

# Providers' beliefs and behaviors regarding antibiotic prescribing and antibiotic resistance in persons with spinal cord injury or disorder

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**Context:** Persons with spinal cord injury or disorder (SCI/D) are at increased risk for antibiotic resistance because of recurrent infections and subsequent use of antibiotics. However, there are no studies focused on providers who care for these patients and their perceptions regarding antibiotic use and resistance.

**Objective:** To characterize SCI/D provider behavior and attitudes about antibiotic prescribing and resistance.

**Design/methods:** Anonymous internet-based, cross-sectional survey.

**Participants:** A total of 314 SCI/D clinicians who prescribe antibiotics (physicians, physician assistants, and nurse practitioners).

**Results:** A total of 118 providers responded (37.6% response rate) including 80 physicians, 20 nurse practitioners, and 18 physician assistants. The majority of respondents agreed with statements regarding the societal impact of antibiotic resistance; only 17.8% agreed that they prescribed antibiotics more than they should, but 61.0% agreed that patient demand was a major reason for prescribing unnecessary antibiotics. The most frequent problematic organisms reported were: methicillin-resistant *Staphylococcus aureus* (83.1%), multidrug-resistant *Pseudomonas* (61.0%), and *Clostridium difficile* (57.6%). The most frequent antibiotics selected for outpatient treatment of community-acquired pneumonia treatment, based on a clinical scenario were azithromycin (36.4%) and respiratory fluoroquinolones (22.9%).

**Conclusion:** These data show that the respondents are aware of and concerned with the problem of antibiotic resistance in their practice. Clinician respondents also endorsed the need to improve their own knowledge and that of their colleagues regarding appropriate antibiotic prescribing. These findings suggest that interventions should focus on provider education, particularly regarding appropriate antibiotic prescribing.

**Keywords:** Spinal cord injuries, Infectious disease, Pneumonia, Drug resistance, Anti-bacterial agents, Azithromycin, Amoxicillin/clavulanate, Moxifloxacin, Antibiotic prescribing patterns, Attitude of health personnel

## Introduction

Antimicrobial-resistant infections are associated with increased morbidity, mortality, and cost, and their prevalence has been increasing. The major factor promoting resistance is the extensive use of antimicrobials. Persons with spinal cord injury or disorder (SCI/D) are at increased risk for antibiotic resistance because of recurrent infections and subsequent use of antibiotics.<sup>1,2</sup> In addition, as a result of these frequent evaluations for possible infections, opportunities for inappropriate antibiotic use may be more likely than in the general patient population. However, when

making decisions about antimicrobial prescribing, providers need to weigh the individual need of the patient, the likelihood of an antimicrobial-resistant pathogen (using information such as hospital and unit level antibiograms), and the health needs of the public, in terms of promoting antimicrobial resistance.

There have been few studies focusing on provider perceptions concerning use of antibiotics and their relation to antibiotic resistance.<sup>3-5</sup> Most have shown that providers consider antimicrobial resistance to be a national problem; however, attitudes vary on the significance of the problem in their own practices.<sup>3,4</sup>

Concerns with balancing the individual patient needs with the public health needs are evident. Metlay *et al.*<sup>5</sup> showed that in treatment for community-acquired

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pneumonia (CAP), both generalists and infectious disease specialists preferred newer, broader spectrum antibiotics (azithromycin, levofloxacin, amoxicillin/clavulanate) compared to older agents (erythromycin, doxycycline), even though the most current available guidelines at the time did not recommend newer agents over older agents for typical cases. In addition, although most physicians acknowledged that antimicrobial resistance was a major public health problem caused by over-prescribing, this issue was ranked lower than patient-specific issues such as efficacy, cost, and tolerability in determining drug choices.<sup>5</sup> Another provider survey reported that 97% of physicians believed widespread and inappropriate antibiotic use were important causes of resistance, and yet only 60% favored restricting the use of broad-spectrum antibiotics.<sup>3</sup>

A recent technical review has shown that provider factors such as sociodemographics, training/specialty, knowledge, attitudes, and judgment are associated with prescribing.<sup>6</sup> Identifying attitudes and decision making in providers who care for persons with SCI/D could facilitate the identification of facilitators and barriers to appropriate antimicrobial prescribing. The goal of this study was to assess current perceptions and attitudes about antibiotic prescribing and antibiotic resistance in providers who care for persons with SCI/D.

