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Title

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Permalink

<https://escholarship.org/uc/item/2w7697sv>

Journal

Infection Control and Hospital Epidemiology, 38(5)

ISSN

0899-823X

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Publication Date

2017-05-01

DOI

10.1017/ice.2016.328

Peer reviewed

**1A Report of the Efforts of the Veterans Health Administration National Antimicrobial
2Stewardship Initiative**

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32A portion of the data presented in this manuscript was presented as an abstract (#37663) at ID

33week 2012 in San Diego, CA.

34

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

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37**Manuscript Word count:** 2887

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39**Abstract Word Count:** 239

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47**ABSTRACT:**

48Objective: To detail the activities of the Veterans Health Administration (VHA) Antimicrobial
49Stewardship Initiative and evaluate outcomes of the program.

50Design: Observational analysis

51Setting: The VHA is a large integrated healthcare system serving approximately 6 million
52individuals annually at over 140 medical facilities.

53Methods: Utilization of nationally developed resources, proportional distribution of antibiotics,
54changes in stewardship practices and patient safety measures were reported. In addition, inpatient
55antimicrobial use was evaluated before and after inception of national stewardship activities.

56Results: Nationally developed stewardship resources were well utilized and many stewardship
57practices significantly increased, including development of written stewardship policies at 92%
58of facilities by 2015 ($p < 0.05$). While the proportional distribution of antibiotics did not change,
59inpatient antibiotic use significantly decreased after the start of activities by the VHA
60Antimicrobial Stewardship Initiative ($p < 0.0001$). A 12% decrease in antibiotic use was noted
61overall. VHA has also noted significantly declining use of antimicrobials prescribed for resistant
62Gram-negative organisms including carbapenems and declining hospital readmission and
63mortality rates. Concurrently VHA experienced decreasing rates of *Clostridium difficile*
64infection.

65Conclusions: The VHA has implemented a national antimicrobial stewardship program with
66continued education, disease-specific guideline and example policy development in addition to
67other highly utilized resources. While no specific ideal level of antimicrobial utilization is
68known, VHA has shown that improving antimicrobial usage in a large healthcare system may be
69achieved through national guidance and resources with local implementation of antimicrobial
70stewardship programs.

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92INTRODUCTION:

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93The Centers for Disease Control and Prevention (CDC) estimates that two million people
94annually acquire infections due to antimicrobial-resistant organisms in the United States.¹
95Increasing resistance and a decrease in development of effective therapeutics create challenges in
96the management of infectious diseases. Antimicrobial use is one of the strongest risk factors for
97the development of antimicrobial-resistant infections and may also lead to unintended
98consequences such as adverse drug events and infection due to *Clostridium difficile*.^{2,3,4,5}
99Antimicrobial stewardship programs (ASPs) strive to optimize antimicrobial use to avoid
100unintended consequences and improve clinical outcomes.

101

102The Department of Veterans Affairs (VA), Veterans Health Administration (VHA) recognized the
103importance of antimicrobial stewardship programs and began the VHA Antimicrobial
104Stewardship Initiative in mid-2010 with the goal of providing national guidance and resources
105for implementation of ASPs at local VHA medical centers (VAMCs). This initiative is
106coordinated through the VHA National Antimicrobial Stewardship Taskforce (ASTF) chartered
107in May 2011. The ASTF, co-chaired by representatives from the VHA National Infectious
108Diseases Service and the National Pharmacy Benefits Management Services, is comprised of a
109twenty-five member multidisciplinary team selected based on their areas of expertise. In January
1102014, with the publication of VHA Directive 1031 which requires all VHA medical facilities to
111implement, maintain and annually evaluate ASPs, the VA solidified its commitment to optimize
112antimicrobial usage and improve the care of Veterans.⁶

113

114The purpose of this report is to detail the activities of the VHA Antimicrobial Stewardship
115Initiative and evaluate national process and outcome measures of the program.

116

117**METHODS:**

118**Setting:**

119The VHA is a large, federal, integrated healthcare system serving approximately 6 million
120individual patients annually at over 140 medical facilities distributed throughout the country.

