



# Analysis of the economic impact associated with susceptibility patterns and antimicrobial treatment of *Proteus* species at a community hospital over five years



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METHODIST HEALTHCARE

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### Background/Objective

We previously reported a significant decline in susceptibility to *Proteus* species for several antibiotics, including ceftriaxone. Since the phenotypic susceptibility pattern from the automated system appeared to resemble an ESBL isolate, we performed susceptibility testing for several antimicrobials using E-test. Surprisingly, none of the isolates produced an extended-spectrum beta-lactamase. Furthermore, all of the isolates were susceptible to ceftriaxone with all MICs being < 1 mcg/mL. Upon further investigation, it was discovered that the algorithm selected in the automated system led to classifying ceftriaxone and other beta-lactams as resistant. Building on previously reported data, this study will evaluate a yearly antibiogram for 7 antibiotics against *Proteus* species and determine the economic impact of resistant isolates.

### Methods

- All susceptibility data for *Proteus* cultures from May 2006 – August 2011 were obtained from adult patients in an 850-bed community hospital.
- Duplicate isolates were removed and a yearly antibiogram was created for the following: ampicillin, amoxicillin/clavulanate, cefazolin, ceftriaxone, gentamicin, levofloxacin, and trimethoprim/sulfamethoxazole.
- Patient information (e.g., demographics, date of admission and discharge) was collected from the health system's electronic medical records for multi-drug resistant (MDR) isolates.
- Patient location at time of culture was grouped by unit: critical care, step down, general medicine, outpatient.
- Length of hospital stay and antibiotic therapy cost was calculated for patient's with an MDR *Proteus* infection.
- MDR was defined as resistant to ceftriaxone plus 2 other antibiotic classes.

### Results

Figure 1: *Proteus* Susceptibility Over 5 Years

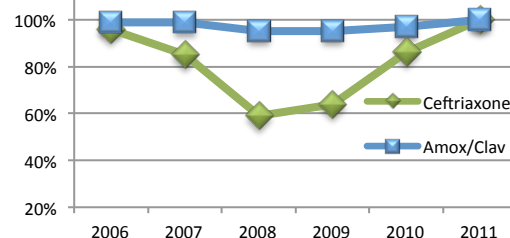
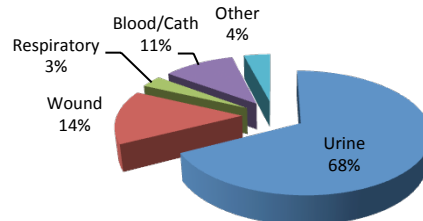


Figure 2: Source of MDR *Proteus* Infections



- Overall, 1383 patients were identified of which 222 patients (249 isolates) were considered MDR organisms.
- All antibiotics evaluated except ceftriaxone demonstrated a relative stable susceptibility pattern over the time period
- Ceftriaxone susceptibility was 96% (2006), 85% (2007), 59% (2008), 64% (2009), 86% (2010), and 89% (2011); while amoxicillin/clavulanate displayed the highest susceptibility (average of 96%) (See Figure 1).
- The majority of MDR isolates were found in the urine (68%) (See Figure 2).
- The average age was 70 years with the majority (56%) being females.
- The average length of hospital stay was 6.6 days for patients with MDR *Proteus* infections.
- The majority of the MDR *Proteus* infections were from the outpatient setting (53%).

### Results (Continued)

- Prior to culture results, the most common antimicrobials prescribed were levofloxacin, ceftriaxone, and piperacillin/tazobactam. However, after the culture results were provided, a dramatic increase of carbapenems and amoxicillin/clavulanate usage occurred. (See Table 1). This led to an unnecessary increase in antibiotic expenditures of >\$30,000.

Table 1: Antibiotic Prescribing Patterns Pre-and Post-*Proteus* Culture Result

Antibiotic/Class	Before N = 267	After N = 126
Levofloxacin	28%	12%
Ceftriaxone	25%	3%
Piperacillin/tazobactam	17%	9%
Cefotetan	<1%	5%
Carbapenem	1%	17%
Amoxicillin/Clavulanate	1%	25%

### Conclusions

Selection of some algorithms in automatic susceptibility testing can lead to inappropriate susceptibility reporting and potential increased cost of therapy. The overall economic impact of MDR *Proteus* infections resulted in increased use of costly antibiotic therapy. The multidisciplinary teamwork between pharmacy and microbiology laboratory personnel is vital in maximizing antimicrobial stewardship.

### References

Performance standards for antimicrobial susceptibility testing; twenty-first informational supplement; Clinical and Laboratory Standards Institute, Wayne, PA 2011.

### Disclosure

Authors of this presentation have the following to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this presentation. All authors have nothing to disclose.