Prevalence of Antimicrobial Resistance among most Gram-negative Isolates in Inpatients at USTH

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Outline

• Introduction
• Methodology
• Results & Discussions
• Conclusion & Recommendations
Introduction
Introduction

• **Gram-negative bacteria (GNB)** are considered one of the most common causes of hospital-acquired infections.
  – GNB are responsible for more than **30% of hospital-acquired infections**.
  – In **ICU** GNB account for about **70% of infections**.

Hidron AI, et al. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections
Introduction

• **Antibiotic resistance (ABR)** among GNB are increasing continuously and this issue must be dealt with as a major worldwide issue.

• As the burden of morbidity and mortality resulting from ABR has **serious consequences** for individuals and society in terms of clinical outcomes and added costs.


WHO. Antibiotic resistance, Global Report on surveillance 2014
Introduction

Antibiotic Development is Dwindling
Introduction

• **The aim of this study** was to determine the prevalence of antimicrobial resistance for the most isolated GNB in USTH among inpatients

• As variations do exist among different countries and hospitals, the **local resistance data is essential** for appropriate initial therapy of nosocomial infections
Methodology
Methodology

• Retrospective study

• Data collection (Jan-2006 to Dec-2013) USTH.

• Samples were analyzed, and identified by:
  – Standard microbiological techniques
  – Vitek2 system
Methodology

• The susceptibility following antibiotics (HIMEDIA discs) were tested:

1. Imipenem
2. Meropenem
3. Piperacillin/tazobactam
4. Cefepime
5. Ceftazidime
6. Ciprofloxacin
7. Levofloxacin
8. Moxofloxacin
9. Amikacin
10. Gentamicin
11. Ampicillin/sulbactam
12. Cefoperazone/sulbactam
13. Polymyxin
Methodology

• The isolates were classified as (CLSI) – (S), (I), or (R)

• Chi-square tests (hypothesis testing)

• SPSS version 14.0 (statistical analysis)

• $p$-values $< 0.05$ (significant)
Results & Discussions
## Distribution of Isolates among Samples

<table>
<thead>
<tr>
<th>Samples</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory tract</td>
<td>15</td>
<td>26</td>
<td>47</td>
<td>87</td>
<td>115</td>
<td>95</td>
<td>126</td>
<td>126</td>
<td>637</td>
</tr>
<tr>
<td>Blood</td>
<td>8</td>
<td>18</td>
<td>23</td>
<td>56</td>
<td>54</td>
<td>28</td>
<td>50</td>
<td>48</td>
<td>285</td>
</tr>
<tr>
<td>Urine</td>
<td>18</td>
<td>36</td>
<td>44</td>
<td>50</td>
<td>54</td>
<td>46</td>
<td>42</td>
<td>58</td>
<td>348</td>
</tr>
<tr>
<td>Pus</td>
<td>9</td>
<td>23</td>
<td>18</td>
<td>42</td>
<td>43</td>
<td>83</td>
<td>114</td>
<td>63</td>
<td>395</td>
</tr>
<tr>
<td>Wound</td>
<td>6</td>
<td>6</td>
<td>5</td>
<td>34</td>
<td>5</td>
<td>28</td>
<td>34</td>
<td>15</td>
<td>133</td>
</tr>
<tr>
<td>Others</td>
<td>12</td>
<td>16</td>
<td>17</td>
<td>33</td>
<td>26</td>
<td>32</td>
<td>35</td>
<td>36</td>
<td>207</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>125</td>
<td>154</td>
<td>302</td>
<td>297</td>
<td>312</td>
<td>401</td>
<td>346</td>
<td>2005</td>
</tr>
</tbody>
</table>

Respiratory > Pus > Urine > Blood
Distribution of Isolates among Samples

• In other studies:

1. Respiratory > Blood > Urine

2. Respiratory > Urine > Blood


Most Common GNB Isolates

1. **E. coli** (834, **41.6%**)

2. **Acinetobacter spp.** (536, **26.7%**)

3. **K. pneumonia** (422, **21.0%**)

4. **P. aeruginosa** (213, **10.6%**)


Most Common GNB Isolates

• Other studies:

**A. baumannii** (2,124, 37.3%), **P. aeruginosa** (1,736, 30.3%), **Enterobacter spp.** (594, 10.4%), **E. coli** (592, 10.4%), and **Klebsiella spp.** (509, 8.9%)¹

