Introduction

• Prevalence of community-associated urinary tract infections (UTIs) is 0.7% in the United States.¹
• A UTI is defined as symptomatic bacteriuria, and UTIs can be further divided into bladder infections (cystitis) or kidney infections (pyelonephritis).
• Signs and symptoms associated with cystitis: pain or burning with urination (dysuria), an increase in frequency of urination, an increase in urgency to urinate, suprapubic pain, and/or blood in urine (hematuria)
• Signs and symptoms associated with pyelonephritis: fever, chills, flank pain, costovertebral-angle tenderness, and/or nausea or vomiting, with or without symptoms of cystitis²
• E. coli is the most common pathogen responsible for UTIs³⁴
• Studies have found unique characteristics associated with strains of E. coli that commonly cause cystitis,₅ but there has yet to be a study that directly links patients’ symptoms to the exact strains of E. coli.

Aims and Objectives

Aim 1: Determine whether connection can be made between specific bacterial strains and the development of a symptomatic UTI vs. asymptomatic bacteriuria.

Aim 2: Analyze relatedness of strains in different types of symptomatic UTIs.

Aim 2A: Determine if specific strains are more associated with cystitis or pyelonephritis.

Aim 2B: Determine if specific strains are more associated with mild infection (without sepsis) vs severe infection (with sepsis) based on clinical presentation of patients.

Aim 3: Geomap the strains which cause UTIs and asymptomatic bacteriuria to determine if there are postal codes with hotspots for specific strains and if those strains have a clear clinical association as noted in Aim 2.

Methods

• Cultures that grew E. coli from adult patients (≥18 years old) seen in the emergency department (ED) or admitted to Beaumont Royal Oak (RO) Hospital ordered in routine clinical care and processed by standard operating procedures in the Clinical Microbiology Laboratory were collected.

• Isolates were prepared for typing by the manufacturer’s guidelines. 15 µL of each isolate’s suspension were pipetted in triplicates onto a 96 well silicon microtiter plate. Controls were provided with each biotyping kit, and 12 µL of a positive and negative control were spotted in duplicates on the plate.

• The Bruker IR Biotyper fingerprinted the the E. coli based on its carbohydrate profile and generated a dendrogram.

Figure 1. Dendrogram showing 13 distinct major clusters among the urinary E. coli isolates.

Table 1. Symptomatic presentation as related to strain type with patient urine cultures positive for E. coli

<table>
<thead>
<tr>
<th>Cluster</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>None</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation</td>
<td>Unknown</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Asymptomatic</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>38</td>
<td>0</td>
<td>1</td>
<td>7</td>
<td>28</td>
</tr>
<tr>
<td>Altered mental status</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>25 (8%)</td>
</tr>
<tr>
<td>Symptomatic</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>13</td>
<td>3</td>
<td>34</td>
<td>7</td>
<td>7</td>
<td>16</td>
<td>45</td>
<td>153 (48%)</td>
<td></td>
</tr>
<tr>
<td>Type of UTI</td>
<td>Cystitis</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>31</td>
<td>4</td>
<td>5</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>Pyelonephritis</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>18</td>
<td>25</td>
<td>67</td>
<td>317 (100%)</td>
</tr>
<tr>
<td>Severity</td>
<td>Mild</td>
<td>2</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>28</td>
<td>3</td>
<td>4</td>
<td>13</td>
<td>33</td>
</tr>
<tr>
<td>Severe</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<td>0</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>12</td>
<td>40 (26%)</td>
</tr>
<tr>
<td>Total of Each Strain Type</td>
<td>5</td>
<td>11</td>
<td>14</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>23</td>
<td>9</td>
<td>34</td>
<td>66</td>
<td>7</td>
<td>16</td>
<td>45</td>
<td>153 (48%)</td>
</tr>
</tbody>
</table>

Figure 2. Geomap of each strain cluster of urinary E. coli within the local catchment area for Beaumont RO.

References


Conclusions

• 13 distinct major clusters of E. coli were found.
• Strain type J was by far the most common (27.1%).
• A number (87) of isolates were not a part of any major cluster.
• None of the clusters had a clear association with asymptomatic bacteriuria, cystitis, or pyelonephritis nor mild or severe presentations.
• A few clusters had no cases of pyelonephritis or severe presentation; however, due to the low number of symptomatic patients (<3 patients) in these clusters, pyelonephritis and severe presentations may not have been detected simply due to their lower prevalence.
• Findings suggest that host factors play a larger role in patients’ presentations and the disease course than the specific strain of the E. coli.
• Limitations:
  - A relatively low number (317) of E. coli isolates were collected and analyzed.
  - Only samples from the North Clinical Microbiology Laboratory at Beaumont RO were collected and analyzed.
  - Only isolates from patients in the ED and those admitted who grew E. coli in their urine cultures were analyzed as those had clinical information available.
• Future study:
  - A larger study which sub-divides patients by community acquired UTIs, healthcare associated UTIs, or catheter associated UTIs.

Acknowledgements

I would like to thank Kimberly Powell for teaching me the laboratory techniques for this project.
I would like to thank Chantal Lang for setting up times for me to meet with Dr. Sims.
I would like to thank the OUWB Capstone Program for funding my research project.