



Annual Surveillance Summary: *Acinetobacter* Species Infections in the Military Health System (MHS), 2016

NMCPHC-EDC-TR-373-2017

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Abstract

The EpiData Center Department (EDC) conducts routine surveillance of *Acinetobacter* species incidence and prevalence among all beneficiaries seeking care within the Military Health System (MHS). This report describes demographics, clinical characteristics, prescription practices, and antibiotic resistance patterns observed for *Acinetobacter* species infections in calendar year (CY) 2016.

Several data sources were linked to assess a variety of descriptive and clinical factors related to *Acinetobacter* species infections. Health Level 7 (HL7)-formatted Composite Health Care System (CHCS) microbiology data identified *Acinetobacter* species infections. These infections were matched to HL7-formatted CHCS pharmacy data to assess prescription practices, the Standard Inpatient Data Record (SIDR) to determine healthcare-associated exposures, Defense Manpower Data Center (DMDC) rosters to determine burden among Department of Defense (DOD) active duty (AD) service members, and the DMDC Contingency Tracking System (CTS) to determine Department of the Navy (DON) deployment-related infections.

In 2016, the *Acinetobacter* species incidence rate was 5.32 per 100,000 persons per year, which reflects a slight decrease from the weighted historic incidence rate. The majority of infections in 2016 were identified in the outpatient setting and manifested as wounds and skin and soft tissue infections (SSTIs). *Acinetobacter baumannii-calcoaceticus* complex (ABC) was the most common species isolated (27.6%). Overall, incidence of drug-resistant *Acinetobacter* species remains low in the DOD (0.22 per 100,000 persons per year) and antibiotic susceptibilities are high. Many antibiotics display statistically significant ascending trends in efficacy. Current infection control practices appear effective and continued surveillance is recommended.



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Background, Methods, and Limitations

The EpiData Center (EDC) at the Navy and Marine Corps Public Health Center (NMCPHC) prepares a retrospective report each calendar year (CY) that summarizes the demographics, clinical characteristics, prescription practices, and antibiotic susceptibility patterns for *Acinetobacter* species infections among Military Health System (MHS) beneficiaries.

Literature review did not provide any new developments or research for *Acinetobacter* species infections. Additionally, no new methods or limitations were applied to this annual summary. As such, this report presents analytical results and discussion of CY 2016 data for *Acinetobacter* species infections in the MHS. The background, methods, and limitations relevant to this analysis have been presented in a previous report (CY 2015 annual report for *Acinetobacter*¹).

The EDC also monitors other multidrug-resistant organisms (MDROs) of interest in the MHS.^{2,3}



Results

Section A – Descriptive Epidemiology

Incidence of *Acinetobacter* Species

In 2016, the annual incidence rate (IR) for *Acinetobacter* species infection among MHS beneficiaries treated at a military treatment facility (MTF) was 5.32 per 100,000 persons per year. This reflects a 0.37% change below the weighted historic IR. Population-specific IRs were above weighted historic IRs with the exception of the Marine Corps and Department of Defense (DOD) active duty (AD) populations. All current rates remained within two standard deviations of the weighted historic IRs except the Marine Corps, which experienced a 35.91% decrease below the weighted historic IR (Table 1).

Table 1. Incidence Rate (IR) for *Acinetobacter* Species Infections in the MHS, CY 2016

Population	2016 IR	Weighted Historic ^a IR 2013 - 2015	Two Standard Deviations: Weighted Historic ^a IR	2016	
				Direction	Percent Change ^b
MHS Beneficiaries	5.32	5.34	0.58	↓	0.37%
Air Force	3.43	3.43	0.91	↑	0.04%
Army	5.76	5.37	0.54	↑	7.38%
Marine Corps	5.62	8.77	1.65	↓	35.91%
Navy	4.63	4.44	0.52	↑	4.09%
DOD Active Duty	8.72	10.02	2.72	↓	12.97%

Rates are presented as the rate per 100,000 persons per year.

A green arrow indicates an increasing percent change and a blue arrow indicates a decreasing percent change.