121VHA medical facilities offer a wide range of acute care, long term care, outpatient and
122rehabilitation services to enrolled Veterans across the United States. (Veteran population
123demographics and VHA medical facility characteristics in Supplemental Tables 1 and 2)

124

125**Engagement: Education and Information Gathering:**

126The VHA Antimicrobial Stewardship Initiative began with a series of educational conferences to
127discuss the concept of stewardship with interested VHA field practitioners. This series consisted
128of a face-to-face conference repeated in three separate geographic regions to ensure system-wide
129representation from May through July of 2010 and a follow-up conference, in November 2011,
130focused more specifically on implementation of stewardship activities and development of ASP
131networks.

132

133A number of additional stewardship activities were undertaken in 2011. A nationwide group of
134approximately 250 volunteer field stewardship champions, representing diverse disciplines
135including clinical pharmacists and infectious diseases physicians, was identified to serve as a
136resource for communication and dissemination of stewardship topics and from whom multiple
137stewardship “best-practices” documents were collected. To aid in antimicrobial optimization the
138on-line version of The Sanford Guide[®] To Antimicrobial Therapy, an authoritative reference on

139antimicrobial therapy, was provided for use at all VHA medical facilities beginning in October
1402011. Also in October 2011, the ASTF administered a voluntary self-reported survey of
141stewardship practices across the VA to gain an understanding of existing ASPs and determine
142which ASTF activities and resources might be most useful.

143

144In January 2012, the ASTF implemented two additional key activities. An internal VHA
145Antimicrobial Stewardship Microsoft SharePoint® site was launched to serve as a robust
146repository of stewardship documents, resources and tools for facilities to utilize in development
147and expansion of local stewardship programs. The ASTF also launched an ongoing monthly
148series of educational web-based teleconferences (e.g. webinars) which covered a range of
149infectious diseases clinical topics and implementation strategies pertinent to stewardship.

150

151To follow up on the 2011 voluntary survey of stewardship practices, a required comprehensive
152systematic survey, performed with the assistance of the VHA Healthcare Analysis and
153Informatics Group, was administered to each VHA facility in November 2012. This survey was
154revised and performed again in December 2015 to evaluate uptake and progress of stewardship
155activities in the field.

156

157Encouragement: Policy Development and Dissemination:

158Beginning in 2012, a series of stewardship-related example policies and intervention tools,
159itemized in Table 1, were developed by the ASTF. The general approach to drafting these
160documents involved conducting a literature search of existing evidence and, when possible,
161performing a retrospective review of VHA practice patterns in areas targeted for intervention.
162Many of these policies were created within a framework that utilized antimicrobial stewardship

163champions, particularly clinical pharmacists, to identify appropriate patients and make
164recommendations to optimize therapy. These example policies and intervention tools were
165subsequently “launched” through the monthly webinar series and posted to the VHA
166Antimicrobial Stewardship Microsoft SharePoint® site for elective adaptation and
167implementation as facilities deemed appropriate.

168

169The ASTF coordinated with VA Central Office to encourage local facility institutional support
170for stewardship. Leadership support for ASPs was demonstrated at the highest levels with the VA
171Under Secretary for Health’s Information Letter on Antimicrobial Stewardship published in July
1722012⁷. This Letter, distributed to all VAMCs, described the importance and encouraged
173development of ASPs in the VA. Additionally, a memorandum was distributed through the VA
174operational hierarchy in September 2013 encouraging local administration at each VAMC to
175provide funding for clinical pharmacists to complete antimicrobial stewardship certificate
176programs dependent upon need. Clinical pharmacists were to be selected locally for certificate
177programs based on training, background and job requirements. VA Central Office leadership
178confirmed its commitment to stewardship with the publication of VHA Directive 1031:
179Antimicrobial Stewardship Programs in January 2014.⁶ This Directive required all VAMCs to
180implement, maintain and evaluate ASPs designed to optimize available local resources including
181identification of local stewardship provider and pharmacist champions.

182

183 **Data sources:**

184 Resource Utilization Data

185 Attendance at face-to-face educational meetings and “attendee lines” used for webinars were
186 tallied at the time of the events. Attendee lines represents the minimal number of attendees as

187multiple individuals may have viewed a presentation together using a single line. Utilization of
188computerized stewardship resources was obtained through each individual website's totaled log-
189in data per month. Individual VAMC stewardship activities were identified through the three
190distinct national surveys conducted in 2011, 2012 and 2015.

