



The Burden of Invasive *Staphylococcus aureus*, Carbapenem-Resistant Gram-Negative Bacilli and *Clostridium difficile* Infections in Nursing Homes in Monroe County, NY

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Background and Objective

- Infections due to Methicillin-resistant *Staphylococcus aureus* (MRSA), Methicillin-sensitive *S. aureus* (MSSA), carbapenem-resistant gram-negative bacilli [CR-GNB], and *Clostridium difficile* are common causes of healthcare associated infections.¹⁻³
- Over 100,000 cases of *C. difficile* infection (CDI) are estimated to occur yearly in US nursing homes (NH).⁴ Administrative data shows that the prevalence of multidrug-resistant organisms varies widely among US NH residents.⁵
- Both resident and NH factors may affect the incidence of these organisms but trends in incidence using clinical data are not well-described.
- The Centers for Disease Control and Prevention's Emerging Infections Program (EIP) conducts population-based, active, laboratory-based surveillance for MRSA, MSSA, CR-GNB and CDI.
- Utilizing EIP data from 2016, we sought to better understand the local epidemiology of infections caused by these organisms in 33 NH in Monroe County, NY.

Methods

Setting:

- The median bed size (25-75% interquartile range [IQR]) of the 33 NH is 120 (110), with an average occupancy rate of 94%. Three (9%) NH have ventilator beds.

Surveillance Methods:

- Positive MRSA/MSSA, CR-GNB and CDI cultures are reported to EIP by local laboratories. Data are abstracted from medical records for all identified cases.
- Only incident, NH-onset cases were included, defined as cases with positive specimens collected in the NH or ≤ 3 days after hospital admission from a NH.
- Cases were limited to county residents; inclusion criteria vary by organism:
 - CDI:** ≥ 1 year of age with a stool specimen positive for *C. difficile* by toxin or molecular assay without a positive test in the prior 8 weeks.
 - CR-GNB:** CR *E. coli*, *Enterobacter* species, *Klebsiella* species, or carbapenem-non-susceptible *A. baumannii* complex, isolated from normally sterile sites/ urine.
 - MRSA/MSSA:** isolated from a normally sterile site, collected at least 30 days apart from a previous positive culture.

Analysis:

- Case characteristics were compared using student's t-tests, chi-square and analysis of variance.
- Poisson regression was used to detect differences between the observed and expected number of cases by NH based on bed size.
- Using Centers for Medicare and Medicaid Services data obtained from LTCFocus⁶, NH were stratified on several characteristics to compare incidence rates.

Results

Case Characteristics:

- A total of 205 cases in 193 persons were identified; CDI was most common (156 cases, 76%).
- Twenty-one (10%) cases died within 30 days; MSSA cases had the highest mortality rate (24%).
- Ninety-six (47%) infections developed within 30 days post-hospitalization (Table 2).