## Methods

### *Survey design and participants*

This was an anonymous, internet-based cross-sectional survey administered from August 2008 through September 2008. The initial sample of providers was composed of Veterans Affairs (VA) physicians, nurse practitioners, and physician assistants. These individuals were identified through: (1) a VA email list of VA SCI/D and rehabilitation clinicians (physicians, nurse practitioners, physician assistants) organized by the VA SCI/D Services Program Office, and (2) the American Paraplegia Society membership mailing list, which included clinicians who practice in either VA or non-VA settings, primarily in the United States. The initial sampling frame included 374 clinicians.

### *Survey instrument and procedures*

The survey included questions regarding attitudes about antimicrobial prescribing and infections including those resistant to antimicrobials, prescribing behavior through a clinical scenario, and demographics. Some attitude and behavior questions were identified from earlier surveys in providers from other specialties.<sup>3,5</sup> Possible responses for most attitude questions and the clinical

scenario followed a five-point Likert scale. Due to smaller-than-expected sample sizes, these categories were collapsed to result in three final categories: disagree (strongly disagree, disagree), neutral, and agree (strongly agree, agree).

Catapult Systems Corporation's InquisiteWeb Survey System 7.0 (Austin, TX, USA) was used for the survey. An initial notification letter was sent by email to 374 clinicians introducing the study. The following week each practitioner was electronically sent the survey by email.

A reminder to clinicians was sent 2 weeks later, followed by a second reminder after an additional 2 weeks without a response. Eighteen clinicians were excluded because of undeliverable responses due to the termination of VA employment and 42 responded that they did not treat SCI/D patients or were not involved in direct patient care. Our final eligible sample size included 314 potential respondents.

### *Statistical analysis*

All survey questions and demographics were described using univariate statistics (frequencies, percentages, means). The clinical scenario outcome was also compared with demographic characteristics, knowledge, and attitude questions using a global chi-square statistic. All analyses were conducted using SAS software version 9.2 (SAS Institute Inc, Cary, NC, USA).

## Results

The survey was completed by 118 providers (37.6% response rate), comprised of 80 physicians, 20 nurse practitioners, and 18 physician assistants (Table 1). The response rate varied by clinician type: physicians (32.4%), nurse practitioners (51.3%), and physician assistants (64.3%). Respondents on average had 10 years of experience treating patients with SCI/D and frequently had affiliations with academic institutions. Nearly half of the physicians (46.2%) held subspecialty certification in SCI medicine.

### *General attitudes*

Table 2 describes overall attitudes on antibiotic prescribing and resistance. Nearly all respondents agreed that antibiotic resistance is a major public health problem and that over-prescribing is a major cause of antibiotic resistance. A large majority (77.1%) also felt their own antibiotic prescribing actions increase the probability that their patients will be infected with drug-resistant bacteria in the future. A majority of respondents agreed that patient demand was a major reason that clinicians over-prescribe antibiotics (61.0%), but a