191

192Antimicrobial Use Data

193The VA's Office of Information and Technology built the Corporate Data Warehouse (CDW) to
194standardize and consolidate VA clinical data including Bar Code Medication Administration Data
195(BCMA) for administered medications incorporated in the VA's electronic medical record. The
196CDW was used to obtain BCMA data for the calculation of inpatient antimicrobial days of
197therapy (DOT). DOT was defined as a single dose of an antimicrobial given intravenously or
198orally to a patient on a single day regardless of the strength or frequency of the drug.⁸ For
199example, administration of vancomycin as a single 1-gm dose or as two 1-gm doses given 12
200hours apart both constitute one DOT. DOT for an antibiotic with possible intravenous and oral
201forms combined both formulations in the usage data for that agent. Nationwide VAMC inpatient
202bed days of care (BDOC) were obtained from the VA's Austin Information Technology Center
203data center. BDOC were defined as day during which a person is confined to a bed in which the
204patient stays overnight. Inpatient status was defined as an admission to an acute care bed
205including an intensive care unit, step down unit, medical or surgical unit and observational bed
206status. The antimicrobial use calculations excluded hemodialysis, psychiatric, rehabilitation or
207long-term care nursing units. DOT/1000 BDOC by quarter were evaluated for all antibiotics
208from 2007 through 2015. All antibiotic use data were analyzed in an aggregated de-identified

209manner. Of note, at no time during the analysis period did the VHA experience any significant
210national formulary changes or prolonged shortages of antibiotics.

211

212For dissemination of these data beyond programmatic needs, the analysis was evaluated by the
213institutional review board at the Cincinnati VA Medical Center.

214

215**Statistics:**

216Using SAS version 9.3 (SAS Institute), linear regression analysis was used to examine the
217progression of the DOT/1000 BDOC by quarter for the time periods before and after inception of
218the VHA Antimicrobial Stewardship Initiative. A comparison of the linear regression slopes was
219performed to determine any significance in the difference of the slopes for the two time periods.
220Chi-square analyses were used to examine the proportional distribution of antibiotic use for
221specific antibiotics, antibiotic classes or groups from 2007 to 2015. Chi-square analyses were
222also used to determine the differences in selected stewardship activities and reported challenges
223from the 2011, 2012 and 2015 surveys.

224

225**RESULTS:**

226**Process Measures - Utilization of Resources and Stewardship Practices Nationwide:**

227The VHA Antimicrobial Stewardship Initiative's face-to-face educational conferences combined
228hosted nearly 450 participants from VHA facilities evenly distributed throughout the country.
229The on-line version of the Sanford Guide® and the VHA Antimicrobial Stewardship Microsoft
230SharePoint® site experienced consistently increasing utilization with an average number of
231monthly visits of more than 5000 and 2400, respectively. In addition, the ASTF monthly

232webinars were well attended with an average of more than 175 attendee lines used per month.
233(Figure 1) As shown in Table 1, the ASTF example policies were utilized as varying rates with a
234high of fifty-one percent of facilities with intravenous to oral conversion interventions reporting
235use of that ASTF example policy in development of local processes.

236

237The initial 2011 ASTF Inventory of Stewardship Practices indicated that each of the 126
238respondent acute care VAMCs performed at least one stewardship activity with over 70% of
239facilities performing the following activities: generation of annual antibiograms, imposed
240formulary restrictions, policies for criteria for use of certain antimicrobials, utilization of
241inpatient clinical pathways/guidelines, selective microbiology results reporting and dose
242optimization of selected antimicrobials. The subsequent 2012 and 2015 surveys, completed by
243130 and 140 VAMCs respectively, demonstrated progressive increases in numerous additional
244stewardship practices and decreases in reported challenges to ASPs. By the time of the 2015
245Stewardship Survey, eighty-nine percent of facilities had defined a stewardship team, up from
24641% in 2011 ($p < 0.05$), and ninety-two percent of facilities had a written policy for stewardship,
247up from 17% in 2011 ($p < 0.05$). The results of selected stewardship practices and challenges
248with improvements from the 2011, 2012 and 2015 surveys are summarized in Figures 2 and 3.

