National Prevalence of Extended Spectrum Beta-lactamase-Producing Enterobacteriaceae (ESBL) in the Ambulatory and Acute Care Settings in the United States in 2015-2016

V Gupta, Pharm.D., BCP's, M Oleksy, PhD, J Mohr, PharmD, K Luepke, PharmD, H Hoffman-Roberts, PharmD, YP Tabak, PhD, and RS Johannes, MD, MS,a,4

1Becton, Dickinson and Company, Franklin Lakes, NJ, USA; 2Tetraphase Pharmaceuticals, Watertown, MA, USA; 3Former Employee Tetraphase Pharmaceuticals, Watertown, MA, USA; 4Harvard Medical School, Boston, MA, USA

Abstract

Extended spectrum beta-lactamase (ESBL)-producing Enterobacteriaceae (ESBL-producing E. coli, Klebsiella pneumoniae, and Proteus mirabilis) are traditionally nosocomial pathogens, but have begun to emerge in the outpatient setting. Approximately 15% of healthcare-associated infections (HAI) due to ESBL-producing Enterobacteriaceae are caused by ESBL-producing Enterobacteriaceae in ambulatory care. Additionally, HAI caused by ESBL can often result in high mortality and economic burdens. According to National Healthcare Safety Network (NHSN) report of antimicrobial resistance patterns for HAI in 2010–2010, extended-spectrum cephalosporin-resistant K. aerobacter spp. and K. colae were found in 12% of catheter-associated urinary tract infections, central line-associated infections, ventilator-associated bacterial pneumonia and surgical site infection (SSI) data in the United States (US). The CDC estimates 17,000 infections and 9,000 HAI caused by ESBL-producing Enterobacteriaceae and E. coli, respectively, occur annually in the US. The purpose of this study was to estimate the national prevalence of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis in the acute care and ambulatory settings in the US from July 2015 to June 2016 based on a large database from Becton Dickinson & Company.

Results

Non-duplicate isolates (first isolate of a species per 30-day period) were collected from 348 US hospitals (hospital characteristics listed in Table 1). Sources were respiratory, blood, urinary, skin, intra-abdominal, and other, and ESBLs were identified per the following criteria: E. coli, K. pneumoniae, and P. mirabilis isolates were defined as ESBL-positive by performing commercially or reported as intermediate or resistant to any of the four extended spectrum cephalosporins (ceftazidime, cefoperazone, cefotaxime, and ceftriaxone). Isolates were categorized into three settings by the specimen collection time totals:

- **Admission**: Within 3 days of an inpatient admission and no previous admission within 30 days
- **Hospital-onset**: 3 days or more post-admission or within 14 days of discharge
- **Ambulatory** neither a or b

Data were compiled into publicly available US Centers for Medicare and Medicaid Services (CMS) hospital data using Provider IDs and monitoring the rate of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis (Table 2). The top three sources of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis isolates were: urinary (73.0% of isolates), skin (13.9% of isolates), and blood (6.0% of isolates) (Figure 2).

Sustainability data from non-duplicate isolates from 348 nationwide facilities were used to project national prevalence by setting type:

- **Admission**: 3.6% (109,746/3,057,351) of the isolates were defined as ESBL-producing organisms (Table 2) in 109,746 patients
- **Hospital-onset**: 10.0% (13,132/131,320) of the isolates were defined as ESBL-producing organisms (Table 2) in 13,132 patients
- **Ambulatory**: 8.3% (20,904/252,003) of the isolates were defined as ESBL-producing organisms (Table 2) in 20,904 patients

Table 2. National projections of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis events estimated from observed events from the 348 hospitals in the BD database

<table>
<thead>
<tr>
<th>Region</th>
<th>National Total</th>
<th>Observed</th>
<th>Projected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>348,922</td>
<td>11,935</td>
<td>15,850</td>
</tr>
<tr>
<td>Northeast</td>
<td>438,182</td>
<td>10,306</td>
<td>13,132</td>
</tr>
<tr>
<td>South</td>
<td>538,452</td>
<td>10,062</td>
<td>11,284</td>
</tr>
<tr>
<td>West</td>
<td>538,452</td>
<td>9,385</td>
<td>10,920</td>
</tr>
<tr>
<td>Total</td>
<td>1,854,908</td>
<td>32,692</td>
<td>41,289</td>
</tr>
</tbody>
</table>

Figure 3: Source distribution of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis isolates from 348 facilities

Figure 4: National projections of ESBL-producing E. coli, K. pneumoniae, and P. mirabilis events [5] by period tested and region

Conclusions

These data suggest that national hospital onset ESBL rates in the 12 month ending June 2015 may be higher than previously reported estimates with urine being the primary source of ESBL-producing organisms. The highest rates of projected ESBL events occur in the hospital-onset period, however 67% of ESBL events occur in the ambulatory period. The highest rates of ESBL are in the Northeast and the highest projected cases are in the Midwest and South regions. The limitation of this study include that many methodologies are available to determine projections, and projections beyond the underlying data sample always have underlying assumptions and carry some risk.

References


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Author Disclosure Information