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Healthcare Associated Infections and Patterns of Antibiotic Resistance in Tropical Medicine Department in Egypt

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A B S T R A C T

Health-care-associated infection (HAI) is a major problem in hospitals worldwide. This study was conducted to describe culture-confirmed HAIs, its patterns of antibiotic resistance and risk factors for acquiring HAIs and multidrug resistant (MDR) pathogens. A retrospective analysis was made between January 2013 and August 2015 for HAIs among7063 patients in tropical medicine department in Mansoura University Hospital, Egypt. A total of 1658 samples were collected for culture**,** isolation, identification and antibiotic susceptibility of nosocomial pathogens. Multidrug resistant pathogens were characterized phenotypically and extended spectrum β lactamase (ESBL) production was assessed by modified double disc synergy test(MDDS). HAI rate was 2.4/100 admission and 5.07/1000 patient days. The most common site of infection was urinary tract infection (UTI) (45.2%) and the most frequent nosocomial pathogen was *E.coli* (27.9%). Multi drug resistant organisms (MDRO) accounted for 40.6% of all bacterial isolates. The highest prevalence of ESBL production was among *E.coli* (47.6%). Age >65 years; invasive device utilization; neutropenia, abdominal paracentes is and hospital stay longer than seven days were significantly associated with HAI occurrence. Multiple antibiotic therapy, use of beta lactam, invasive device utilization and hospital stay longer than seven days were significantly associated with MDRO acquisition. The cumulative incidence of HAI in this study was low; however, the high rates of UTI and multi-resistant pathogens necessitate urgent comprehensive interventions of infection control.

Introduction

Health Care-associated Infection (HAI) is a term relating to an infection that is acquired during the delivery of health care that was not present or incubating at the time of admission. It includes infections acquired in a hospital but appearing after discharge. It also includes such infections among staff.[1]HAI is a major problem in hospitals worldwide and the prevalence is two to three

fold higher in developing countries compared to Europeor USA.[2,3] These infections are caused by a wide range of pathogens, and are associated with an increase in crude mortality, length of stay in the intensive care unit (ICU), and hospital costs.[4–7]

Antimicrobial resistant pathogens causing HAIs pose an ongoing and increasing challenge to hospitals, both in the treatment of patients and in the prevention of the cross-transmission of these problematic pathogens.[8]These pathogens include methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin resistant Enterococci (VRE), extended-spectrum β-lactamase(ESBL) producing *Escherichia coli* (*E. coli*) and *Klebsiella* species, and fluoroquinolone or carbapenem-resistant Enterobacteriaceae (CRE) or *Pseudomonas aeruginosa* (*P. aeruginosa*).[9-13]

This retrospective study aimed at describing culture-confirmed HAIs, its patterns of antibiotic resistance and risk factors for acquiring HAIs and MDR pathogens in Mansoura University Tropical Medicine Department.

Subjects and Methods

A retrospective data analysis was made for HAIs in patients admitted to Tropical Medicine Department in Mansoura University Hospital. Seven hundred and sixty three (7063) patients were admitted between January 2013 and August 2015 corresponding to 33124 total inpatient days. A total of 1658 samples were collected from those patients who were suspected to have healthcare associated infections. Data of those patients were recruited from their files. The patients' samples included 1102 ascitic fluid (66.5%), 298 urine (18.0%), 174 blood (10.5%), 70 sputum samples (4.2%), 10 wound swabs (0.6%), and 4 stool samples (0.24%).