249

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

251Aggregated quarterly inpatient antibiotic use, shown in Figure 4, significantly decreased after the
252start of activities by the VHA Antimicrobial Stewardship Initiative in the second quarter of 2010
253($p < 0.0001$). 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
255the final quarter of 2015.

256

257Use of broad spectrum antimicrobials for highly resistant organisms, such as carbapenems,
258polymyxins and tigecycline, are potential surrogates for resistance given their role in the
259treatment of such resistant organisms. All three of these antimicrobial classes/agents
260demonstrated significantly increased use prior to inception of the VHA Antimicrobial
261Stewardship Initiative, with a decreasing trend in the use of carbapenems and significantly
262decreased use of polymyxins and tigecycline noted after the Initiative began. (Figure 5) A
263comparison of the linear regression slopes determined significant decreases in use of each of the
264antimicrobial classes/agents ($P < 0.05$ for each).

265

266Vancomycin, fluoroquinolones, piperacillin-tazobactam and cephalosporins were consistently the
267most frequently administered antibiotics or antibiotic classes from January 2007 through
268December 2015 with vancomycin and piperacillin-tazobactam alone consistently totaling nearly
269one-third of all antibiotic use. The proportion of fluoroquinolone use dropped from 18% in 2007
270to 13% in 2015 and the proportion of cephalosporin use increased from 16% in 2007 to 22% in
2712015 but neither trend was significant ($p = 0.95$ and 0.97 respectively). Percentage distributions
272of the remainder of the antibiotic agents, classes and groupings remained stable throughout the
273time period with no significant differences seen across the years ($p = 0.99$). (Supplemental
274Figure 1)

275

276The VHA Multidrug Resistant Organism Prevention Initiative, a highly active complementary
277national program, maintains a specific prevention initiative for *Clostridium difficile* infection,
278implemented July 2012, incorporating a bundled approach of infection control and
279environmental management practices with cultural transformation. This parallel program has
280published decreasing rates of *C. difficile* infection in both acute and long term care VHA
281facilities in the same time period as concomitant activity by the VHA Antimicrobial Stewardship
282Initiative.^{9,10}

283

284Hospital acute and intensive care length of stays have remained stable while readmission and
285mortality rates have decreased since inception of the VHA Antimicrobial Stewardship Initiative.
286(Supplemental Table 3) Total hospital discharges related to infectious diseases as determined by
287diagnosis related group have increased from 2012 to 2014 and the percentage distribution of
288those discharges by infectious diseases diagnosis group have remained stable. (Supplemental
289Figure 3)

290

291**DISCUSSION:**

292Antimicrobial use is a known driver of antimicrobial resistance with recent reports showing
293global antibiotic consumption rising by 36% from 2000-2011.¹¹ With as much as half of all
294antibiotic use potentially unnecessary, antimicrobial stewardship programs with methods to
295optimize antimicrobial use have become essential.^{12,13,14} To this end, the VHA has instituted a
296successful National Antimicrobial Stewardship Initiative coordinated through its National
297Antimicrobial Stewardship Taskforce. The Taskforce has developed effective, highly utilized
298educational programs, tools and resources to support implementation and augmentation of local

299VHA ASPs and spearheaded publication of VHA national policies regarding stewardship. VHA
300national stewardship policies allow VAMCs to utilize local experts and resources to optimize and
301individualize their ASPs. After the start of the VHA National Antimicrobial Stewardship
302Initiative's activities, inpatient antimicrobial use declined significantly by 12% overall with
303673.3 DOT/1000 BDOC noted in the final quarter of 2015. No change was noted in the yearly
304proportional distribution of specific antimicrobial agents, classes and groups which intimates that
305the decrease in antimicrobial use was not related specifically to one agent or class but a more
306global overall decline in use across antimicrobial classes. Additionally, from 2012 to 2015 VA
307has noted decreasing rates of *C. difficile* infection and significant declining use of antimicrobial
308agents prescribed for highly resistant Gram-negative organism including carbapenems.^{9,10}
309During this same period of time, improvements in VHA medical facility readmission and
310mortality rates were observed.