**Table 1 Demographics of clinician respondents (n = 118)**

Demographics	Number (%) or mean (range)
Position (n = 118)	
Physicians	80 (67.8)
Nurse practitioners	20 (16.9)
Physician assistants	18 (15.3)
Gender (n = 112)	
Female	47 (42.0)
Male	65 (58.0)
Age in years (n = 112)	51.8 (33.0–75.0)
Years since graduation (n = 117)	22.5 (2.0–50.0)
Years since completion of training (n = 110)	17.3 (0–48.0)
Time worked with SCI patient, in years (n = 116)	10.1 (0–35.0)
Employment location (n = 118)	
VA SCI center	42 (35.6)
Other*	76 (64.4)
SCI medicine certified? (n = 80) <sup>†</sup>	
Yes	47(58.8)
No	33 (41.2)
Affiliated with an academic institution? (n = 118)	
Yes	82 (69.5)
No	36 (30.5)
Supervise residents or medical student? (n = 105)	
Yes	51 (48.6)
No	54 (51.4)
Primary medical specialty (n = 118)	
Internal medicine	28 (23.7)
Physical medicine and rehabilitation	49 (41.6)
Other <sup>‡</sup>	41 (34.7)

\*VA outpatient center, VA non-SCI center, SCI model system, and other.

<sup>†</sup>Physicians only.

<sup>‡</sup>Urology, neurology, general surgery, infectious disease, and other, n/a.

minority (17.8%) indicated that they individually over-prescribe antibiotics.

**Problem of antibiotic resistance in SCI/D practice and potential approaches to the problem**

Respondents were asked about whether antibiotic resistance was a current problem in their SCI/D clinical practice, and three-fourths agreed that it was a problem (Table 3). The resistant organisms most frequently identified as problematic were methicillin-resistant *Staphylococcus aureus* (MRSA) (83.0%) and multi-drug-resistant *Pseudomonas aeruginosa* (62.6%). *Clostridium difficile* infection was also commonly endorsed as a significant problem in their clinical practice (58.1%).

Interventions that could be used to reduce antibiotic resistance were endorsed as potentially helpful by respondents, including improving clinician as well as their own knowledge about appropriate antibiotic use (Table 3). Three-fourths believed in conducting active surveillance for a specific antibiotic-resistant organism.

**Table 2 Provider attitudes**

	Number (%) n = 118
Societal impact	
Antibiotic resistance is a major public health problem	
Agree	116 (98.3)
Neutral	1 (0.85)
Disagree	1 (0.85)
By prescribing antibiotic drugs today, I increase the probability that my patients will be infected with drug-resistant bacteria in the future	
Agree	91 (77.1)
Neutral	21 (17.8)
Disagree	6 (5.1)
Over-prescribing antibiotics is a major cause of antibiotic resistance	
Agree	117 (99.2)
Neutral	1 (0.8)
Disagree	0
Before prescribing an antibiotic, I weigh the potential benefit against the potential harm to society	
Agree	83 (70.3)
Neutral	27 (22.9)
Disagree	8 (6.8)
Non-provider factors	
Patient actions, such as skipping doses and stopping the medication before it is recommended, are a major cause of antibiotic resistance	
Agree	95 (80.5)
Neutral	18 (15.3)
Disagree	5 (4.2)
Clinicians should move to newer antibiotics when common bacteria begin to show resistance to older antibiotics	
Agree	43 (36.4)
Neutral	36 (30.5)
Disagree	39 (33.1)
Clinicians should consider only the needs of the individual patient when prescribing an antibiotic	
Agree	51 (43.2)
Neutral	29 (24.6)
Disagree	38 (32.2)
Providers as gatekeepers	
To avoid the development of antibiotic resistance, newer antibiotics should be reserved for patients infected with resistant bacteria	
Agree	109 (92.4)
Neutral	6 (5.1)
Disagree	3 (2.5)
The milder the infection, the more I am willing to use an older antibiotic with some reported resistance	
Agree	68 (57.6)
Neutral	29 (24.6)
Disagree	21 (17.8)
Antibiotic overuse	
I prescribe antibiotics more often than I should	
Agree	21 (17.8)
Neutral	30 (25.4)
Disagree	67 (56.8)
Patient demand is a major reason that clinicians prescribe unnecessary antibiotics	
Agree	72 (61.0)
Neutral	26 (22.0)
Disagree	20 (17.0)

However, only two-thirds (67.8%) believed that reducing the use of a particular drug could reduce antibiotic resistance.