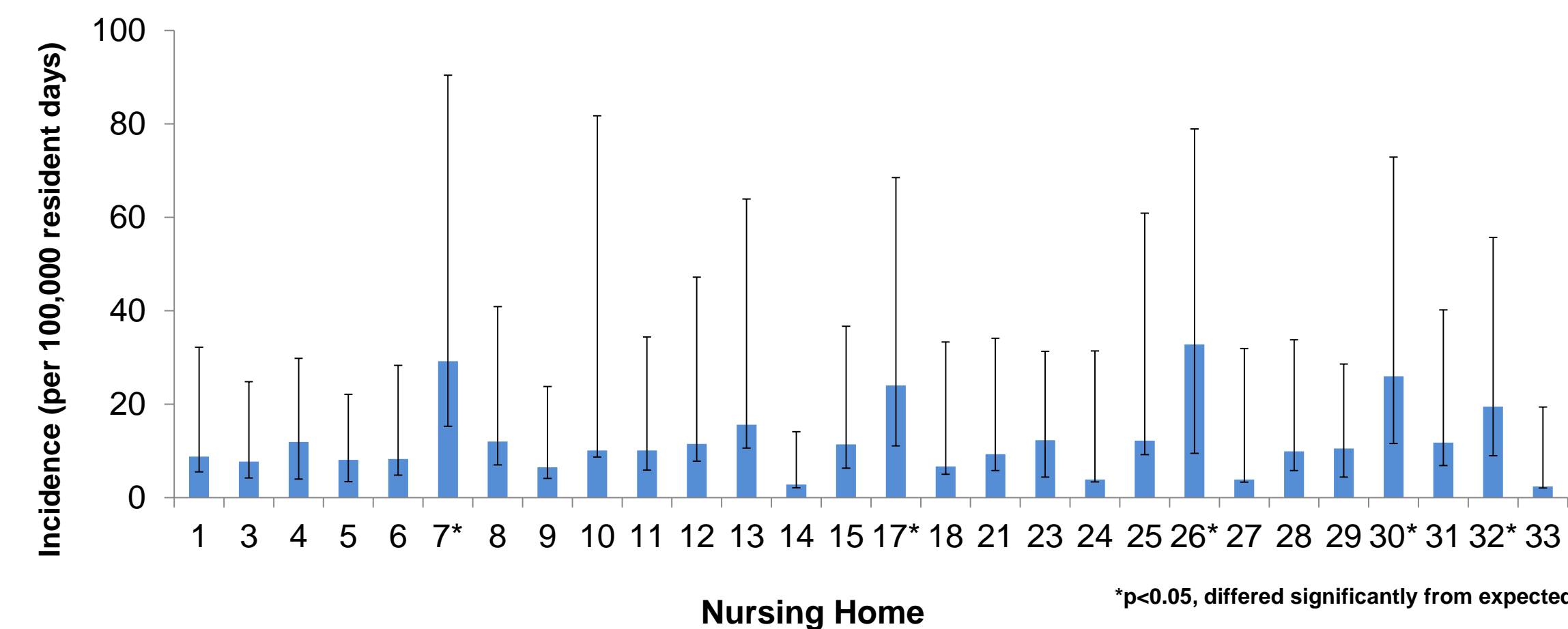
Table 1. Case Characteristics

Unique Cases	CDI (N=147)	MRSA (N=22)	MSSA (N=16)	CR-GNR (N=8)	Total (N=193)	P-value
	n (%)					
Demographics						
Sex, female	94 (64)	9 (41)	8 (50)	7 (88)	118 (61)	0.0602
Age in years, mean (SD)	79 (12)	71 (18)	66 (16)	82 (11)	77 (14)	0.0007
Race, White	122 (83)	16 (73)	10 (63)	6 (75)	154 (80)	0.1534
Ethnicity, Non-Hispanic/Latino	133 (91)	20 (91)	15 (94)	7 (88)	175 (91)	0.4187
Charlson Score, mean (SD)	3 (2)	4 (2)	5 (3)	3 (3)	4 (2)	0.1133

Table 2. Healthcare Exposures

All Cases	CDI (N=156)	MRSA (N=24)	MSSA (N=17)	CR-GNR (N=8)	Total (N=205)	P-value
Hospitalized in the 30 days prior to infection	75 (48)	8 (33)	9 (53)	4 (50)	96 (47)	0.5403
Median days to infection post-hospitalization (IQR)	13 (11)	11 (22)	15 (9)	22 (13)	13 (12)	0.1461

Figure 1. Incidence (with associated 95% confidence intervals) for all Organisms by NH



Incidence by Organism and NH and Analysis of NH Characteristics:

- Pooled incidence for all organisms ranged from 2.4 to 33.3 (Figure 1); 5 (15%) NH had no cases.
- In 5 NH, the number of cases differed significantly from expected based on bed size (Figure 1).
- CDI incidence was highest (median=7.7 [SD 6.4]), followed by MRSA (3.1 [1.4]), MSSA (2.4 [2.1]) and CR-GNB (2.0 [1.1]).
- NH with a higher percentage of Medicare residents (i.e., transitional care patients) had a marginally significant higher incidence of infection caused by all organisms (Table 3).

Table 3. Infection Incidence Rates by NH Characteristic

	No. Cases	Res. Days	Rate	RR	p-Value	95% CI
No. of beds						
≤ 120	53	424,834	12.5	1		
> 120	147	1,332,607	11.0	0.88	0.4422	0.62-1.21
% Medicare residents						
$\leq 5.16\%$	51	558,711	9.1	1		
$> 5.16\%$	149	1,198,730	12.4	1.36	0.0561	0.99-1.87
RN hours per resident days						
≤ 0.415	78	765,705	10.2	0.83		
> 0.415	122	991,736	12.3	1	0.1925	0.62-1.10
CNA hours per resident days						
≤ 2.43	97	803,652	12.1	1.11		
> 2.43	103	953,789	10.8	1	0.4314	0.85-1.47
LPN hours per resident days						
≤ 1.10	82	776,434	10.6	0.88		
> 1.10	118	981,007	12.0	1	0.3652	0.66-1.16
Mean Resource Utilization Group						
≤ 1.14	108	895,816	12.1	1		
> 1.14	92	861,625	10.7	0.89	0.3918	0.67-1.17

Conclusion

- Incidence varied by both organism and NH but a significant association with NH or resident characteristics was not found, potentially due to the small sample size. Additionally, the inclusion of urine in the CR-GNB case definition does not allow us to separate infection from colonization.
- Our findings suggest that the time post-hospitalization is a high risk period. NH that accept a higher percentage of transitional care residents may have a higher infection incidence and can be targeted for prevention.

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Nothing to disclose