Title
A report of the efforts of the veterans health administration national antimicrobial stewardship initiative

Permalink
https://escholarship.org/uc/item/2w7697sv

Journal
Infection Control and Hospital Epidemiology, 38(5)

ISSN
0899-823X

Authors
Kelly, AA
Jones, MM
Echevarria, KL
et al.

Publication Date
2017-05-01

DOI
10.1017/ice.2016.328

Peer reviewed
A Report of the Efforts of the Veterans Health Administration National Antimicrobial Stewardship Initiative

Allison A. Kelly, M.D., M.S.O.H. 1,2,3, Makoto Jones, M.D., M.S. 4,5, Kelly Echevarria, PharmD. 6,7,8, Stephen M. Kralovic, M.D., M.P.H. 1,2,3, Matthew Samore, M.D. 4,5, Matthew B. Goetz, M.D. 9,10, Karl Madaras-Kelly, PharmD., M.P.H. 11,12, Loretta A. Simbartl, M.S. 1, Anthony P. Morreale, M.B.A., PharmD., BCPS 13, Melinda M. Neuhauser, PharmD., M.P.H. 14, Gary A. Roselle, M.D. 1,2,3

National Infectious Diseases Service, Veterans Health Administration, Washington, DC; 2Cincinnati VA Medical Center, Cincinnati, OH; 3University of Cincinnati College of Medicine, Cincinnati, OH; 4IDEAS Center, Salt Lake City VA Medical Center, Salt Lake City, UT; 5University of Utah School of Medicine, Salt Lake City, UT; 6South Texas Veterans Healthcare System, San Antonio, TX; 7University Texas Health Science Center, San Antonio, TX; 8University of Texas, Austin, TX; 9VA Greater Los Angeles Healthcare System, Los Angeles, CA; 10David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA; 11Boise VA Medical Center, Boise, ID; 12College of Pharmacy, Idaho State University, Meridian, ID; 13Pharmacy Benefits Management Services, Veterans Health Administration, Washington, DC; 14Pharmacy Benefits Management Services, Veterans Health Administration, Hines, IL

Corresponding Author: Allison A. Kelly
A portion of the data presented in this manuscript was presented as an abstract (#37663) at ID week 2012 in San Diego, CA.

**Abbreviated title:** VHA Antimicrobial Stewardship Initiative Report

**Manuscript Word count:** 2887

**Abstract Word Count:** 239

**ABSTRACT:**
Objective: To detail the activities of the Veterans Health Administration (VHA) Antimicrobial Stewardship Initiative and evaluate outcomes of the program.

Design: Observational analysis

Setting: The VHA is a large integrated healthcare system serving approximately 6 million individuals annually at over 140 medical facilities.

Methods: Utilization of nationally developed resources, proportional distribution of antibiotics, changes in stewardship practices and patient safety measures were reported. In addition, inpatient antimicrobial use was evaluated before and after inception of national stewardship activities.

Results: Nationally developed stewardship resources were well utilized and many stewardship practices significantly increased, including development of written stewardship policies at 92% of facilities by 2015 (p < 0.05). While the proportional distribution of antibiotics did not change, inpatient antibiotic use significantly decreased after the start of activities by the VHA Antimicrobial Stewardship Initiative (p <0.0001). A 12% decrease in antibiotic use was noted overall. VHA has also noted significantly declining use of antimicrobials prescribed for resistant Gram-negative organisms including carbapenems and declining hospital readmission and mortality rates. Concurrently VHA experienced decreasing rates of *Clostridium difficile* infection.

Conclusions: The VHA has implemented a national antimicrobial stewardship program with continued education, disease-specific guideline and example policy development in addition to other highly utilized resources. While no specific ideal level of antimicrobial utilization is known, VHA has shown that improving antimicrobial usage in a large healthcare system may be achieved through national guidance and resources with local implementation of antimicrobial stewardship programs.
The Centers for Disease Control and Prevention (CDC) estimates that two million people annually acquire infections due to antimicrobial-resistant organisms in the United States. Increasing resistance and a decrease in development of effective therapeutics create challenges in the management of infectious diseases. Antimicrobial use is one of the strongest risk factors for the development of antimicrobial-resistant infections and may also lead to unintended consequences such as adverse drug events and infection due to *Clostridium difficile*. Antimicrobial stewardship programs (ASPs) strive to optimize antimicrobial use to avoid unintended consequences and improve clinical outcomes.