^a Historic IR reflects the weighted average of the three years prior to the analysis year.

^b This reflects the percent change from the weighted historic IR to the IR of the current analysis year.

Data Source: NMCPHC HL7-formatted CHCS microbiology and MHS M2 databases.

Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.



Demographic Distribution of *Acinetobacter* Species

In 2016, there were 501 incident *Acinetobacter* species infections with highest incidence among 18-24 year olds, males, and AD service members (Table 2).

Table 2. Demographic Characteristics of *Acinetobacter* Species Infections in the MHS, CY 2016

	N = 501	
	Count	Rate
Gender		
Female	223	4.8
Male	278	5.8
Age Group (in Years)		
0-17	98	5.0
18-24	84	7.3
25-34	80	6.7
35-44	43	5.1
45-64	94	4.6
65+	102	4.6
Beneficiary Type		
Active Duty	119	8.7
Family Members	218	4.0
Retired	80	3.7
Other ^a	84	--

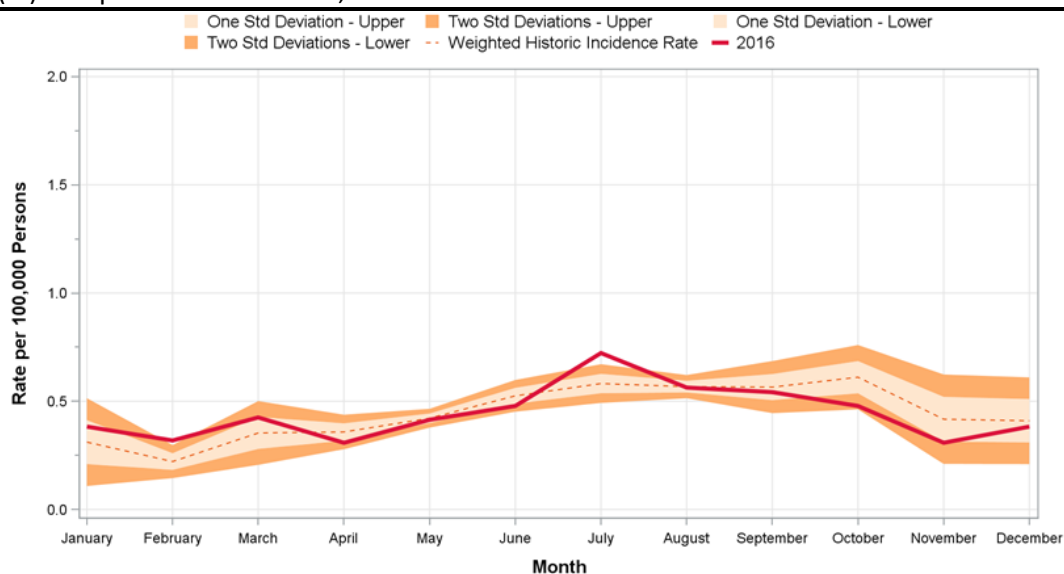
^a Rate is not reported due to variation in population denominator.
 Rates are presented as the rate per 100,000 persons per year.
 Data Source: NMCPHC HL7-formatted CHCS microbiology and MHS M2 databases.
 Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.



Seasonality

Monthly incidence rates of *Acinetobacter* species infections in 2016 were variable. IRs in February and July exceeded two standard deviations; however, all other monthly IRs remained within two standard deviations of the weighted historic IR. Seasonality was observed in 2016, with a peak in monthly incidence in July and then a gradual descent into the fall and winter months. The monthly IR for *Acinetobacter* species infections remained below 0.7 per 100,000 persons throughout the year (Figure 1).

Figure 1. Monthly Incidence of *Acinetobacter* Species Infections and Weighted Historic Incidence Rate (IR) Comparisons in the MHS, CY 2016



Rates are presented as the rate per 100,000 persons per year.

Bands indicate one and two standard deviations above and below the weighted historic monthly incidence rates (IR).

The weighted historic monthly IR is a weighted average of the three years prior to the analysis year.

Data Source: NMCPHC HL7-formatted CHCS microbiology and MHS M2 databases.

Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.



Acinetobacter Species Clinical Characteristics

There were 511 prevalent *Acinetobacter* species infections identified among all MHS beneficiaries treated at an MTF in 2016. The infection burden was higher in the outpatient setting (87.5%) and generally presented as non-invasive infections (88.6%). The majority of *Acinetobacter* species infections was classified from sources indicative of a skin or soft tissue infection (SSTI) or wound (42.3%). *A. baumannii-calcoaceticus* complex (ABC) accounted for 27.6% of all infections followed closely by *Acinetobacter* species, not otherwise specified (NOS) (23.9%), *A. baumannii* (23.5%), and *A. lwoffii* (18.8%). All other species each accounted for less than 5% of infections in 2016 (Table 3).

Table 3. Clinical Characteristics of *Acinetobacter* Species Prevalence Infections in the MHS, CY 2016

	N = 511	
	Count	Percentage
Specimen Collection Location		
Inpatient	64	12.5
Outpatient	447	87.5
Infection Type		
Invasive	58	11.4
Non-Invasive	453	88.6
Body Collection Site		
Blood	29	5.7
Respiratory	84	16.4
SSTI/Wound	216	42.3
Urine	127	24.9
Other	55	10.8
Organism Species		
<i>Acinetobacter baumannii calcoaceticus</i> complex	141	27.6
<i>Acinetobacter</i> species, NOS	122	23.9
<i>Acinetobacter baumannii</i>	120	23.5
<i>Acinetobacter lwoffii</i>	96	18.8
<i>Acinetobacter radioresistens</i>	14	2.7
<i>Acinetobacter ursingii</i>	6	1.2
<i>Acinetobacter haemolyticus</i>	4	0.8
<i>Acinetobacter junii</i>	4	0.8
<i>Acinetobacter calcoaceticus</i>	2	0.4
<i>Acinetobacter johnsonii</i>	2	0.4

Data Source: NMCPHC HL7-formatted CHCS microbiology database.

Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.



Exposure Burden Metrics

Table 4 presents two metrics describing healthcare-associated exposures burden for multidrug-resistant (MDR) *Acinetobacter* species by region. The admission MDRO prevalence metric measures the magnitude of infection at the time of admission (importation of *Acinetobacter* species into the healthcare system) or one year prior, and the overall MDRO prevalence metric measures the exposure of infection at any point during the admission or one year prior. In 2016, the overall MDRO prevalence count for *Acinetobacter* species was 19 and the admission MDRO prevalence count was 17. The United States (US) South Atlantic region had a higher burden of overall MDRO prevalence, while the US West region had the greater burden for admission MDRO prevalence.

Table 4. MDRO Healthcare-Associated Exposure Burden Metrics among *Acinetobacter* Species in the MHS, CY 2016

	Overall MDRO Prevalence ^a	Admission MDRO Prevalence ^b
	Count ^c	Count ^c
Region		
OCONUS	5	5
US Midwest	0	0
US Northeast	0	0
US South	1	1
US South Atlantic	7	5
US West	6	6
Total	19	17

^a Overall MDRO prevalence included all individuals with an MDRO infection identified from a sample collected at any point during the admission, as well as samples that tested positive for infection in the prior calendar year.

^b Admission MDRO prevalence included all individuals with an MDRO infection identified from samples collected up to and including the third day of admission, as well as samples that tested positive for infection in the prior calendar year.

^c Rates are not provided for these metrics due to low counts.

Data Source: NMCPHC HL7-formatted CHCS microbiology and SIDR databases.

Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.