311

312There are few reports in the literature describing antimicrobial use in a large diverse healthcare
313system such as the VA. Polk et al, working with the University HealthSystem Consortium,
314reported on antibiotic use in 2009 from seventy academic medical centers in the United States.¹⁵
315These researchers found a mean hospital-wide use of 839.0 DOT/1000 patient-days while
316inpatient VHA antimicrobial usage for that calendar year was considerably lower at 718.1
317DOT/1000 BDOC. Also, more recently, Baggs et al published an analysis of inpatient antibiotic
318use from 2006 to 2012 demonstrating an overall national DOT of 755 per 1000 patient-days
319which is higher than VHA's average quarterly use from 2007 to 2012, 718.6 DOT/1000 BDOC.¹⁶
320In addition, these researchers estimated significant increases in several antibiotic classes
321including carbapenems with 32.3 DOT/1000 patient-days noted in 2012. Carbapenem use in

322VHA initially increased prior to the inception of the VHA Antimicrobial Stewardship Initiative
323but subsequently decreased with an average quarterly use of 28.3 DOT/1000 BDOC noted in
3242012.

325

326There are some limitations of this report. At the time of this report validated national
327microbiologic data extraction tools for VHA were not available, therefore use of broad spectrum
328antimicrobials for highly resistant organisms were employed as surrogates for resistance.
329Additionally, the concomitant successful VHA MDRO *C. difficile* Prevention Initiative limits
330interpretation of the impact of the VHA Antimicrobial Stewardship Program on *C. difficile* rates.
331The VHA Antimicrobial Stewardship Initiative provides national support and resources for local
332implementation of stewardship interventions but does not require implementation of specific
333stewardship policies or define appropriateness of use. VHA facilities are encouraged to design
334ASPs around their unique needs and available resources. This approach and the diverse nature of
335VAMCs with varying levels of facility capabilities and patient complexities do not allow for
336analysis of the impact of specific stewardship interventions from a national perspective nor can
337we conclude which interventions may be most effective at optimizing antimicrobial use to
338appropriate levels. VA researchers, however, are utilizing the VHA Stewardship Surveys to
339overlay stewardship activities with antimicrobial use to define key characteristics of effective
340ASPs. From information provided on the 2012 VHA Stewardship Survey, Chou et al concluded
341that decreased antimicrobial use was associated with having infectious diseases physicians and
342pharmacists present, as well as the frequency of patient-level reviews of antimicrobial use, and
343having a policy to address antimicrobial use in patients with *C. difficile* infection.¹⁷ A similar
344analysis from data reported on the 2015 VHA Stewardship Survey is in process.

345

346Over the course of several years with dedicated national and local volunteers, the VA has
347established stewardship programs nationwide. Through continued education, disease-specific
348guideline reviews, sample policy development and other resources, along with leadership
349engagement and support, the VHA Antimicrobial Stewardship Initiative has ongoing efforts to
350optimize antimicrobial use and attain the goal of a 20% reduction in inpatient antibiotic use by
3512020 set forth in the National Action Plan for Combatting Antibiotic-Resistant Bacteria.¹⁸ While
352no specific ideal level of antimicrobial utilization is known, the VA has shown that decreasing
353antimicrobial usage in a large healthcare system may be achieved through national guidance and
354resources with local implementation of ASPs. The VHA Antimicrobial Stewardship Initiative
355will continue to lead in the development of stewardship programs with expansion of stewardship
356activities to other areas of patient care, particularly long-term and outpatient care, hopefully
357serving as a model for other large healthcare systems.

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365ACKNOWLEDGEMENTS:

366We wish to thank Kevin Nechodom of the IDEAS Center Salt Lake City VA Medical Center for
367his expert technical support; the Antimicrobial Stewardship Taskforce and workgroup members;

368and most importantly the Antimicrobial Stewardship Champions at each VHA facility across the
369country for their efforts in optimizing antimicrobial use and improving the health care of U.S.
370Veterans.