The Department of Veterans Affairs (VA), Veterans Health Administration (VHA) recognized the importance of antimicrobial stewardship programs and began the VHA Antimicrobial Stewardship Initiative in mid-2010 with the goal of providing national guidance and resources for implementation of ASPs at local VHA medical centers (VAMCs). This initiative is coordinated through the VHA National Antimicrobial Stewardship Taskforce (ASTF) chartered in May 2011. The ASTF, co-chaired by representatives from the VHA National Infectious Diseases Service and the National Pharmacy Benefits Management Services, is comprised of a twenty-five member multidisciplinary team selected based on their areas of expertise. In January 2014, with the publication of VHA Directive 1031 which requires all VHA medical facilities to implement, maintain and annually evaluate ASPs, the VA solidified its commitment to optimize antimicrobial usage and improve the care of Veterans.

The purpose of this report is to detail the activities of the VHA Antimicrobial Stewardship Initiative and evaluate national process and outcome measures of the program.
METHODS:

Setting:

The VHA is a large, federal, integrated healthcare system serving approximately 6 million individual patients annually at over 140 medical facilities distributed throughout the country. VHA medical facilities offer a wide range of acute care, long term care, outpatient and rehabilitation services to enrolled Veterans across the United States. (Veteran population demographics and VHA medical facility characteristics in Supplemental Tables 1 and 2)

Engagement: Education and Information Gathering:

The VHA Antimicrobial Stewardship Initiative began with a series of educational conferences to discuss the concept of stewardship with interested VHA field practitioners. This series consisted of a face-to-face conference repeated in three separate geographic regions to ensure system-wide representation from May through July of 2010 and a follow-up conference, in November 2011, focused more specifically on implementation of stewardship activities and development of ASP networks.

A number of additional stewardship activities were undertaken in 2011. A nationwide group of approximately 250 volunteer field stewardship champions, representing diverse disciplines including clinical pharmacists and infectious diseases physicians, was identified to serve as a resource for communication and dissemination of stewardship topics and from whom multiple stewardship “best-practices” documents were collected. To aid in antimicrobial optimization the on-line version of The Sanford Guide® To Antimicrobial Therapy, an authoritative reference on...
antimicrobial therapy, was provided for use at all VHA medical facilities beginning in October 2011. Also in October 2011, the ASTF administered a voluntary self-reported survey of stewardship practices across the VA to gain an understanding of existing ASPs and determine which ASTF activities and resources might be most useful.

In January 2012, the ASTF implemented two additional key activities. An internal VHA Antimicrobial Stewardship Microsoft SharePoint® site was launched to serve as a robust repository of stewardship documents, resources and tools for facilities to utilize in development and expansion of local stewardship programs. The ASTF also launched an ongoing monthly series of educational web-based teleconferences (e.g. webinars) which covered a range of infectious diseases clinical topics and implementation strategies pertinent to stewardship.

To follow up on the 2011 voluntary survey of stewardship practices, a required comprehensive systematic survey, performed with the assistance of the VHA Healthcare Analysis and Informatics Group, was administered to each VHA facility in November 2012. This survey was revised and performed again in December 2015 to evaluate uptake and progress of stewardship activities in the field.

**Encouragement: Policy Development and Dissemination:**

Beginning in 2012, a series of stewardship-related example policies and intervention tools, itemized in Table 1, were developed by the ASTF. The general approach to drafting these documents involved conducting a literature search of existing evidence and, when possible, performing a retrospective review of VHA practice patterns in areas targeted for intervention. Many of these policies were created within a framework that utilized antimicrobial stewardship
champions, particularly clinical pharmacists, to identify appropriate patients and make recommendations to optimize therapy. These example policies and intervention tools were subsequently “launched” through the monthly webinar series and posted to the VHA Antimicrobial Stewardship Microsoft SharePoint® site for elective adaptation and implementation as facilities deemed appropriate.

