstrated a 12% reduction in volume. Despite this, non-microbiologically-driven prescribing continues indicating a need for systematic educational initiatives and objective analysis of the impact of such interventions.

Studies indicate that up to 50 percent of antimicrobial use is inappropriate<sup>3</sup>, exposing patients to potential medication toxicity and contributing to antimicrobial resistance.<sup>4</sup> Increasing resistance to linezolid has been reported in association with extensive use<sup>5-7</sup>, and developing resistance to daptomycin has been demonstrated.<sup>8</sup> The Centers for Disease Control and Prevention, the Joint Commission on the Accreditation of Healthcare Organizations and the Infectious Diseases Society of America (IDSA) have identified improving appropriate antibiotic use as a national public health priority.<sup>9-11</sup> Studies demonstrate that although physicians believe they practice according to published evidence-based antimicrobial guidelines, they largely fail to choose guideline-concordant therapy when tested.<sup>1</sup> While studies have shown that clinicians are receptive to antimicrobial prescribing recommendations following post-prescription review, there is a paucity of data demonstrating the impact of such interventions on physician prescribing practices and on total antimicrobial use.<sup>2</sup>

MGH has approximately 50,000 inpatient admissions a year, and 20 to 25 percent of MGH inpatients are MRSA-, VRE- or combined MRSA/VRE colonized; approximately 2 percent of MGH inpatients receive daptomycin or linezolid. Internal audits performed by the MGH Antimicrobial Stewardship Program have demonstrated that, compared to physicians at similar medical institutions, those at MGH treat a larger percentage of patients with daptomycin and linezolid (Table A), and for a longer duration (Table B). These data underscore the need for targeted, educational interventions to promote appropriate antimicrobial prescribing.

Table A

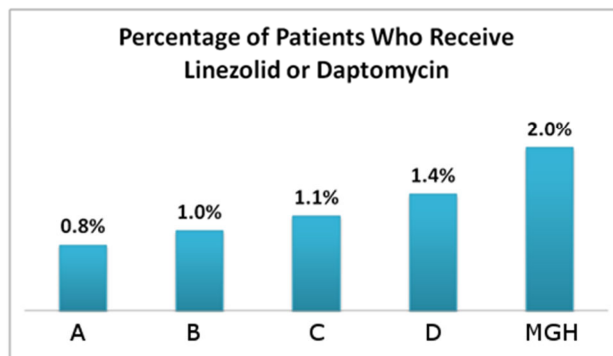
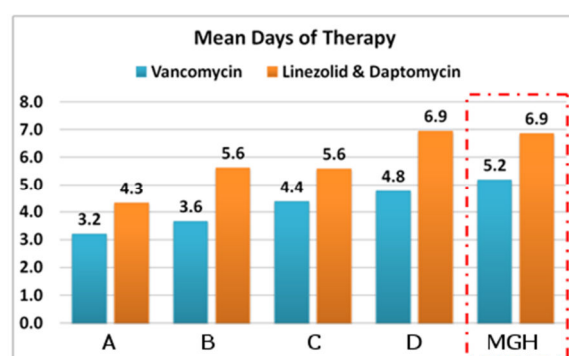


Table B



(Note: Comparator institutions de-identified)

**ii. Primary Audience:** Infectious Disease Specialists and multidisciplinary teams who prescribe daptomycin and linezolid or work with patients receiving these two powerful antibiotics in an inpatient setting.

## B. Intervention Design and Methods


The activity will utilize the MGH Academy's state-of-the-art enterprise-level learning (LMS) and content management system (CMS) to guide participants through the performance improvement process (<http://www.mghacademy.org>) The LMS was designed to complement the capabilities of the Partners HealthCare electronic medical record system (5.6 million patients accessed from over 70,000 active desktops within the Partners HealthCare System). The LMS system has been routinely used by over 35,000 health care providers – including registrants from 121 countries (95 percent US based) and has had hundreds of thousands of disseminated activities per year. The LMS has been built and customized to be easily accessible - facilitating data collection and dissemination of outcomes data with minimal disruption to provider workflow.

The LMS is currently being used in similar MGH initiatives, including PI-CME programs in HIV and ADHD (on file). A sample screen shot from the Academy's PI CME platform can be seen in figure below.