371

372**Financial support:** The authors acknowledge funding support from the Center for Disease
373Control and Prevention’s Safety and Healthcare Epidemiology Prevention Research
374Development (SHEPHerD) [Task Order 2013-03] to develop the collection of Bar Code
375Medication Administration data to form antimicrobial days of therapy.

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

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388**REFERENCES:**

3891) Centers for Disease Control and Prevention: Antibiotic Resistance Threats in the United
390States, 2013. <http://www.cdc.gov/drugresistance/threat-report-2013/> Accessed March 20, 2015.

391

3922) Patel G, Huprikar S, Factor SH, Jenkins SG, Calfee DP. Outcomes of Carbapenem-Resistant
393*Klebsiella pneumoniae* Infection and the Impact of Antimicrobial and Adjunctive Therapies.
394*Infect Control Hosp Epidemiol* 2008;29:1099-1106.

395

3963) Talon D, Bailly P, Bertrand X, Thouverez M, Mulin B. Clinical and Molecular Epidemiology
397of Chromosome-mediated Resistance to Third Generation Cephalosporins in Enterobacter
398Isolates in Eastern France. *Clin Micro Infect* 2000; 6:374-382.

399

4004) Shehab N, Patel PR, Srinivasan A, Budnitz DS. Emergency Department Visits for Antibiotic-
401Associated Adverse Events. *Clin Infect Dis* 2008; 15:735-43.

402

4035) Chang HT, Krezolek D, Johnson S, Parada JP, Evans CT, Gerding DN. Onset of Symptoms
404and Time to Diagnosis of *Clostridium difficile*-Associated Disease Following Discharge from an
405Acute Care Hospital. *Infect Control Hosp Epidemiol* 2007; 28:926–931.

406

4076) VHA Directive 1031: Antimicrobial Stewardship Programs.

408http://www.va.gov/vhapublications/ViewPublication.asp?pub_ID=2964 Accessed March 17,
4092015.

410

4117) VHA Under-Secretary for Health's (USH's) Information Letter on Antimicrobial Stewardship.

412<http://vaww.vhaco.va.gov/pubarchives/docs/IL-10-2012-011.pdf> (Internal VA intranet site)

413Accessed March 17, 2015.

414

4158) Polk RE, Fox C, Mahoney A, Letcavage J, MacDougall C. Measurement of Adult
416Antibacterial Drug Use in 130 US Hospitals: Comparison of Defined Daily Dose and Days of
417Therapy. *Clin Infect Dis* 2007; 44:664-670.

418

4199) Evans ME, Kralovic SM, Simbartl LA, Jain R, Roselle GA. Effect of a Clostridium difficile
420Infection Prevention Initiative in Veterans Affairs Acute Care Facilities. *Infect Control Hosp*
421*Epidemiol* 2016; 37:720-722.

422

42310) Reeves JS, Evans ME, Simbartl LA, Kralovic SM, Kelly AA, Jain R, Roselle GA.
424*Clostridium difficile* Infections in Veterans Health Administration Long-Term Care Facilities.
425*Infect Control Hosp Epidemiol* 2016; 37:295-300.

426

42711) Van Boeckel TP, Gandra S, Ashok A, Caudron Q, Grenfell BT, Levin SA, Laxminarayan R.
428Global Antibiotic Consumption 2000 to 2010: An Analysis of National Pharmaceutical Sales
429Data. *Lancet Infect Dis* 2014; 14:742-750.

430

43112) Dellit TH, Owens RC, McGowan JE, et al. Infectious Diseases Society of America; Society
432for Healthcare Epidemiology of America. Infectious Diseases Society of America and the
433Society for Healthcare Epidemiology of America guidelines for developing an institutional
434program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007; 44:159–177.

435

43613) Hecker MT, Aron DC, Patel NP, Lehmann MK, Donskey CJ. Unnecessary Use of
437Antimicrobials in Hospitalized Patients: Current Patterns of Misuse with an Emphasis on the
438Anti-anaerobic Spectrum of Activity. *Arch Intern Med* 2003; 163:972–978.

439

44014) Hicks LA, Taylor TH, Hunkler RJ. U.S. Outpatient Antibiotic Prescribing, 2010. *N Engl J*
441*Med* 2013; 368:1461-1462.