The ASTF coordinated with VA Central Office to encourage local facility institutional support for stewardship. Leadership support for ASPs was demonstrated at the highest levels with the VA Under Secretary for Health’s Information Letter on Antimicrobial Stewardship published in July 2012. This Letter, distributed to all VAMCs, described the importance and encouraged development of ASPs in the VA. Additionally, a memorandum was distributed through the VA operational hierarchy in September 2013 encouraging local administration at each VAMC to provide funding for clinical pharmacists to complete antimicrobial stewardship certificate programs dependent upon need. Clinical pharmacists were to be selected locally for certificate programs based on training, background and job requirements. VA Central Office leadership confirmed its commitment to stewardship with the publication of VHA Directive 1031: Antimicrobial Stewardship Programs in January 2014. This Directive required all VAMCs to implement, maintain and evaluate ASPs designed to optimize available local resources including identification of local stewardship provider and pharmacist champions.

Data sources:

Resource Utilization Data

Attendance at face-to-face educational meetings and “attendee lines” used for webinars were tallied at the time of the events. Attendee lines represents the minimal number of attendees as
multiple individuals may have viewed a presentation together using a single line. Utilization of computerized stewardship resources was obtained through each individual website’s totaled log-in data per month. Individual VAMC stewardship activities were identified through the three distinct national surveys conducted in 2011, 2012 and 2015.

Antimicrobial Use Data

The VA’s Office of Information and Technology built the Corporate Data Warehouse (CDW) to standardize and consolidate VA clinical data including Bar Code Medication Administration Data (BCMA) for administered medications incorporated in the VA’s electronic medical record. The CDW was used to obtain BCMA data for the calculation of inpatient antimicrobial days of therapy (DOT). DOT was defined as a single dose of an antimicrobial given intravenously or orally to a patient on a single day regardless of the strength or frequency of the drug. For example, administration of vancomycin as a single 1-gm dose or as two 1-gm doses given 12 hours apart both constitute one DOT. DOT for an antibiotic with possible intravenous and oral forms combined both formulations in the usage data for that agent. Nationwide VAMC inpatient bed days of care (BDOC) were obtained from the VA’s Austin Information Technology Center data center. BDOC were defined as day during which a person is confined to a bed in which the patient stays overnight. Inpatient status was defined as an admission to an acute care bed including an intensive care unit, step down unit, medical or surgical unit and observational bed status. The antimicrobial use calculations excluded hemodialysis, psychiatric, rehabilitation or long-term care nursing units. DOT/1000 BDOC by quarter were evaluated for all antibiotics from 2007 through 2015. All antibiotic use data were analyzed in an aggregated de-identified
manner. Of note, at no time during the analysis period did the VHA experience any significant national formulary changes or prolonged shortages of antibiotics.

For dissemination of these data beyond programmatic needs, the analysis was evaluated by the institutional review board at the Cincinnati VA Medical Center.

Statistics:

Using SAS version 9.3 (SAS Institute), linear regression analysis was used to examine the progression of the DOT/1000 BDOC by quarter for the time periods before and after inception of the VHA Antimicrobial Stewardship Initiative. A comparison of the linear regression slopes was performed to determine any significance in the difference of the slopes for the two time periods. Chi-square analyses were used to examine the proportional distribution of antibiotic use for specific antibiotics, antibiotic classes or groups from 2007 to 2015. Chi-square analyses were also used to determine the differences in selected stewardship activities and reported challenges from the 2011, 2012 and 2015 surveys.

RESULTS:

Process Measures - Utilization of Resources and Stewardship Practices Nationwide:

The VHA Antimicrobial Stewardship Initiative’s face-to-face educational conferences combined hosted nearly 450 participants from VHA facilities evenly distributed throughout the country. The on-line version of the Sanford Guide® and the VHA Antimicrobial Stewardship Microsoft SharePoint® site experienced consistently increasing utilization with an average number of monthly visits of more than 5000 and 2400, respectively. In addition, the ASTF monthly
Webinars were well attended with an average of more than 175 attendee lines used per month.

(Figure 1) As shown in Table 1, the ASTF example policies were utilized as varying rates with a high of fifty-one percent of facilities with intravenous to oral conversion interventions reporting use of that ASTF example policy in development of local processes.