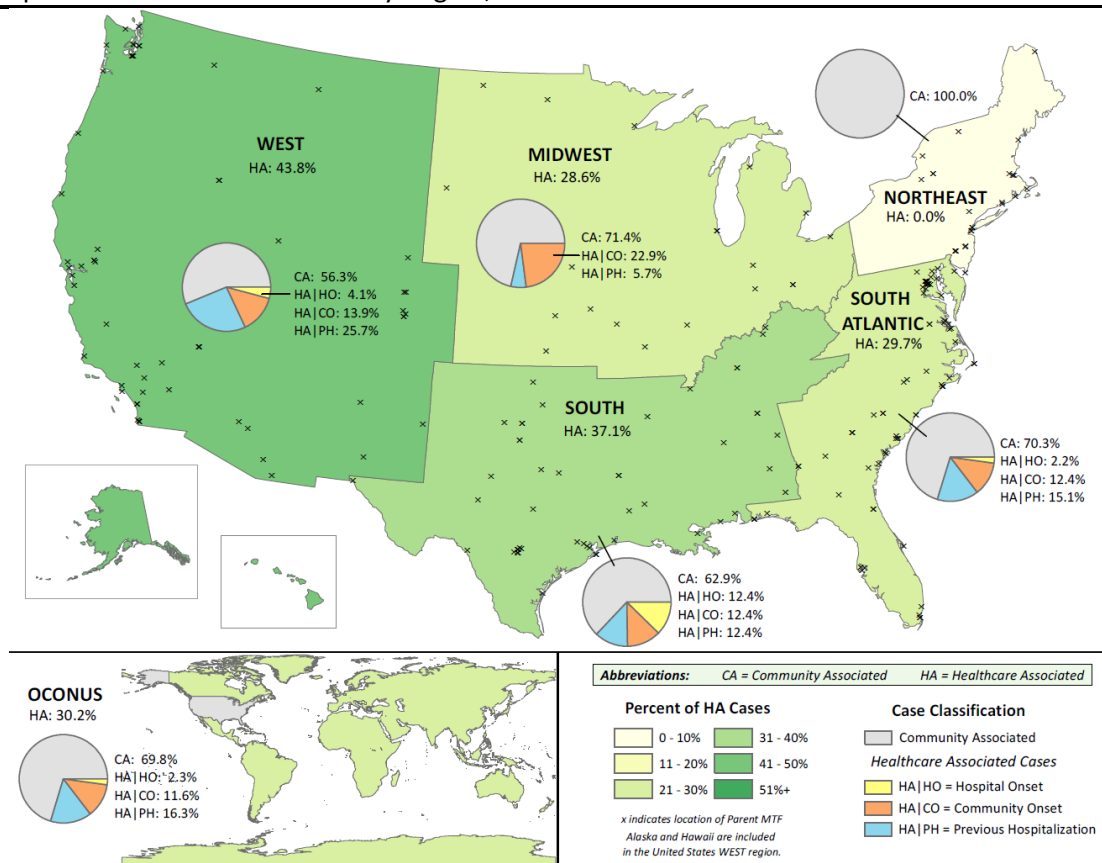
Regional Epidemiologic Infection Classifications

Among all prevalent *Acinetobacter* species infections identified in the MHS in 2016, 65.4% were community-associated (CA) cases and 34.6% were healthcare-associated (HA) cases. Regionally, the US West reported the highest proportion of HA *Acinetobacter* species cases (43.8%), followed by the US South (37.1) (Figure 2).

HA cases were further categorized into hospital-onset (HO), community-onset (CO), or previous hospitalization (PH) groupings. Among all prevalent *Acinetobacter* species cases (regardless of HA or CA classification or regional location), 13.3% were CO cases, indicating that the infection most likely originated from the community. Only 4.5% of all prevalent *Acinetobacter* species cases were HO, indicating that the infection most likely resulted from the current hospitalization exposure. PH cases, indicating the patient had a prior hospitalization exposure within the past 12 months, comprised 16.8% of the total prevalent cases (data not shown). Regionally, the US West, US South Atlantic, and locations outside the continental United States (OCONUS), showed a similar pattern, with PH cases accounting for the majority of HA *Acinetobacter* species cases. In the US Midwest, the majority of HA cases were CO cases (22.9%), converse to the US South region, where HO, CO, and PH cases were equally distributed (12.4%) (Figure 2).



Figure 2. Proportion of Healthcare- and Community-Associated Cases among *Acinetobacter* Species Infections in the MHS by Region, CY 2016



Data Source: NMCPHC HL7-formatted CHCS microbiology, SIDR, and MHS M2 databases.
 Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.