Microbiologic Studies

Samples were processed in Microbiology Diagnostics and Infection Control Unit (MDICU) in the Microbiology Department, Mansoura Faculty of Medicine using standard laboratory protocols.[14] Antimicrobial susceptibility was determined by disc diffusion method as recommended by the Clinical and Laboratory Standards Institute.[15] Isolates resistant to more than two different classes of antibiotics were considered as multidrug resistant (MDR). [16]

Gram negative strains which showed a diameter of less than 27mm and 25mm for cefotaxime and ceftriaxone respectively were tested for ESBL production by the modified double disc synergy test (MDDS). MDDS was done by using a disc of amoxicillin-clavulanate (20/10 μg) along with four cephalosporins; 3GC-cefotaxime, ceftriaxone, cefpodoxime and one 4GC-cefepime. A lawn culture of the organisms was made on a Mueller-Hinton agar plate, as was recommended by CLSI 2009. A disc which contained amoxicillin-clavulanate (20/10 μg) was placed in the center of the plate. The discs of 3GC and 4GC were placed 15mm and 20mm apart respectively, center to center to that of the amoxicillin-clavulanate disc.[17] Any distortion or increase in the zone towards the disc of amoxicillin-clavulanate was considered as positive for the ESBL production. *K.pneumoniae* 700603 was used as a positive control and *E.coli* 25922 was used as a negative control for the ESBL production.

Statistical Analysis

Data were analysed using the statistical package for social science (SPSS v16, Chicago, USA) program in Windows 7. The data were presented in the form of numbers and percentages. The infection rates were

calculated as cumulative incidence rate (the number of infections per 100 admitted patients) and incidence density (number of infections per 1000 patient days). Categorical data were analysed using chi-square tests to study the significance between 2 groups. The test was considered significant if *P* value was < 0.05.

Results and Discussion

HAI Rates

There were 7063 patients admitted to the tropical medicine department during the study period. This represented 33124 total patient days of admission. Of the 7063 admissions, 121 (1.7%) developed culture confirmed HAI. Table (1) lists the infection rates during the study period.

Distribution and Sites of Isolated Pathogens

As shown in table (2), 45.2% of patients had isolates from urinary specimens (indwelling catheter or clean catch),21.4% from peritoneal fluid (spontaneous bacterial peritonitis), 15.5% from respiratory specimens (sputum or pleural fluid), 14.3% from blood specimens (peripheral or centralline), and 2.4% from wound infections. *E.coli* was the commonest isolate (27.9%) and was most frequently isolated from urine specimens (55.3%), followed by *Candida* spp. (17.8%), then *Staphylococcus aureus* (*S.aureus*) (17.3%) which was most frequently isolated from blood specimens (34.5%).

Other isolates included *Klebsiella spp*. (10.7%) which was isolated most frequently from UTI (55.6%), *Proteus* spp. (6.5%), MRSA (4.8%), *P.aeruginosa* (3.6%), *S.pneumoniae* (4.2%), *Enterococci* (2.4%), *S. viridians* (2.4%), *S.epidermidis* and *Salmonella* spp. (1.2% each).

Antibiotic Resistance Pattern of Isolated Organisms

Regarding Gram positive bacteria Fig.1(a), high resistance was detected to ampicillin (84.6%), clindamycin (80%), ampicillin/ sulbactam (66.7%) and amoxicillin clavulinate (58.3%). Fifty percent resistance was detected with erythromycin, azithromycin, Sulfametoxazole/trimetho-prime and cephalothin. Around 38% resistance to ciprofloxacin, 10 % resistance to imipenem. No resistance was detected to vancomycin. On the other hand, Gram negative bacteria Fig.1(b) showed higher resistance to ampicillin (94.1%), aztereonam (90%), ceftriaxone (88.9%), norfloxacin (88.2%), ceftazidime (84.6%), ciprofloxacin (83.4%). Seventy five percent resistances were detected with cefotaxime, cefipime, and ampicillin/ sulbactam. Fifty percent resistance was found with cefaclor. Relatively low resistance was found with amikacin (12%) and imipenem (14.3%).