The initial 2011 ASTF Inventory of Stewardship Practices indicated that each of the 126 respondent acute care VAMCs performed at least one stewardship activity with over 70% of facilities performing the following activities: generation of annual antibiograms, imposed formulary restrictions, policies for criteria for use of certain antimicrobials, utilization of inpatient clinical pathways/guidelines, selective microbiology results reporting and dose optimization of selected antimicrobials. The subsequent 2012 and 2015 surveys, completed by 130 and 140 VAMCs respectively, demonstrated progressive increases in numerous additional stewardship practices and decreases in reported challenges to ASPs. By the time of the 2015 Stewardship Survey, eighty-nine percent of facilities had defined a stewardship team, up from 41% in 2011 (p < 0.05), and ninety-two percent of facilities had a written policy for stewardship, up from 17% in 2011 (p < 0.05). The results of selected stewardship practices and challenges with improvements from the 2011, 2012 and 2015 surveys are summarized in Figures 2 and 3.

Outcome Measures - Nationwide VHA Antimicrobial Use, Resistance and Patient Safety:

Aggregated quarterly inpatient antibiotic use, shown in Figure 4, significantly decreased after the start of activities by the VHA Antimicrobial Stewardship Initiative in the second quarter of 2010 (p <0.0001). A 12% decrease in antibiotic use was noted overall from a quarterly high of 761.2
254DOT/1000 BDOC prior to the Initiative in the first quarter of 2008 to 673.3 DOT/1000 BDOC in the final quarter of 2015.

256

257Use of broad spectrum antimicrobials for highly resistant organisms, such as carbapenems, polymyxins and tigecycline, are potential surrogates for resistance given their role in the treatment of such resistant organisms. All three of these antimicrobial classes/agents demonstrated significantly increased use prior to inception of the VHA Antimicrobial Stewardship Initiative, with a decreasing trend in the use of carbapenems and significantly decreased use of polymyxins and tigecycline noted after the Initiative began. (Figure 5) A comparison of the linear regression slopes determined significant decreases in use of each of the antimicrobial classes/agents (P < 0.05 for each).

265

266Vancomycin, fluoroquinolones, piperacillin-tazobactam and cephalosporins were consistently the most frequently administered antibiotics or antibiotic classes from January 2007 through December 2015 with vancomycin and piperacillin-tazobactam alone consistently totaling nearly one-third of all antibiotic use. The proportion of fluoroquinolone use dropped from 18% in 2007 to 13% in 2015 and the proportion of cephalosporin use increased from 16% in 2007 to 22% in 2015 but neither trend was significant (p = 0.95 and 0.97 respectively). Percentage distributions of the remainder of the antibiotic agents, classes and groupings remained stable throughout the time period with no significant differences seen across the years (p = 0.99). (Supplemental Figure 1)
The VHA Multidrug Resistant Organism Prevention Initiative, a highly active complementary national program, maintains a specific prevention initiative for *Clostridium difficile* infection, implemented July 2012, incorporating a bundled approach of infection control and environmental management practices with cultural transformation. This parallel program has published decreasing rates of *C. difficile* infection in both acute and long term care VHA facilities in the same time period as concomitant activity by the VHA Antimicrobial Stewardship Initiative.9,10

Hospital acute and intensive care length of stays have remained stable while readmission and mortality rates have decreased since inception of the VHA Antimicrobial Stewardship Initiative. (Supplemental Table 3) Total hospital discharges related to infectious diseases as determined by diagnosis related group have increased from 2012 to 2014 and the percentage distribution of those discharges by infectious diseases diagnosis group have remained stable. (Supplemental Figure 3)

**DISCUSSION:**

Antimicrobial use is a known driver of antimicrobial resistance with recent reports showing global antibiotic consumption rising by 36% from 2000-2011.11 With as much as half of all antibiotic use potentially unnecessary, antimicrobial stewardship programs with methods to optimize antimicrobial use have become essential.12,13,14 To this end, the VHA has instituted a successful National Antimicrobial Stewardship Initiative coordinated through its National Antimicrobial Stewardship Taskforce. The Taskforce has developed effective, highly utilized educational programs, tools and resources to support implementation and augmentation of local
VHA ASPs and spearheaded publication of VHA national policies regarding stewardship. VHA national stewardship policies allow VAMCs to utilize local experts and resources to optimize and individualize their ASPs. After the start of the VHA National Antimicrobial Stewardship Initiative’s activities, inpatient antimicrobial use declined significantly by 12% overall with 3.3 DOT/1000 BDOC noted in the final quarter of 2015. No change was noted in the yearly proportional distribution of specific antimicrobial agents, classes and groups which intimates that the decrease in antimicrobial use was not related specifically to one agent or class but a more global overall decline in use across antimicrobial classes. Additionally, from 2012 to 2015 VA has noted decreasing rates of *C. difficile* infection and significant declining use of antimicrobial agents prescribed for highly resistant Gram-negative organism including carbapenems. During this same period of time, improvements in VHA medical facility readmission and mortality rates were observed.