**Table 3 Antibiotic resistance and infection problems and potential approaches to solve antibiotic resistance**

	Number (%) n = 118
The following are current problems in your SCI clinical practice	
Antibiotic resistance in general	
Agree	93 (78.8)
Disagree	25 (21.2)
MRSA	
Agree	98 (83.0)
Disagree	20 (17.0)
Vancomycin-resistant enterococci	
Agree	60 (51.3)
Disagree	57 (48.7)
Multidrug-resistant <i>P. aeruginosa</i>	
Agree	72 (62.6)
Disagree	43 (37.4)
Multidrug-resistant <i>Acinetobacter</i>	
Agree	55 (48.2)
Disagree	59 (51.8)
Penicillin-resistant <i>S. pneumoniae</i>	
Agree	41 (35.3)
Disagree	75 (64.7)
<i>C. difficile</i> infection	
Agree	68 (58.1)
Disagree	49 (41.9)
The following approaches will help reduce the problem of antibiotic resistance	
Reducing the use of a particular drug (over an extended period)	
Yes	80 (67.8)
No	38 (32.2)
Improving providers' knowledge of appropriate antibiotic use	
Yes	113 (96.6)
No	4 (3.4)
Improving your own knowledge of appropriate antibiotic use	
Yes	112 (94.9)
No	6 (5.1)
Conducting active surveillance of specific antibiotic organisms	
Yes	91 (77.1)
No	27 (22.9)

**Behaviors: clinical scenario on the choice of antibiotic for treatment of CAP**

Respondents were presented with a clinical scenario of a 55-year-old man with paraplegia presenting with uncomplicated CAP (Table 4). The purpose of this scenario was to determine which antibiotic choices were made and the reasons for their choices. One-third (36.4%) of respondents indicated that they would treat the patient described with azithromycin, followed by amoxicillin/clavulanate (18.6%) and moxifloxacin (12.7%). After grouping of responses, 22.9% would treat with a respiratory fluoroquinolone. Table 5 describes clinician reasons for selecting their antibiotic of choice. Most respondents chose these antibiotics for ease of use, the efficacy of these drugs, their previous experience, and knowledge with the antibiotic, whereas 56.4% chose them because of their concerns with antibiotic resistance and 21.5% indicated for the likelihood of the patient harboring a

**Table 4 Antibiotic selections for clinical patient scenario\***

	Number (%) n = 118
Azithromycin	43 (36.5)
Respiratory fluoroquinolones (n = 27)	
Levofloxacin	12 (10.2)
Moxifloxacin	15 (12.7)
Other antibiotics (n = 48)	
Amoxicillin/clavulanate	22 (18.6)
Amoxicillin	8 (6.8)
Ciprofloxacin	3 (2.5)
Amoxicillin/clavulanate plus azithromycin	7 (5.9)
Trimethoprim-sulfamethoxazole	4 (3.4)
Cefpodoxime proxetil plus azithromycin	1 (0.9)
Doxycycline	3 (2.5)

\*Scenario description: healthy 55-year-old male non-smoker with T6 complete paraplegia with uncomplicated CAP. He has small consolidation on his chest X-ray located in the right middle lobe. The patient has no comorbidities other than SCI or drug allergies and has no history of antibiotic use in the previous 30 days, is mobilizing secretions with an unassisted cough, has 95% oxygen saturation on room air, and will be treated as an outpatient. His blood pressure is 110/70, temperature is 99.2 F, pulse is 80, and respiratory rate is 18.

resistant organism. Clinicians who chose azithromycin (97.7%) or the respiratory fluoroquinolones (96.3%) were more likely to agree that its ease of use was the reason for their selection, compared to those who chose other antimicrobials (77.1%) ( $P = 0.02$ ). There were no significant differences seen in demographic characteristics and attitudes and clinicians' choice of antibiotics.