Isolates resistant to more than two different classes of antibiotics were considered as MDR.[16] Table (3)shows the frequency of MDR organisms (MDROs) among total isolates. As whole MDROs accounted for 40.6% of total bacterial isolates (56/138). MRSA accounted for 21.6% of all *S. aureus* isolates, ESBL producing *Klebsiella* spp. represented 77.8% of all *Klebsiella* isolates, ESBL producing *E.coli* was 42.6% of all *E.coli* isolates, ESBL producing Proteus spp. accounted for 72.7% of all Proteus spp. isolates. Ceftazidime resistant *P.aeruginosa* represented 33.3% of all *P.aeruginosa* isolates, and CRE accounted for 5.1% of all *enterobacteriaceae* isolates.

As shown in table (4), of the ESBL Gram negative bacilli (GNB) 47.6% were *E. coli*, 33.3% *Klebsiella* spp., and 19.1% *Proteus* spp. while the 4 isolates of CRE were *E.coli*.

One half of MRSA isolates were from lower respiratory tract specimens and the other half were from peritoneal fluid specimens. Isolation of ESBL GNB was from urine (57.1%), blood (14.3%), peritoneal fluid (23.8%), and sputum (4.8%) samples. While all CRE and ceftazidime resistant Pseudomonas spp. were isolated from urine samples (100%).

Risk Factors Associated with HAI

The risk factors significantly associated with HAIs occurrence were: age >65 years (*P*<0.001), invasive device utilization (vascular or urinary catheters) (*P*<0.001); neutropenia (*P*=0.021), abdominal paracentesis (*P*=0.034), and hospital stay longer than seven days(*P*<0.001), table(5). While, the risk factors significantly associated with infection with MDR pathogens were multiple antibiotic therapy *(P <0.001)*, beta lactam use *(P =0.023)*, invasive device utilization (vascular or urinary catheters) (*P= 0.045*), and hospital stay longer than seven days (*P = 0.037*), table (6).

HAI are infections that patients acquire while receiving treatment for medical or surgical conditions and are the most frequent adverse event during care delivery.[18] The impact of HAI can result in prolonged hospital stay, long-term disability, and increased resistance of microorganisms to antimicrobial agents, a massive additional financial burden for the health system, patients and their families, and excess deaths. [2,19]

During the study period the prevalence of HAI was 2.4 per 100 admission and 5.07 per 1000 patient days, table(1).Lower rates were detected by Scherbaum *et al.,* whom found that, the cumulative incidence of nosocomial infections at a rural hospital in Gabon was 1.6 infections per 100 patients in six months or 3.6 infections per 1000 in-patient days. [20]

On the other hand, our rates are much lower than that reported from the prevalence of HAI in resource-limited settings which was 15.5/100 patients, with the highest infection densities in intensive care (47.9/1000 patient/days). [2]Also another study in a pediatric hospital in Cambodia found that, the overall HAI prevalence was 13.8/100 patients.[21]The explanation for these contradictory results is that our study was limited to one department (with only 30 beds) with no ICU and not to a whole hospital. Also this study included only culture confirmed infections and not all infections.

The most frequent site of infection in this study was UTI followed by SBP, and LRTI accounting for (45.2%), (21.4%) and (15.5%) respectively. Blood stream infection accounted for 14.3%of all infections. Wound infections represented (2.4%) of all infections. Different frequencies were detected by Scherbaum *et al.,*[20]who reported that, SSIs were the most frequent type of HAI (44%), followed by UTI (26%), BSI(20%)and other infections (11%).The low rate of SSI in our study is due to the fact that patients underwent surgeries were admitted to the gastroenterology center and not to the tropical medicine department and the cases of wound infection in this study were developed at the incision site of liver biopsy. Also the higher UTI rate in our study is due to that, most patients were catheterized with indwelling urinary catheter which is an independent risk factor for UTI occurrence.[22]

Our results were in agreement with other two studies stating that the SBP occurs in 8 to 30 % of hospitalized patient with ascites.[23,24]

In our study, *E. coli* was the commonest isolate (27.9%) and most commonly isolated from urine specimens (55.3%), followed by Candida spp. (17.8%), then *S.aureus* (17.3%) which was most frequently isolated from BSI (34.5%). Other pathogen included *Klebsiella spp* (10.7%) and was isolated frequently from UTI (55.6%).