There are few reports in the literature describing antimicrobial use in a large diverse healthcare system such as the VA. Polk et al, working with the University HealthSystem Consortium, reported on antibiotic use in 2009 from seventy academic medical centers in the United States. These researchers found a mean hospital-wide use of 839.0 DOT/1000 patient-days while inpatient VHA antimicrobial usage for that calendar year was considerably lower at 718.1 DOT/1000 BDOC. Also, more recently, Baggs et al published an analysis of inpatient antibiotic use from 2006 to 2012 demonstrating an overall national DOT of 755 per 1000 patient-days which is higher than VHA’s average quarterly use from 2007 to 2012, 718.6 DOT/1000 BDOC. In addition, these researchers estimated significant increases in several antibiotic classes including carbapenems with 32.3 DOT/1000 patient-days noted in 2012. Carbapenem use in
VHA initially increased prior to the inception of the VHA Antimicrobial Stewardship Initiative but subsequently decreased with an average quarterly use of 28.3 DOT/1000 BDOC noted in 2012.

There are some limitations of this report. At the time of this report validated national microbiologic data extraction tools for VHA were not available, therefore use of broad spectrum antimicrobials for highly resistant organisms were employed as surrogates for resistance. Additionally, the concomitant successful VHA MDRO C. difficile Prevention Initiative limits interpretation of the impact of the VHA Antimicrobial Stewardship Program on C. difficile rates.

The VHA Antimicrobial Stewardship Initiative provides national support and resources for local implementation of stewardship interventions but does not require implementation of specific stewardship policies or define appropriateness of use. VHA facilities are encouraged to design ASPs around their unique needs and available resources. This approach and the diverse nature of VAMCs with varying levels of facility capabilities and patient complexities do not allow for analysis of the impact of specific stewardship interventions from a national perspective nor can we conclude which interventions may be most effective at optimizing antimicrobial use to appropriate levels. VA researchers, however, are utilizing the VHA Stewardship Surveys to overlay stewardship activities with antimicrobial use to define key characteristics of effective ASPs. From information provided on the 2012 VHA Stewardship Survey, Chou et al concluded that decreased antimicrobial use was associated with having infectious diseases physicians and pharmacists present, as well as the frequency of patient-level reviews of antimicrobial use, and having a policy to address antimicrobial use in patients with C. difficile infection. A similar analysis from data reported on the 2015 VHA Stewardship Survey is in process.
Over the course of several years with dedicated national and local volunteers, the VA has established stewardship programs nationwide. Through continued education, disease-specific guideline reviews, sample policy development and other resources, along with leadership engagement and support, the VHA Antimicrobial Stewardship Initiative has ongoing efforts to optimize antimicrobial use and attain the goal of a 20% reduction in inpatient antibiotic use by 2020 set forth in the National Action Plan for Combatting Antibiotic-Resistant Bacteria. While no specific ideal level of antimicrobial utilization is known, the VA has shown that decreasing antimicrobial usage in a large healthcare system may be achieved through national guidance and resources with local implementation of ASPs. The VHA Antimicrobial Stewardship Initiative will continue to lead in the development of stewardship programs with expansion of stewardship activities to other areas of patient care, particularly long-term and outpatient care, hopefully serving as a model for other large healthcare systems.

ACKNOWLEDGEMENTS:

We wish to thank Kevin Nechodom of the IDEAS Center Salt Lake City VA Medical Center for his expert technical support; the Antimicrobial Stewardship Taskforce and workgroup members;
and most importantly the Antimicrobial Stewardship Champions at each VHA facility across the
country for their efforts in optimizing antimicrobial use and improving the health care of U.S.
Veterans.

**Financial support:** The authors acknowledge funding support from the Center for Disease
Control and Prevention’s Safety and Healthcare Epidemiology Prevention Research
Development (SHEPHerD) [Task Order 2013-03] to develop the collection of Bar Code
Medication Administration data to form antimicrobial days of therapy.

