Proportion of bacteria causing healthcare associated infection in Khartoum North Teaching Hospital
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Abdullahi Nur Hassan2

Abstract

Background: This study was conducted at Khartoum North Teaching Hospital (KNTH) in the period between June 2005 to September 2007 in order to determine the bacteria that causes common healthcare associated infection (HAI.)

Methods: Hundred bacteriological specimens from patients with HAI from different surgical and internal medicine departments (27 from patients in obstetrics and gynecology units, 33 from patients in surgical ward, and 16 from urology units, 12 from the medicine, 8 from the otorhinolaryngology and 4 from ophthalmology departments) were collected. All samples were cultured on suitable bacterial culture media and processed. Presence of significant growth was further studied to identify type of pathogen and its susceptibility against selected (common used) antibiotics.

Results: Study showed that the most frequent bacteria isolated from patients as a cause of HAI were Pseudomonas aeruginosa (23%) , Proteus mirabilis (17%) , and E. coli (13%) respectively.

Conclusion: The study also revealed that all Gram-negative isolates were highly sensitive to antibiotic such as ceftriaxone, ciprofloxacin and imipenem, while P aeruginosa showed resistant to many commonly used antibiotics, but was sensitive to imipenem and pipracillin. All Gram-positive isolates were sensitive to vancomycin.
Further studies are needed to evaluate the common microorganisms causing HAI and their drug susceptibility and proportion of HAI in this setting.

Keywords: Gram-negative, Gram-positive, Nosocomial, microorganisms, antibiotic resistance.
Fadwa G Yousif and Abdullahi N Hassan. Bacteria causing healthcare associated infection

Methods and materials
Hospital based descriptive case study was conducted during June 2005 to September 2007 in KNTH in order to identify the common bacterial agent causing HAI and their antibiotic susceptibility. Hundred bacteriological samples (43 urine, 33 wound swab, 12 sputum, 4 eye swab and 2 throat swab) were collected from patients who fulfilled the designed case definition of HAI and who were admitted to the different departments of KNTH (27 from patients in obstetrics and gynecology units, 33 from patients in surgical ward, and 16 from urology units, 12 from the medicine, 8 from the otorhinolaryngology and 4 from ophthalmology departments) and subjected to laboratory studies. The age of the patients ranged between 3-78 years old. All samples were cultured on suitable bacterial culture media and processed. Presence of significant growth was further studied to identify type of pathogen by using appropriate biochemical tests and its susceptibility against selected (common used) antibiotics according to the National Committee for Clinical Laboratory Standards (NCCLS). The data were analyzed by using Statistical Package for Social Studies (SPSS).

Ethical consideration
All patients enrolled in this study were informed about study and consented. Results were reported to the patients and their doctors.

Results
Hundred bacteriological samples from the patients were collected and processed. Bacterial growth was seen in 74 of collected samples, with different bacteria isolates as shown in Table 1. *Pseudomonas aeruginosa* (23%), *Proteus mirabilis* (17%), *E coli* (13%), and *Staphylococcus aureus*, (9%) were most commonly isolated pathogens, followed by others such as *Klebsiella pneumoniae* (8%), *Staphylococcus saprophytic* (3%) and *Enterococci* (1%).

*E coli* 10 (23.2%), *P aeruginosa* 8 (18.6%), *P mirabilis* 6 (14%), *S aureus* 3 (7%) and *K pneumonia* 3 (7%), were the most common causative agents isolated from urine, while *K pneumonia* 3 (25%), *P aeruginosa* 2 (16,7%) with *Staphylococcus aureus* 2 (16.7%) were isolates from sputum. The most common bacteria isolated from wound swab were *Proteus mirabilis* 11 (33.3), *Pseudomonas aeruginosa* 7 (21.2%), followed by *Staphylococcus aureus* 4 (12.1%) and *E. coli* 3 (9.1%). While *P aeruginosa* were most common bacteria isolated from ear and eye swabs, as shown Table 1.

<table>
<thead>
<tr>
<th>Sample</th>
<th>E c</th>
<th>Ec</th>
<th>K P</th>
<th>P m</th>
<th>Pa</th>
<th>S S</th>
<th>S a</th>
<th>No growth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ear swab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Eye swab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Sputum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Wound swab</td>
<td>3</td>
<td>2</td>
<td>11</td>
<td>7</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Urine</td>
<td>10</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>12</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Throat swab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>1</td>
<td>8</td>
<td>17</td>
<td>23</td>
<td>3</td>
<td>9</td>
<td>26</td>
<td>100</td>
</tr>
</tbody>
</table>

Ec=E coli, Ec=Enterococci, K P= Klebsiella Pneumoniae, P m =Proteus mirabilis, Pa = Pseudomonas aeruginosa, Ss= Staphylococcus Saprophytic, Sa= Staphylococcus aureus
All Gram-negative isolates were highly sensitive to antibiotic such as ceftriaxone, ciprofloxacin and imipenem, while *P. aeruginosa* showed resistant to many commonly used antibiotics, but was highly sensitive to imipenem and pipracillin as shown Table 2. All Gram-positive isolates were sensitive to vancomycin, while all isolated enterococci were resistant to gentamicin. Table 3.