**Discussion**

This study is a first step in assessing the beliefs and behaviors of clinicians who treat persons with SCI/D regarding antimicrobial prescribing and resistance. The majority of respondents agreed that antimicrobial resistance is a public health problem and can be affected by their antibiotic choices; however, a little over half endorsed contributing to resistance as a reason for their antibiotic choice in the clinical scenario. These findings are similar to a study by Metlay *et al.*<sup>5</sup> that showed that general internists and infectious disease physicians ranked concerns with contributing to resistance lower than other issues for selecting antibiotic treatment such as efficacy and cost.

The majority of respondents agreed with statements regarding the provider's role in balancing societal and individual patient needs. Most respondents recognized that patient demand was a major reason that clinicians over-prescribe antibiotics; however, most of these respondents did not include themselves in this group of over-prescribers. A small percentage admitted that they individually over-prescribe antibiotics.

**Table 5 Reasons for antibiotic choice for clinical patient scenario**

	Number (%) n = 118
Of its low side effects	
Agree	76 (64.4)
Neutral	36 (30.5)
Disagree	6 (5.1)
Of its ease of use*	
Agree	105 (89.0)
Neutral	10 (8.5)
Disagree	3 (2.5)
Of efficacy of drug in treating CAP	
Agree	114 (96.6)
Neutral	3 (2.5)
Disagree	1 (0.9)
Of my previous experience and knowledge about the drug	
Agree	105 (89.0)
Neutral	11 (9.3)
Disagree	2 (1.7)
Of severity of illness	
Agree	96 (82.1)
Neutral	18 (15.4)
Disagree	3 (2.5)
Of risk of contributing to the problem of antibiotic resistance	
Agree	66 (56.4)
Neutral	36 (30.8)
Disagree	15 (12.8)
The patient is likely to have a resistant organism causing the pneumonia	
Agree	25 (21.5)
Neutral	35 (30.2)
Disagree	56 (48.3)
The patient has no comorbidities	
Agree	70 (59.3)
Neutral	21 (17.8)
Disagree	27 (22.9)
The patient has no prior antibiotic exposure*	
Agree	71 (60.7)
Neutral	28 (23.9)
Disagree	18 (15.4)
Using this drug is my usual practice for this type of patient	
Agree	86 (74.8)
Neutral	28 (24.3)
Disagree	1 (0.9)

For azithromycin, respiratory fluoroquinolones, and other antibiotics: \* $P < 0.05$ .

Most clinicians agreed that antibiotic resistance is a problem in their own clinical SCI/D practice and three-fourths believed that conducting active surveillance of specific organisms could help reduce resistance. MRSA was the highest-reported problem for these providers, followed by multidrug-resistant *Pseudomonas*. This is not surprising considering that infections and/or colonization are common in these patients. In fact, VA disseminated a policy in January 2007 requiring all VA acute care facilities to implement guidelines focused on preventing the spread of MRSA, which was subsequently expanded to other specialty areas including the VA SCI/D centers.<sup>7</sup> *C. difficile* infection was also endorsed by over half of providers as a problem in their practices.

The increasing prevalence of this organism in healthcare settings, its increased fluoroquinolone resistance, and recent data showing an increase in the community spread of this organism suggest that it is an important infection associated with healthcare and causes significant morbidity and mortality.<sup>8</sup>

Only two-thirds of respondents thought that reducing the use of a particular antibiotic could improve antibiotic resistance although nearly all reported over-prescribing as a major cause of antibiotic resistance. Current Infectious Disease Society of America (IDSA) guidelines on antimicrobial stewardship recommend evidence-based strategies to reduce antibiotic use and costs, such as formulary restriction.<sup>9</sup>