This system has been built and customized to support quality improvement initiatives. The LMS and CMS include the following features:

- Chart abstraction tools and self-assessment surveys
- Automated data import
- Real-time measure calculation
- Benchmarking and comparison to peers and national standards
- Data extraction and analysis reporting
- Multimedia educational content and dynamic performance improvement modules
- Virtual “lunch and learn” forums that facilitate Stage B group problem solving
- Resource center
- Online activity evaluation
- Automated Quality Review Board (QRB) and Continuing Professional Development (CPD) integrated committee reviews (e.g., linking PI/CME and MOC IV program development)
- Automated appropriate certificate generation

[com/Users/ActivityList.aspx?ProductID=238&PageCode=AL](#)


**MASSACHUSETTS  
GENERAL HOSPITAL**

STEP 1:  
Activity Overview

STEP 2:  
Purchase

STEP 3:  
CE Information

STEP 4:  
Pre Test

STEP 5:  
Course Activities

STEP 6:  
Post Test

STEP 7:  
Discussion Board


STEP 8:  
Evaluation

STEP 9:  
Print Certificate

## Course Activities

**Congratulations, you have successfully registered for the following events.**  
Click on each event to complete the event and claim credits. You may log into and out of this activity as often as necessary to complete all events.

Identifying and Reducing Cardiovascular Disease Risk Factors in Adult Patients with HIV (PI-CME Program)

 **CME** - You have earned 5 credits for completing stage A

Event Name	Start Date	Claimed Credits
<a href="#">Stage A – Collect your baseline ADHD data (5 charts)</a>	2/26/2012	✓
<a href="#">Stage B – Review data and compare to peers</a>	3/4/2012	
Stage B – View Webinar	3/11/2012	
Stage B – Attend virtual problem solving session with peers	3/18/2012	
Stage C – Collect follow-up data (5 additional charts)	Available starting 4/1/2012	

PI CME Platform: the platform has been adaptable to training sessions across the US where providers learn about evidence-based adoption of best practice standards into routine clinical practice. As an example, 176 learners participated in the Academy’s “Cognitive Behavioral Therapy” training program and were required to pay tuition.

This educational initiative will be conducted in a 3-stage quality improvement format:

**STAGE A: Learn from Current Practice:**

Data will be collected on DOT/1000 patient days for daptomycin and linezolid for the year prior to the intervention to serve as the baseline metric. A survey instrument using REDCap (Research electronic data capture), a secure web-based application hosted by Partners Research Computing, will be developed. A cohort of inpatient clinicians—house officers, hospitalist staff, physicians assistants and nurse practitioners will be surveyed regarding current antimicrobial prescribing practices and understanding of and adherence to institutional and national guidelines. This will provide a baseline knowledge assessment.

The Research Team has prior experience with such surveys. For example, in February 2012 the team completed a pre-post quality improvement intervention survey of over 400 resident physicians at MGH regarding their knowledge of prevention of catheter-associated urinary tract infections. The survey was completed in October 2012 the data are under analysis. In the past two years, the research team has designed, implemented and published two additional national surveys related to infection control practices.<sup>12,13</sup>

*STAGE B: Apply Quality Improvement Strategies to Patient Care:*

The specific physician behavior targeted in Stage B is de-escalation of therapy after an empiric trial (i.e. 72 hours) of either daptomycin or linezolid. A post-prescription audit will be instituted to identify patients receiving daptomycin and linezolid at or exceeding 72 hours from initiation of treatment. During daily rounds, multidisciplinary teams will review these patients' charts and microbiological data, and make specific recommendations to teams caring for patients. De-escalation strategies will be recommended in cases where:

1) Microbiological data exist that do not support use of either drug (e.g. vancomycin-sensitive enterococcus isolated from the urine, no indication to continue with linezolid therapy)

*or*

2) No microbiological data exist at all, and de-escalation should be considered.

In cases in which microbiological data do support continued use, no intervention will occur. This daily review will generate feedback in the form of email/page/discussion with the team. We have experience with multidisciplinary team review of antibiotic prescribing; such teams are currently in place for review of carbapenem prescribing, and will have their role expanded to include this project.



Using the MGH Academy's innovative Learning Management System, a case-based Interactive Learning Module (ILM) will be developed to address the clinical and knowledge gaps identified in Stage A. An example of an ILM may be found at: [www.mghacademy.org/ILMdemo](http://www.mghacademy.org/ILMdemo).

This learning module will also include an interactive online clinical simulation using our Computer Simulation Assessment Tool (CSAT); in this simulation exercise, participants will be shown video vignettes of clinical interviews during which they will choose from a menu of treatment and discussion options that mirror the choices typically faced in an actual clinical encounter. An example of a CSAT may be found at: [www.mghacademy.org/CSATdemo](http://www.mghacademy.org/CSATdemo).

Data derived from the interactive and on-line clinical simulation tools provide additional documented gap analyses for iterative educational interventions and/or User Interface (UI) ordering improvements (e.g., changes in EMR template and/or 'flags').