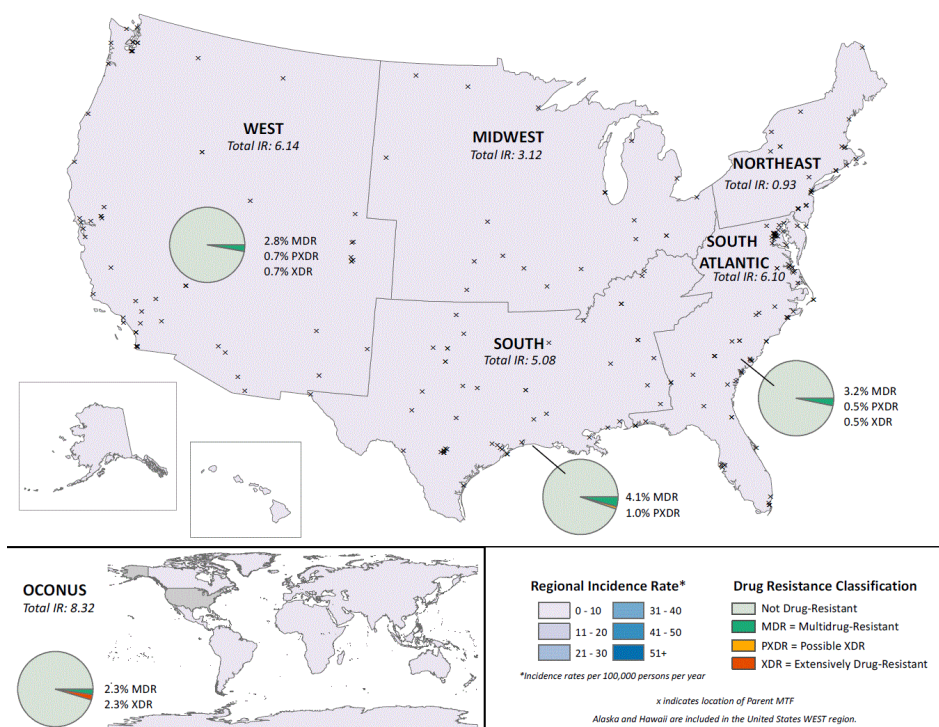
Section B – Antimicrobial Resistance and Use

Regional Multidrug Resistance

In 2016, the IR of *Acinetobacter* species infection was 5.34 infections per 100,000 persons per year; the IR of drug-resistant *Acinetobacter* species infection (i.e., resistant to antibiotics in at least three classes) was 0.22 infections per 100,000 persons per year. OCONUS locations had the highest incidence rate (8.32 per 100,000 persons per year) of *Acinetobacter* species infections. The lowest incidence rate was observed in the US Northeast region at 0.93 per 100,000 persons per year. Across all regions, *Acinetobacter* species total incidence rates were less than 10 infections per 100,000 persons per year (Figure 3).

Approximately 4.1% of all prevalent infections of *Acinetobacter* species were multidrug-resistant (MDR, extensively drug-resistant (XDR), or possibly drug-resistant (PXDR). Of these prevalent cases, 72% (n=15) were MDR, 14% (n=3) were XDR, and 14% (n=3) were PXDR. One XDR infection was identified in each of the following regions: the US South Atlantic, US West, and OCONUS locations. The US South had the largest percentage of drug-resistant *Acinetobacter* species infections with 4.12% MDR and 1.03% PXDR (Figure 3).

Figure 3. Annual Incidence Rate (IR) and Percentage of Multidrug-Resistance among *Acinetobacter* Species Infections in the MHS by Region, CY 2016



Rates are presented as the rate per 100,000 persons per year.

Data Source: NMCPHC HL7-formatted CHCS microbiology, SIDR, and MHS M2 databases.

Prepared by the EpiData Center Department, Navy and Marine Corps Public Health Center, on 21 June 2017.