The selection of azithromycin and fluoroquinolones for the treatment of CAP was consistent with another study showing that the most common outpatient treatments for veterans with SCI/D with CAP were macrolides and fluoroquinolones.<sup>10</sup> Wester and associates<sup>3</sup> showed that most clinicians felt antibiotic misuse was an important factor in resistance, but slightly under half were opposed to restricting broad-spectrum antibiotic use. Of the antibiotic choices we provided in the clinical scenario, levofloxacin, moxifloxacin, amoxicillin/clavulanate plus azithromycin, and cefpodoxime proxetil plus azithromycin are the regimens that are recommended by the IDSA guidelines for the CAP management of outpatients with comorbidities.<sup>11,12</sup> We found that 31.5% of clinicians chose antibiotics that were recommended by CAP guidelines for use in outpatients with comorbidities, although 75% of these respondents agreed that they chose the antibiotic because the patient had no comorbidities, contradictory to their intended use. This indicates that a considerable number of providers may not be aware of the recommended use for these antibiotics or that there are other underlying reasons as to why clinicians choose these specific antibiotics, illuminating potential areas for training.

Contrary to other studies, clinician demographic factors, such as specialty and training, were not associated with prescribing choice for the clinical scenario.<sup>5,6,13,14</sup> We did not find any differences between physicians with or without physical medicine and rehabilitation specialty training. However, we did not have a group of non-SCI/D clinicians to compare with in order to determine whether provider specialty/training was a factor in prescribing behavior. Healthcare system factors have also been indicated as playing a role such as healthcare plan guidelines, national and regional formulary restrictions, geographic location, and exposure to pharmaceutical representatives.<sup>6</sup>

Although some of these strategies may not be as pertinent in VA, the VA SCI/D system of care poses unique attributes that could be assessed further in their effects on antimicrobial prescribing including its unique 'hub and spoke' system. We did not find any difference in antibiotic selection between providers located at SCI/D centers and those at other facilities.

There were several limitations to this study. The response rate was lower than expected which may mask actual associations in provider perceptions, behaviors, and attitudes. Although respondents were aware of and concerned with the problem of antibiotic resistance in their practice, the low response rate may suggest that a percentage of providers who care for veterans with SCI/D have a lower concern for the topic. In addition, due to the anonymous nature of the survey we could not compare respondents with non-respondents, although we were able to report response rates by the provider type. It is possible that there may be differences between those that responded to the survey and those who did not, which could potentially affect the generalizability of our results. The survey was also conducted during the dissemination of guidelines for reducing MRSA transmission in SCI/D units in the VA. This may have had an effect on respondent perceptions and attitudes, particularly about MRSA. Finally, the prescribing choices were not linked to facility-level guidelines for treatment, and thus we were unable to determine whether treatment strategies selected were concordant with facility policies.

## Conclusion

These data show that SCI/D providers who responded to the survey are aware of and concerned with the problem of antibiotic resistance in their practice. However, response to the clinical scenario suggests that a portion of SCI/D providers may not be utilizing evidence-based guidelines for antibiotic treatment of certain conditions. It is encouraging that clinicians endorsed the need to improve their own and their colleagues' knowledge on appropriate antibiotic prescribing. An Agency for Healthcare Research and Quality technical review notes that active clinician education was more effective at reducing antibiotic prescribing than passive clinician education such as distribution of education materials. This indicates that interventions of this nature are more likely to produce positive results to appropriate antibiotic prescribing knowledge. Understanding these attitudes is the first step in determining effective provider-focused strategies in reducing antibiotic resistance and how patient safety initiatives are implemented in VA SCI units.

## Acknowledgments

Survey questions were derived from surveys conducted and/or published by Stephen P. Burns, Joshua P. Metlay, Arthur T. Evans, and C. William Wester. Supported by the Department of Veterans Affairs, Office of Research and Development, Health Services Research and Development Service, SCI QUERI (98-000), and the Paralyzed Veterans of America Research Foundation (Project#2562). The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs.

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