The MGH Academy has significant experience in using this approach to evaluate clinician performance. For example, in a 2011 program, 123 participants completed a CSAT on the evaluation of insomnia in a patient with treatment-resistant depression (full data on file). In this CSAT, participants' performance was reflected in their ability to identify necessary elements of an optimal clinical evaluation (TABLE C).

TABLE C

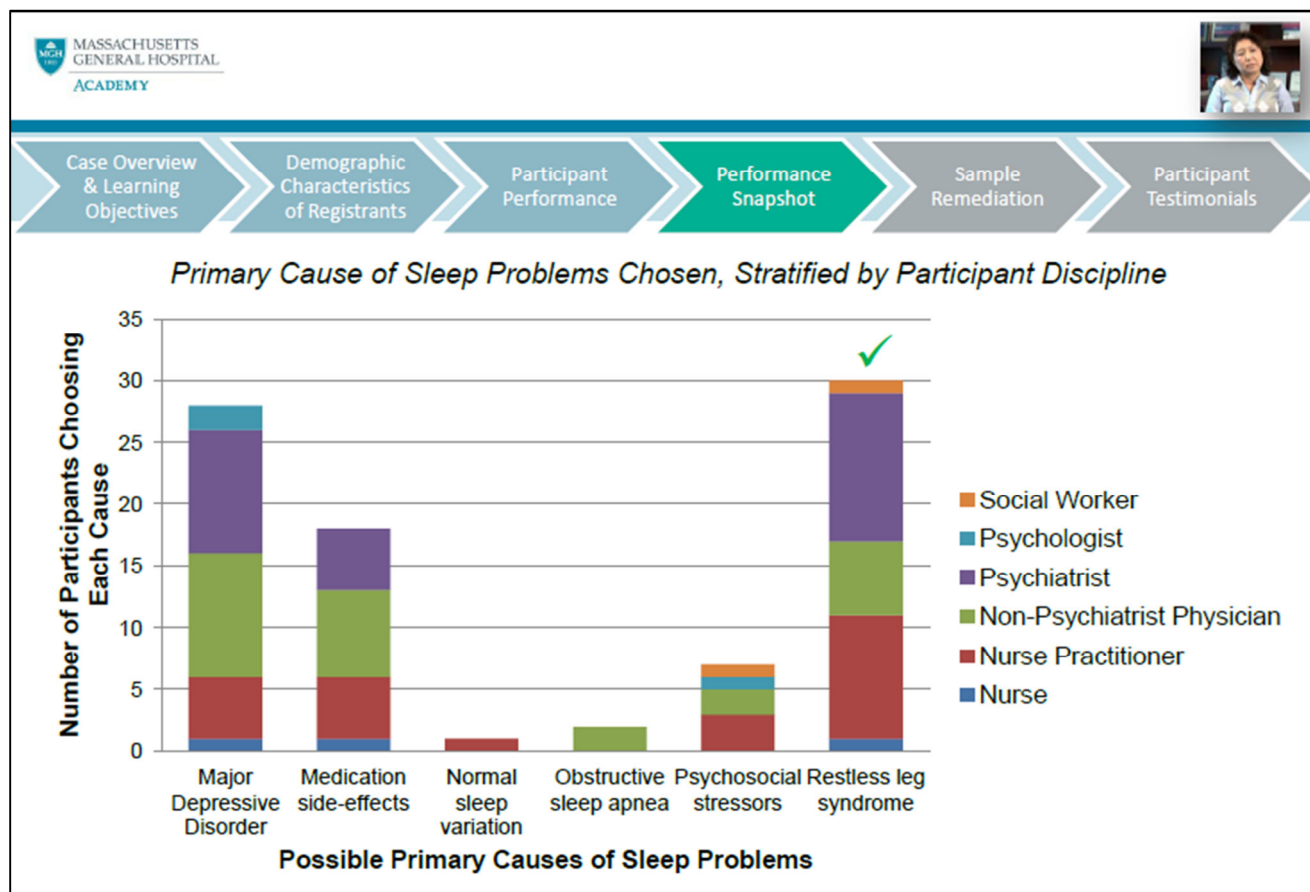



Case Overview & Learning Objectives	Demographic Characteristics of Registrants	Participant Performance	Performance Snapshot	Sample Remediation	Participant Testimonials
<b>Breakdown of Required Items, Ordered by Frequency</b>					
Required Items	% Participants Selected (N = 123)	Required Items	% Participants Selected (N = 123)		
Early cycle sleep	72%	Gasping for air	42%		
Medication Use	68%	Day structure	42%		
Caffeine intake	67%	Concentration	40%		
Anhedonia	62%	Check serum ferritin	39%		
Substance Use	59%	Relief after moving legs	37%		
Anxiety	57%	Energy	37%		
Snoring	57%	Appetite	33%		
Need to move legs	56%	Pain	33%		
Suicidal Ideation and Intent	54%	Examine Airway	32%		
Stop son's medication	53%	Worse at night/evening	31%		
Late cycle sleep	52%	Duration of symptoms	30%		
Sadness	44%	Order sleep study	29%		
Feel rested	43%	Irritability	28%		
Mid cycle sleep	43%	Guilt	24%		
Social stressors	43%	Start ropinirole	24%		
Work performance	43%	Distress to bed partner	23%		



Additionally, diagnostic choices were stratified by participant discipline (TABLE D):

TABLE D



MGH Psychiatry Academy CSAT modules are also a current component of the MGH clinician re-credentialing process, and have been used to evaluate the performance of over 400 clinicians to date.

Participants will also fill out an evaluation / self-reflection form to give feedback about the educational interventions and any potential barriers they believe may impede adaptation of the recommendations.

**STAGE C: Evaluate Results of the Quality Improvement Initiative:**

Data will be collected about response to recommendations given during multidisciplinary daily rounds. Data will be collected on DOT/1000 patient days for daptomycin and linezolid for the year of the intervention to evaluate changes in DOT/1000 patient days resulting from the intervention. The clinicians polled in Stage A will be surveyed again (post- educational intervention) to estimate the impact on their prescribing practices and understanding of and adherence to national guidelines. Participants will also fill out an evaluation / self-reflection form to summarize changes in practice, process or outcomes that resulted from this initiative.



### C. Evaluation Design

#### **Describe how you will determine if the practice gap identified in the needs assessment was addressed for the target group in terms of the metrics used for the needs assessment.**

DOT/1000 patient days for daptomycin and linezolid will be compared pre- and post-educational intervention to determine changes in duration of antimicrobial treatment. In our experience, DOT/1000 patient days is preferable to mean DOT as an accurate reflection of utilization. For example, while mean DOT is affected by length of stay, DOT/1000 patient days is not and can, therefore, more accurately capture utilization.