Antibiogram

Table 5 displays an antibiogram of *Acinetobacter* species incidence infections for all MHS beneficiaries from 2011 through 2016. In 2016, *Acinetobacter* species infections were most susceptible to the aminoglycosides amikacin (96.1%) and gentamicin (95.1%) and the penicillin + β lactamase inhibitor ampicillin/sulbactam (95.1%). Infections were least susceptible to the cephalosporins ceftriaxone (38.6%) and cefotaxime (76.2%). Statistically non-significant trends in susceptibility were observed for ceftriaxone, doripenem, doxycycline, minocycline, and ticarcillin/clavulanate (Table 5).

Table 5. Antibigram of *Acinetobacter* Species Infections Identified in the MHS, CY 2011-2016

Antibiotics	2011	2012	2013	2014	2015	2016	Susceptibility Trend	Comment ^a
Amikacin	78.3	89.5	90.2	96.2	97.5	96.1		↑
Ampicillin/Sulbactam	80.1	88.6	91.6	93.8	91.9	95.1		↑
Cefepime	77.0	83.2	87.4	86.7	91.4	89.2		↑
Cefotaxime	54.0	46.9	58.7	61.0	62.8	76.2		↑
Ceftazidime	71.6	72.7	88.7	79.5	82.2	80.4		↑
Ceftriaxone	37.5	33.3	40.4	39.5	35.2	38.6		
Ciprofloxacin	78.1	86.2	89.7	93.1	93.7	93.6		↑
Doripenem	--	--	--	--	--	--		
Doxycycline	--	--	--	--	--	--		
Gentamicin	82.0	89.1	94.0	96.6	95.9	95.1		↑
Imipenem	77.6	87.4	91.9	95.2	97.5	94.6		↑
Levofloxacin	81.9	87.6	93.4	95.4	93.8	93.7		↑
Meropenem	78.5	66.7	86.8	89.7	94.8	94.5		↑
Minocycline	88.6	--	--	--	100.0	--		
Piperacillin	59.3	72.4	66.7	68.8	79.7	83.8		↑
Piperacillin/Tazobactam	67.4	83.0	83.1	87.0	88.0	84.0		↑
Tetracycline	78.5	90.3	92.8	88.9	88.8	92.9		↑
Ticarcillin/Clavulanate	--	--	--	--	--	--		
Tobramycin	81.4	88.1	93.0	96.4	94.2	93.0		↑
Trimethoprim/Sulfamethoxazole	77.8	81.9	88.7	90.9	88.2	93.6		↑

-- indicates that fewer than 30 isolates were tested.

^a Arrow indicates the antibiotics with a significant change in direction of trend for significant two-tailed Cochrane-Armitage tests for trend established for a single antibiotic over time. A significant increase in susceptibility is denoted by a green upward arrow and a significant decrease in susceptibility is denoted by a blue downward arrow.

Data Source: NMCPHC HL7-formatted CHCS microbiology database.