442

44315) Polk RE, Hohmann SF, Medvedev S, Ibrahim O. Benchmarking Risk-Adjusted Adult
444Antibacterial Drug Use in 70 US Academic Medical Center Hospitals. *Clin Infect Dis* 2011;
44553:1100-1110.

446

447

44816) Baggs J, Fridkin SK, Pollack LA, Srinivasan A, Jernigan JA. Estimating National Trends in
449Inpatient Antibiotic Use Among US Hospitals from 2006 to 2012. *JAMA Intern Med* Published
450online September 19, 2016, E1-E10.

451

45217) Chou AF, Graber CJ, Jones M et al. Characteristics of Antimicrobial Stewardship Programs
453at Veterans Affairs Hospitals: Results of a Nationwide Survey. *Infect Control Hosp Epidemiol*
4542016; 37:647–654.

455

45618) The White House’s National Action Plan for Combatting Antibiotic-Resistant Bacteria.

457https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibot
458[ic-resistant_bacteria.pdf](https://www.whitehouse.gov/sites/default/files/docs/national_action_plan_for_combating_antibot) Accessed November 28, 2016.

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481Table 1: Antimicrobial Stewardship Taskforce Example Policies and Interventions

482¹Facilities that reported performing the specified interventions on the 2015 Stewardship Survey

483²Percentage of facilities performing the specified intervention that reported utilizing the ASTF

484example policies to develop the intervention

Example Policy	Launch	Percent of	Percent
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	Date	Facilities¹ (n = 140)	Facilities that Utilized ASTF Examples²
Intravenous to Oral Conversion Tool	May 2012	116 (83%)	51%
Avoidance of Double Anaerobic Coverage	Jun 2012	99 (71%)	42%
Intervention to Improve Outcome for Patients with <i>C. difficile</i> Infection	Aug 2012	90 (64%)	21%
Stewardship Monitoring of Outpatient Parenteral Antimicrobial Therapy	Nov 2012	85 (61%)	22%
Vancomycin De-escalation	Jan 2013	97 (69%)	32%
Workload Documentation Guidance	May 2013	64 (46%)	27%
Broad-Spectrum Gram-Negative De-escalation	Oct 2013	98 (70%)	24%
Pneumonia Duration of Therapy	Sep 2014	63 (45%)	21%
<i>S. aureus</i> Bacteremia Intervention	Jul 2015	83 (59%)	20%

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489Figure 1: Monthly Use of Nationally Provided Resources

490Total monthly log in usage data for electronic resources provided by the VHA Antimicrobial

491Stewardship Initiative and attendee lines used for stewardship educational webinars. *Note –*

492usage data for the VHA Antimicrobial Stewardship SharePoint® site became unavailable after

493March 2015 due to a website platform change.

494

495Figure 2: Comparison of Selected Stewardship Practices

496Percentage of reported activities at VHA medical centers from surveys completed in 2011, 2012
497and 2015 compared by Chi-square analyses. Abbreviations: IV, intravenous; PO, oral; NS, non-
498significant.

499

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

501Percentage of reported challenges to stewardship programs incurred at VHA medical centers
502from surveys completed in 2012 and 2015 compared by Chi-square analyses. Abbreviations: IT,
503information technology; ID, infectious diseases.

504

505**Figure 4: Veterans Health Administration (VHA) Inpatient Antibiotic Use: Days of
506Therapy (DOT) per 1000 Bed Days of Care (BDOC)**

507Inpatient antibiotic use before and after inception activities for the VHA Antimicrobial
508Stewardship Initiative in the 2nd quarter of calendar year 2010 (denoted by the vertical black
509line) by simple linear regression with comparison of slopes. An overall 12% decline in use was
510noted. Abbreviations: DOT, days of therapy; BDOC, bed days of care.

511

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

513Carbapenems, polymyxins and tigecycline use before and after inception of activities for the
514VHA Antimicrobial Stewardship Initiative in the 2nd quarter of calendar year 2010 (denoted by
515the vertical black line) by simple linear regression with comparison of slopes. Abbreviations:
516DOT, days of therapy; BDOC, bed days of care.

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