#### **Indicate how you will determine if the target audience was fully engaged in the intervention.**

Because there is extensive communication among clinicians at MGH who often work in multidisciplinary teams, the research team does not believe it is feasible to establish a randomized control group that is isolated from the project's interventions. We have substantial data regarding current clinician prescribing practices, and will evaluate data pre- and post-intervention to discern effects of the intervention. Specifically, clinicians' responses to polling questions pre- and post- educational intervention will be compared to determine changes to their knowledge of practices and understanding of/adherence to institutional and national guidelines, while analyses of utilization pre- and post- intervention will allow for an assessment of whether or not the educational interventions (CSAT and multidisciplinary rounds) lead to the desired change in prescribing patterns. Clinicians' evaluation/self-reflection forms from Stage B and Stage C will also be reviewed to assess participants' engagement in the intervention.

#### **Quantify the amount of change expected from this intervention in terms of your target audience (e.g., a 10% increase over baseline or a decrease in utilization from baseline between 20-40%)**

The goal of this initiative is to reduce DOT/1000 patient days for daptomycin and linezolid to the mean for our comparator institutions (see Table A and Table B above) -- a reduction in DOT/1000 patient days of 6%.

#### **Describe how you plan for the project outcomes to be broadly disseminated.**

The MGH Academy routinely shares acquired data with participants in order to foster inter-activity and reinforce the application of new knowledge. For example, clinicians who take our American Board of Psychiatry and Neurology (ABPN) Maintenance of Certification self-assessment modules are given individualized scoring reports that allow them to compare their own scores to national aggregate performance.

The Academy will also share research findings and outcomes data via its dissemination e-newsletter, which has a distribution of 40,000.

The research team will submit findings from the survey to the 2014 IDSA annual meeting. These findings will also be submitted for publication in a peer-reviewed journal (working title: *“Survey of Clinician Knowledge of Appropriate Antimicrobial Utilization”*). The findings of the post-prescription audit in multidisciplinary rounds will be submitted to the 2015 IDSA annual meeting, and to a peer-reviewed journal (working title: *“The Impact of Targeted Education of Clinicians on Appropriate Utilization of Linezolid and Daptomycin”*).