**Acinetobacter spp.** (886 isolates, 31.7%), followed by **P. aeruginosa** (855 isolates, 30.6%), **E. coli** (392 isolates, 14.0%), and **K. pneumonia** (285 isolates, 10.2%)²

Resistance Rate of *E. coli*

- **2006**
- **2013**
Resistance Rate of *E. coli*

- Consistent;

There is **increase in the resistance** to third-generation cephalosporins and the **increasing prevalence of ESBL-producing** *E. coli* (50%, 2011).¹

*E. coli* **susceptibility markedly decreased** to ceftazidime (76% to 46%, 39% decline; *P*=.004), and cefepime (77% to 50%, 35% decline; *P*=.009).²

Resistance Rate of \textit{E. coli}

Escherichia coli: percentage of invasive isolates with resistance to third-generation cephalosporins. ECDC, 2013 report
Resistance Rate of *Acinetobacter* spp.

- Imipenem
- Meropenem
- Pipracillin/tazobactam
- Cefepime
- Ceftazidim
- Ciprofloxacin
- Levofloxacin
- Moxifloxacin
- Amikacin
- Gentamicin
- Ampicillin-sulbactam
- Cefoperazone-sulbactam
- Polymyxin

<table>
<thead>
<tr>
<th>Year</th>
<th>2006</th>
<th>2013</th>
</tr>
</thead>
</table>

*Acinetobacter* spp.
Resistance Rate of *Acinetobacter* spp.

Similar data had been reported from other parts of the world (i.e., Turkey\(^1\), Saudi Arabia\(^2\), USA\(^3\), and Canada\(^4\))

(HIGH consumption of ABX)

However, resistance rate in many developed countries are lower than developing countries\(^3,4\).

Resistance Rate of *K. pneumonia*
Resistance Rate of *K. pneumonia*

- Similar:
  - Increase in the resistance to the third-generation cephalosporins had been reported.\(^1\)
  - Also, increase in the prevalence of ESBL-producing *Klebsiella spp* (80%).\(^1\)
  - Of 285 *K. pneumonia* isolates, the ESBL rate increased from 12% in 2004 and to 21% in 2009.\(^2\)

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Resistance Rate of *K. pneumonia*

Klebsiella pneumoniae: percentage of invasive isolates with combined resistance to third-generation cephalosporins, fluoroquinolones and aminoglycosides

ECDC, 2013 report
Resistance Rate of *P. aeruginosa*

<table>
<thead>
<tr>
<th>Antimicrobial</th>
<th>Year 2006</th>
<th>Year 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imipenem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meropenem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipracillin/tazobactam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
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<td></td>
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<tr>
<td>Ceftazidim</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cefepime</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Levofloxacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moxifloxacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amikacin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gentamicin</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P. aeruginosa*
Resistance Rate of *P. aeruginosa*

• However;

*In Saudi Arabia, P. aeruginosa susceptibility significantly declined* after 2007, especially for carbapenem (66% in 2004 to 26% in 2009)\(^1\)

According to the *National Nosocomial Infection Surveillance (NNIS)* survey data from the CDC (1999), *imipenem* resistance among *P. aeruginosa* strains had increased from *12% to 19%*, *quinolone* resistance in *P. aeruginosa* had increased from *12% to 23%*.\(^2\)

Resistance Rate of *P. aeruginosa*

![Bar chart showing increasing resistance rate of P. aeruginosa from 1993 to 2002.](image)

Increasing prevalence of multidrug resistance among *P. aeruginosa* isolates from ICU patients in the United States.


Conclusion & Recommendations
Conclusion & Recommendations

Our study showed that the prevalence of resistance was quite problematic in our hospital.

The most frequently isolated GNB was *E. coli*, however, *Acinetobacter spp.* shows the highest rate of resistance to most ABXs classes.

Only polymyxine is considered as the drug of choice for carbapenem-resistance *Acinetobacter spp.*
The lack of any new compounds in the near future indicates that national, regional, and local surveillance efforts are imperative to provide clinicians with information for choosing empirical therapy.
Conclusion & Recommendations

We believe that epidemiological informations are helpful for planning more effective infection control policies and rational antibiotic therapy, and can reduce infection-related costs, morbidity, and mortality.
THANK YOU

• Co-authors:
  – Dr. Mahmoud Al-Azab
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