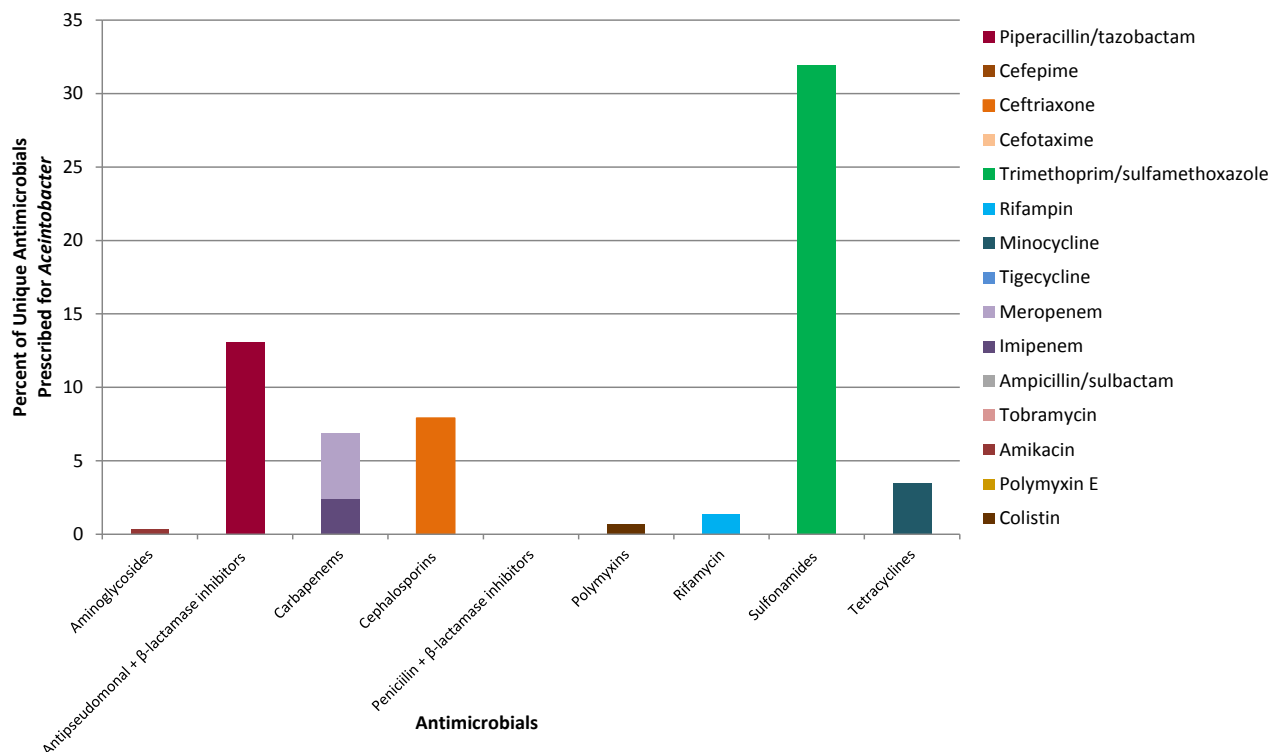
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Antimicrobial Consumption/Prescription Practices

Among all MHS beneficiaries in 2016, the most commonly prescribed antibiotic classes associated with *Acinetobacter* species infections were folate pathway inhibitors/sulfonamides (32%), antipseudomonal + β -lactamase inhibitors (13.1%), cephalosporins (7.9%), and carbapenems (6.9%) (Figure 4). The remaining antibiotic classes were prescribed for less than 5% of infections each.

Figure 4. *Acinetobacter* Species Infection and Prescription Practices in the MHS, CY 2016



Only the first occurrence of a unique antibiotic was counted per person per infection, regardless of administration route.

Data Source: NMCPHC HL7-formatted CHCS microbiology and HL7-formatted pharmacy databases.

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Section C – Special Populations

Of the 511 prevalent *Acinetobacter* species infections in the MHS in 2016, one infection occurred among Department of the Navy (DON) AD deployed personnel. This deployment-related infection was identified in a male between 45-65 years old.



Discussion

This analysis identified a decrease in *Acinetobacter* species infection rates in 2016, though negligible, from the weighted historic IR. Since 2010, overall *Acinetobacter* species infection IRs have continued to decline. A study conducted by the Centers for Disease Control and Prevention (CDC) from 2011-2014 found *Acinetobacter* species infections were decreasing in the general (civilian) population, which aligns with *Acinetobacter* species infection IRs in the MHS.⁴ Despite a slight reduction in the overall MHS IR in 2016 from the weighted historic IR, surveillance of *Acinetobacter* species remains valuable.

The emergence of drug-resistant *Acinetobacter* species has been documented in the literature and reportedly is due to selective pressure from broad-spectrum antibiotics.⁵ In the MHS in 2016, 4.1% of all prevalent *Acinetobacter* species infections were identified with some level of drug resistance. This is a decrease from 2015, which reported MDR in 6.1% of prevalent *Acinetobacter* species infections.¹ Decreasing trends of MDR *Acinetobacter* species infections have not been observed in recent literature for the overall US population.⁵ However, the decline in drug-resistant *Acinetobacter* species infections since 2012 continuing into 2016 among MHS beneficiaries may be due in part to a reduction in exposure as fewer service members are deployed to the Middle East.