### Table 2: Susceptibility test for Gram-negative bacteria

<table>
<thead>
<tr>
<th>Isolates</th>
<th>GN</th>
<th>CU</th>
<th>CF</th>
<th>CI</th>
<th>NA</th>
<th>NX</th>
<th>I</th>
<th>CP</th>
<th>PC</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>E. coli</em></td>
<td>76%</td>
<td>84%</td>
<td>100%</td>
<td>100%</td>
<td>76%</td>
<td>61%</td>
<td>92%</td>
<td>23%</td>
<td>-</td>
</tr>
<tr>
<td><em>K. pneumoniae</em></td>
<td>62%</td>
<td>87%</td>
<td>75%</td>
<td>87%</td>
<td>37%</td>
<td>75%</td>
<td>100%</td>
<td>50%</td>
<td>-</td>
</tr>
<tr>
<td><em>P. aeruginosa</em></td>
<td>0%</td>
<td>-</td>
<td>91%</td>
<td>-</td>
<td>52%</td>
<td>73%</td>
<td>93%</td>
<td>-</td>
<td>86%</td>
</tr>
<tr>
<td><em>P. mirabilis</em></td>
<td>52%</td>
<td>58%</td>
<td>88%</td>
<td>70%</td>
<td>58%</td>
<td>94%</td>
<td>100%</td>
<td>49%</td>
<td>-</td>
</tr>
</tbody>
</table>

GN= Gentamicin, CU= Cefuroxime, CF= Ciprofloxacin, CI= Ceftriaxone, PC= Pipracillin, NA= Nalidixic Acid, NX= Norofloxacin, I= Imipenem, CP= Cephalexin, VA= Vancomycin

### Table 3: Susceptibility test for Gram-positive bacteria

<table>
<thead>
<tr>
<th>Isolates</th>
<th>GN</th>
<th>CU</th>
<th>CF</th>
<th>NX</th>
<th>VA</th>
<th>CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterococci</td>
<td>0%</td>
<td>-</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>-</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>77%</td>
<td>77%</td>
<td>66%</td>
<td>66%</td>
<td>100%</td>
<td>88%</td>
</tr>
<tr>
<td><em>S. saprophyticus</em></td>
<td>66%</td>
<td>100%</td>
<td>66%</td>
<td>66%</td>
<td>100%</td>
<td>66%</td>
</tr>
</tbody>
</table>

GN= Gentamicin, CU= Cefuroxime, CF= Ciprofloxacin, CI= Ceftriaxone, PC= Pipracillin, NA= Nalidixic Acid, NX= Norofloxacin, I= Imipenem, CP= Cephalexin, VA= Vancomycin

### Discussion

In this study it was observed that *Pseudomonas aeruginos* (23%), *Proteus mirabilis* (17%), *E. coli* (13%), and *Staphylococcus aureus*, (9%) were most common bacteria causing HAI in this setting. Gram-negative bacteria accounted for more than two third of isolates. Similar results were reported from different studies done in developed and undeveloped countries. Gram-negatives such as *E. coli, P. aeruginosa, P. mirabilis, K. pneumonia* and *S. aureus* were most common causative agents in patients with nosocomial UTI in this study. Different results were obtained from studies done in European countries which showed low proportion of the microorganism in urine than this study, except *P. aeruginosa* which showed higher proportion than our study.

The most common bacteria causing nosocomial wound infections in this study were *P. mirabilis, P. aeruginosa* followed by *S. aureus* and other Gram-negative bacteria. Studies done in India showed that *Pseudomonas aeruginosa* (51. 5%) was the commonest pathogen followed by *Staphylococcus aureus* (11.15%), *Klebsiella Pneumonia* (9.23%) and *Proteus mirabilis* (2.3%)9.

*K. pneumonia, P. aeruginosa* and *S. aureus* were isolated from lower respiratory tract infection in this study. Similar results were obtained from study done by Kofteridis et.al10.

Studies from Southern Taiwan showed that the most frequently bacteria isolated from ear
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were *Streptococcus pneumonia* (21.8%), followed by *Haemophilus Influenzae* (10.2%), *Staphylococcus aureus* (7%) and *Pseudomonas aeruginosa* (1.8%)\(^11\), while Marton et al showed that *Streptococcus pneumonia* was the most common bacteria causing ear infection\(^12\).

Antibiotic resistance is serious and growing health problem, gaining international and national attention as resistance increases at an alarming rate in both hospital and physician practice setting\(^13-15\). In this study, most of Gram-negative bacteria were sensitive to the imipenem and ciprofloxacin. However, gentamicin resistance was seen among *Pseudomonas aeruginosa*. E.coli resistant to ciprofloxacin were isolated from the urine elsewhere\(^13\).

Gadapalli et al in their study showed pipracillin resistance among *Pseudomonas aeruginosa* isolated from diabetic wound\(^9\). In this study *Pseudomonas aeruginosa* (86%) was sensitive to the pipracillin.

Many studies revealed increasing multi drug resistant (MDR) Gram-negative and Gram-positive bacteria in most of the hospitals settings\(^14-18\). Studies also showed increasing number of patients infected with vancomycin resistance *Enterococcus* and vancomycin intermediate sensitive *Staphylococcus aureus*\(^18-19\). But no vancomycin resistance was observed among all Gram-positive isolates. Also some microorganisms showed resistance to many commonly used drugs.

Conclusion:
This study concluded that the high percentage of bacteria causing HAI have more or less similar drug sensitivity to other countries. However, highly resistant Gram-negative bacteria such as *P aeruginosa* were also seen.

Acknowledgment
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References