**Potential conflict of interest:** All authors: No reported conflicts.

**REFERENCES:**

1) Centers for Disease Control and Prevention: Antibiotic Resistance Threats in the United


5) Chang HT, Krezolek D, Johnson S, Parada JP, Evans CT, Gerding DN. Onset of Symptoms and Time to Diagnosis of *Clostridium difficile*-Associated Disease Following Discharge from an Acute Care Hospital. *Infect Control Hosp Epidemiol* 2007; 28:926–931.


<table>
<thead>
<tr>
<th>Example Policy</th>
<th>Launch</th>
<th>Percent of</th>
<th>Percent</th>
</tr>
</thead>
</table>

1. Facilities that reported performing the specified interventions on the 2015 Stewardship Survey
2. Percentage of facilities performing the specified intervention that reported utilizing the ASTF example policies to develop the intervention
<table>
<thead>
<tr>
<th>Facility Description</th>
<th>Date</th>
<th>Facilities Utilized (n = 140)</th>
<th>Facilities that Utilized ASTF Examples²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intravenous to Oral Conversion Tool</td>
<td>May 2012</td>
<td>116 (83%)</td>
<td>51%</td>
</tr>
<tr>
<td>Avoidance of Double Anaerobic Coverage</td>
<td>Jun 2012</td>
<td>99 (71%)</td>
<td>42%</td>
</tr>
<tr>
<td>Intervention to Improve Outcome for Patients with C. difficile Infection</td>
<td>Aug 2012</td>
<td>90 (64%)</td>
<td>21%</td>
</tr>
<tr>
<td>Stewardship Monitoring of Outpatient Parenteral Antimicrobial Therapy</td>
<td>Nov 2012</td>
<td>85 (61%)</td>
<td>22%</td>
</tr>
<tr>
<td>Vancomycin De-escalation</td>
<td>Jan 2013</td>
<td>97 (69%)</td>
<td>32%</td>
</tr>
<tr>
<td>Workload Documentation Guidance</td>
<td>May 2013</td>
<td>64 (46%)</td>
<td>27%</td>
</tr>
<tr>
<td>Broad-Spectrum Gram-Negative De-escalation</td>
<td>Oct 2013</td>
<td>98 (70%)</td>
<td>24%</td>
</tr>
<tr>
<td>Pneumonia Duration of Therapy</td>
<td>Sep 2014</td>
<td>63 (45%)</td>
<td>21%</td>
</tr>
<tr>
<td>S. aureus Bacteremia Intervention</td>
<td>Jul 2015</td>
<td>83 (59%)</td>
<td>20%</td>
</tr>
</tbody>
</table>

Figure 1: Monthly Use of Nationally Provided Resources

Total monthly log in usage data for electronic resources provided by the VHA Antimicrobial Stewardship Initiative and attendee lines used for stewardship educational webinars. Note – usage data for the VHA Antimicrobial Stewardship SharePoint® site became unavailable after March 2015 due to a website platform change.

Figure 2: Comparison of Selected Stewardship Practices
Percentage of reported activities at VHA medical centers from surveys completed in 2011, 2012 and 2015 compared by Chi-square analyses. Abbreviations: IV, intravenous; PO, oral; NS, non-significant.

**Figure 3: Comparison of Reported Challenges to Stewardship Programs**

Percentage of reported challenges to stewardship programs incurred at VHA medical centers from surveys completed in 2012 and 2015 compared by Chi-square analyses. Abbreviations: IT, information technology; ID, infectious diseases.

**Figure 4: Veterans Health Administration (VHA) Inpatient Antibiotic Use: Days of Therapy (DOT) per 1000 Bed Days of Care (BDOC)**

Inpatient antibiotic use before and after inception activities for the VHA Antimicrobial Stewardship Initiative in the 2nd quarter of calendar year 2010 (denoted by the vertical black line) by simple linear regression with comparison of slopes. An overall 12% decline in use was noted. Abbreviations: DOT, days of therapy; BDOC, bed days of care.

**Figure 5: Inpatient Use of Selected Antibiotics Targeting Resistant Organisms**

Carbapenems, polymyxins and tigecycline use before and after inception of activities for the VHA Antimicrobial Stewardship Initiative in the 2nd quarter of calendar year 2010 (denoted by the vertical black line) by simple linear regression with comparison of slopes. Abbreviations: DOT, days of therapy; BDOC, bed days of care.