## **References**

1. Seymann GB, Di Francesco L, Sharpe B, et al. The HCAP gap: Differences between self-reported practice patterns and published guidelines for health care-associated pneumonia. *Clin Infect Dis*. 2009; 49(12):1868-1874.
2. Cosgrove SE, Patel A, Song X, et al. Impact of different methods of feedback to clinicians after postprescription antimicrobial review based on the centers for disease control and prevention's 12 steps to prevent antimicrobial resistance among hospitalized adults. *Infect Control Hosp Epidemiol*. 2007; 28(6):641-646.
3. Dellit TH, Owens RC, McGowan JE, Jr, et al. Infectious diseases society of america and the society for healthcare epidemiology of america guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis*. 2007; 44(2):159-177.
4. Gaynes RP. Preserving the effectiveness of antibiotics. *JAMA*. 2010; 303(22):2293-2294.
5. Beekmann SE, Gilbert DN, Polgreen PM, IDSA Emerging Infections Network. Toxicity of extended courses of linezolid: Results of an infectious diseases society of america emerging infections network survey. *Diagn Microbiol Infect Dis*. 2008; 62(4):407-410.
6. Kainer MA, Devasia RA, Jones TF, et al. Response to emerging infection leading to outbreak of linezolid-resistant enterococci. *Emerg Infect Dis*. 2007; 13(7):1024-1030.
7. Sanchez Garcia M, De la Torre MA, Morales G, et al. Clinical outbreak of linezolid-resistant staphylococcus aureus in an intensive care unit. *JAMA*. 2010; 303(22):2260-2264.
8. Peleg AY, Miyakis S, Ward DV, et al. Whole genome characterization of the mechanisms of daptomycin resistance in clinical and laboratory derived isolates of staphylococcus aureus. *PLoS One*. 2012; 7(1):e28316.
9. Srinivasan A. Engaging hospitalists in antimicrobial stewardship: The CDC perspective. *J Hosp Med*. 2011; 6 Suppl 1:S31-3.
10. The Joint Commission. Hospital Accreditation Program: National patient safety goals effective January 1, 2012;

[http://www.jointcommission.org/assets/1/6/NPSG\\_Chapter\\_Jan2012\\_HAP.pdf](http://www.jointcommission.org/assets/1/6/NPSG_Chapter_Jan2012_HAP.pdf); Retrieved October 1, 2012.

11. Infectious Diseases Society of America (IDSA), Spellberg B, Blaser M, et al. Combating antimicrobial resistance: Policy recommendations to save lives. *Clin Infect Dis*. 2011; 52 Suppl 5:S397-428.
12. Shenoy ES, Walensky RP, Lee H, Orcutt B, Hooper DC. Resource burden associated with contact precautions for methicillin-resistant staphylococcus aureus and vancomycin-resistant enterococcus: The patient access managers' perspective. *Infect Control Hosp Epidemiol*. 2012; 33(8):849-852.
13. Shenoy E, Hsu H, Noubary F, Hooper D, Walensky R. National survey of infection preventionists: Policies for discontinuation of contact precautions for methicillin-resistant *staphylococcus aureus* (MRSA) and vancomycin-resistant enterococcus (VRE). *Infect Control Hosp Epidemiol*. 2012; In Press.

### **3) Detailed Workplan and Deliverables Schedule**

<b>Date</b>	<b>Step/Deliverable</b>
1/1/2013	Begin REDCap clinician survey design and beta testing.
2/1/2013	Complete REDCap survey design and submission to Partners IRB for approval
4/1/2013- 4/14/2013	Implementation of clinician survey (Stage A).
4/15/2013	Begin development of educational material.
4/15/2013	Begin multidisciplinary daily rounds with physician feedback (Stage B).
6/1/2013	Complete development of educational material.
7/1/2013	Begin Learning Management System exercises (ILMs, CSAT). (Stage B).
4/1/2014- 4/14/2014	Clinician post-intervention survey. (Stage C).
5/15/2014	Submission of survey findings to IDSA 2014 (October 2014 conference).
7/31/2014	Complete clinician post-intervention survey.
8/1/2014	Begin analysis of pre- and post- intervention survey results.
8/1/2014	Begin analysis of post-prescription auditing pre- and post- intervention.
9/1/2014	Submit preliminary findings to Infectious Diseases Society of America annual meeting.
12/1/2015	Begin manuscript preparation.
12/31/2014	Complete analysis of program's impact on antimicrobial utilization (via analysis of post-prescription auditing and clinician survey).
5/15/2015	Submission of program impact analysis to ISDA 2015 (October 2015 conference).
7/1/2015	Complete manuscript; submit to peer-reviewed medicine journal.