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Lack of Seasonality in the Occurrence of Multidrug-Resistant *Acinetobacter baumannii* Complex

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An increase in *A. baumannii* infection rates in summer has been reported to the National Nosocomial Infections Surveillance System since 1970s [1]. The reasons underlying this apparent seasonal variation have not been well understood. Meanwhile, rates of multidrug resistance (MDR) have increased substantially in *A. baumannii* over the last decade [2]. Higher rates of *A. baumannii* infection during the summer months have been acknowledged using more recent local and national surveillance data as well, but the differences observed between seasons were not as striking compared with studies done in the previous era [3, 4]. We therefore conducted the present study to assess seasonal variation in the incidence of *A. baumannii* infection according to antimicrobial susceptibility.

The microbiology records were reviewed documenting isolation of *A. baumannii* complex from both inpatients and outpatients at the University of Pittsburgh Medical Center (Presbyterian Campus) for an 11-year period, from May 2000 to April 2011. Species identification was performed using conventional phenotypic testing until June of 2007. After that, organisms were identified using the Micoscan Walk-Away instrument (Siemens). Susceptibility testing was performed using the disk diffusion method as defined by the Clinical and Laboratory Standards Institute (CLSI) [5]. Thus, *A. baumannii* complex described here contains four closely related species that are not differentiated using biochemical methods: *A. baumannii*, *Acinetobacter nosocomialis*, *Acinetobacter pittii*, and *Acinetobacter calcoaceticus*. If multiple isolates were found from the same patient within a 90-day period, only the first isolate was used to define a case in the analysis. MDR was defined as resistance to 3 or more groups of antimicrobial agents, whereas non-MDR was defined as resistance to 2 or less of them [6]. The number of cases in each month was obtained according to the non-MDR or MDR status. The monthly average high temperatures in Pittsburgh, Pennsylvania were obtained from the National Weather Service Forecast Office (<http://www.erh.noaa.gov/>). As a result, we defined May to September (average high

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temperature $>70^{\circ}\text{F}$) as warm months, and October to April (average high temperature $<70^{\circ}\text{F}$) as cold months. We also defined March to May as spring, June to August as summer, September to November as fall and December to February as winter. Rank sum test (Mann Whitney) was used to assess seasonality. The association of the number of *A. baumannii* complex cases per month with temperature was assessed by Spearman rank correlation coefficient. All statistical analyses were performed with Stata software, version 12.0. The study was approved by the local institutional review board.

During the 11-year study period, 2958 *A. baumannii* complex isolates were recovered from unique clinical cultures. Of these, 1476 isolates defined unique cases after excluding 1482 isolates that were recovered from the same patients within a 90-day period. Of the 1476 cases, 692 (46.9%) were due to non-MDR *A. baumannii* complex and 784 (53.1%) were due to MDR *A. baumannii* complex. Overall, the rates of MDR increased over the years, consistent with national trends. Figure shows the monthly occurrence of non-MDR and MDR *A. baumannii* complex cases over the 11-year study period, with the monthly average high temperatures in our region superimposed. As can be seen, the non-MDR and MDR cases showed distinct trends. The number of cases in warm months (May to September) was then compared to that in cold months (October to April). The median number of isolates in warm months was 5 (Interquartile range (IQR): 3–8) and that in cold months was 4 (IQR: 2–7) ($P=0.0067$). Stratified by susceptibility, the median number of non-MDR *A. baumannii* complex cases in warm months was 7 (IQR: 4–10) and that in cold months was 3 (IQR: 2–5) ($P<0.0001$). On the other hand, the median number of MDR cases in warm months was 4 (IQR: 3–7) and that in cold months was 5 (IQR: 3–9) ($P=0.1362$). There was a moderately positive correlation between non-MDR *A. baumannii* complex cases and temperature ($r_s=0.5436$). MDR *A. baumannii* complex cases had weakly negative correlation with temperature ($r_s=-0.1442$).

In this study, non-MDR *A. baumannii* complex cases were identified significantly more frequently in warm months, which is consistent with previous observations. However, this trend was not observed for MDR *A. baumannii* complex cases despite the large number of these cases over the study period. MDR *A. baumannii* has been recognized to be highly clonal in nature [7]. We have previously shown that isolates of clonal complex (CC) 92 was predominant among carbapenem-nonsusceptible *A. baumannii* in our hospital as well as hospitals across the U.S. [8]. Although molecular analysis was not performed in the present study, our surveillance data show that CC92 continues to predominate among MDR *A. baumannii* at our institution. While information on the molecular epidemiology of non-MDR *A. baumannii* is scarce, it is possible that MDR *A. baumannii* complex, which largely consists of CC92, tends to lack the typical preference towards warmer environment compared with their more antimicrobial-susceptible counterparts. This study was performed in a single tertiary care facility in Pennsylvania, thus it remains to be seen whether the same phenomenon is observed in more diverse clinical settings. The potential clinical implication of this observation is that a heightened activity of MDR *A. baumannii* complex during summer months, if it occurs, may not be due to natural seasonal variation but rather indicate an outbreak situation which merits investigation.

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References

1. Retalliau HF, Hightower AW, Dixon RE, Allen JR. *Acinetobacter calcoaceticus*: a nosocomial pathogen with an unusual seasonal pattern. J Infect Dis. 1979; 139:371–375. [PubMed: 448188]
2. Mera RM, Miller LA, Amrine-Madsen H, Sahm DF. *Acinetobacter baumannii* 2002–2008: increase of carbapenem-associated multiclass resistance in the United States. Microb Drug Resist. 2010; 16:209–215. [PubMed: 20707714]
3. Perencevich EN, McGregor JC, Shardell M, Furuno JP, Harris AD, Morris JG Jr, et al. Summer peaks in the incidences of Gram-negative bacterial infection among hospitalized patients. Infect Control Hosp Epidemiol. 2008; 29:1124–1131. [PubMed: 19031546]
4. Eber MR, Shardell M, Schweizer ML, Laxminarayan R, Perencevich EN. Seasonal and temperature-associated increases in gram-negative bacterial bloodstream infections among hospitalized patients. PLoS One. 2011; 6:e25298. [PubMed: 21966489]
5. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing: twentieth informational supplement. Wayne, PA: 2010.
6. Adams-Haduch JM, Paterson DL, Sidjabat HE, Pasculle AW, Potoski BA, Muto CA, et al. Genetic basis of multidrug resistance in *Acinetobacter baumannii* clinical isolates at a tertiary medical center in Pennsylvania. Antimicrob Agents Chemother. 2008; 52:3837–3843. [PubMed: 18725452]
7. Higgins PG, Dammhayn C, Hackel M, Seifert H. Global spread of carbapenem-resistant *Acinetobacter baumannii*. J Antimicrob Chemother. 2010; 65:233–238. [PubMed: 19996144]
8. Adams-Haduch JM, Onuoha EO, Bogdanovich T, Tian GB, Marschall J, Urban CM, et al. Molecular epidemiology of carbapenem-nonsusceptible *Acinetobacter baumannii* in the United States. J Clin Microbiol. 2011; 49:3849–3854. [PubMed: 21918019]

Figure.

Incidence of non-MDR and MDR *A. baumannii* complex cases by calendar month, along with average monthly high temperatures over the 11-year study period.