In 2016, CA cases of *Acinetobacter* species accounted for nearly two-thirds of all infections, indicating that the majority of cases may not be attributed to healthcare exposures. Although this aligns with previous results,¹ this finding conflicts with current literature that indicates that *Acinetobacter* species infections occur more frequently in the healthcare setting.⁶ This MHS analysis lends credence to the previously suggested notion of a community reservoir of *Acinetobacter* species, which may include soil, vegetables, and human and animal skin.⁶

Acinetobacter species infections in the MHS in 2016 maintained high susceptibilities to many tested antibiotics, similar to previous findings.¹ Amikacin maintained the highest efficacy across the surveillance period. Amikacin has also proven to offer the greatest consistency in efficacy against *Acinetobacter* species infections among all aminoglycosides.⁷ Ampicillin/sulbactam also had high susceptibility at 95.1%, a proportion that has steadily increased from 80.1% since 2011. Current literature suggests that ampicillin/sulbactam has direct antimicrobial activity against *Acinetobacter* species infections, which is evident in these results.⁷

Current clinical guidelines for treating *Acinetobacter* species infections recommend imipenem, meropenem, ampicillin/sulbactam, colistin, tigecycline, or amikacin as primary treatments as these antibiotics are most active against the pathogen. Similar to 2015, trimethoprim/sulfamethoxazole (TMP/SMX) was again the most frequently prescribed antibiotic in the MHS beneficiary population in 2016. However, a peer-reviewed article suggests that TMP/SMX may be a questionable treatment for *Acinetobacter* species infections due to its variable susceptibility.⁸ There is also evidence that TMP/SMX can be an alternative treatment for polymyxin-resistant *Acinetobacter* species infections.⁸ TMP/SMX susceptibility increased from 88.2% in 2015 to 93.6% in 2016 and showed a statistically significant ascending trend in susceptibility from 2011-2016.



In conclusion, this annual report summarized *Acinetobacter* species infection incidence and prevalence in the MHS beneficiary population in 2016 and reported a decline in infection rates from the previous report. Due to variability from year to year, continued surveillance of *Acinetobacter* species infections within the MHS is encouraged.

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Appendix A: Antibiotics Used to Identify Resistance among *Acinetobacter* Species Infections in the MHS, CY 2016

Table A-1. Antibiotics Used to Identify Resistance among *Acinetobacter* Species Infections in the MHS, CY 2016

Antibiotic Class	Antibiotics Included in Class
Polymyxins	Colistin
	Polymyxin E
Aminoglycosides	Amikacin
	Tobramycin
Penicillin + β -lactamase	Ampicillin/sulbactam
Carbapenem	Imipenem
	Meropenem
Tetracycline	Tigecycline
	Minocycline
Rifamycin	Rifampin
Sulfonamides	Trimethoprim/sulfamethoxazole
Cephalosporins	Cefotaxime
	Ceftriaxone
	Cefepime
Antipseudomonal + β -lactamase inhibitors	Piperacillin/tazobactam

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Appendix B: Acronym and Abbreviation List

Acronym/Abbreviation	Definition
ABC	<i>Acinetobacter baumannii-calcoaceticus</i> complex
AD	active duty
CA	community-associated
CHCS	Composite Health Care System
CO	community-onset
CTS	Contingency Tracking System
CY	calendar year
DMDC	Defense Manpower Data Center
DOD	Department of Defense
DON	Department of the Navy
EDC	EpiData Center Department
HA	healthcare-associated
HL7	Health Level 7
HO	hospital-onset
IR	incidence rate
M2	MHS Data Mart
MDR	multidrug-resistant
MDRO	multidrug-resistant organism
MHS	Military Health System
MTF	military treatment facility
NMCPHC	Navy and Marine Corps Public Health Center
NOS	not otherwise specified
OCONUS	outside the continental United States
PH	previous hospitalization
PXDR	possible extensive drug resistance
SIDR	Standard Inpatient Data Record
SSTI	skin and soft tissue infection
TMP/SMX	trimethoprim/sulfamethoxazole
US	United States
XDR	extensive drug resistance