Naidu *et al.*, [25] study in an adult ICU detected Gram negative bacteria were the commonest isolates.

In the present study the most common isolated pathogen from BSI was *S.aureus* (10/24=41.7%) followed by Klebsiella spp. (6/24=25%).As regards UTI, *E.coli* was the commonest isolate (26/76 =34.2%) followed by candida spp. (20/76=26.3%) (Table 2).

Differently, Ghadiri *et al.*,[26] found that CoNS (34.8%) and *E. coli* (29.4%) were the commonest isolates causing nosocomial BSI.Although *E. coli* was the most common Gram-negative bacilli isolated from nosocomial UTI patients but with nearly double the frequency detected by this study(66.7%).

These differences could be attributed to different sample size and different geographical distribution.

In this study, the antibiotic resistance profile of nosocomial Gram positive bacteria Fig.1(a), showedhigh resistance to ampicillin (84.6%), clindamycin (80%), ampicillin/ sulbactam (66.7%) and amoxicillin clavulinate (58.3%). Fifty percent resistance was detected with erythromycin, azithromycin, Sulfametox-azole/ trimethoprime and cephalothin. The reason for resistance to these antibiotics could be mediated by their widespread use in the hospital and the community. Around 38% resistance to ciprofloxacin, 10 % resistance to imipenem and no resistance was detected to vancomycin. Methicillin resistant *S. aureus* accounted for 21.6% (8/37) of all *S. auerues* isolates as detected by cefoxitin disc.

In agreement with our results, Ghadiri *et al.*,[26] found high resistance rate of CoNS to ampicillin(97.1%),erythromycin(42.8%),gen tamicin(28.5%) and cephalothin (51.4%). But in contrast to our results they detected, higher resistance against vancomycin 4.4%, ciprofloxacin (57.1%) and imipenem (28.5%), but lower resistance against clindamycin (57.1%).

Matching with our results, another study limited to UTI cases in Tehran showed, high level of resistance to ampicillin was seen among *S.aureus*, *Enterococcus* and CoNS isolates from UTI, and All isolates were fully sensitive to vancomycin with the exception of Enterococcus spp. (11.9%).[27]

Gram negative bacteria showed higher resistance, ampicillin (94.1%), aztereonam (90%), ceftriaxone (88.9%), norfloxacin (88.2%), ceftazidime (84.6%), ciprofloxacin (83.4%), Fig.1(b).Seventy five percent resistances were detected with cefotaxime, cefipime, and ampicillin/sulbactam. Fifty percent resistance was found with cefaclor. Relatively low resistance was found with amikacin (12%) and imipenem (14.3%).

Christoff *et al.*,[28] analyzed the antibiotic susceptibility of 5000 Gram-negative rods isolated in the ICU and found near results to ours as regard the susceptibility to monotherapy of imipenem was 88.8% (resistance 11.2%).On the other hand, they detected higher susceptibility to ceftazidime (69.2%) than ours (15.4%).

Another study from India found the mean

resistance of GNB isolates from tracheal and bronchial specimens was: ampicillin(98.5% and 96.8%), cotrimoxazole(76.6% and 81.8%), gentamicin (81.8% and 95.6%) amikacin (53% and 44.1%), cefotaxime (82.6% and 89.9%), ceftriaxone (87.9% and 90.5%), ceftazidime (81.1% and 84.9%) and ciprofloxacin (75.3% and 86.7%). These results support ours with the exception of higher resistance to gentamicin and amikacin than ours.[29]

Our results declared that the frequency of MDROs (Table 3) was 40.6% among all bacterial isolates (56/138). Among all *S. aureus* isolates (37) detected in this study, eight were MRSA (21.6%). As regard ESBL production the overall ESBL GNB producers were 42/76 (55.3%),14 of 18 (77.8%) Klebsiella spp., 20 of 47 (42.6%) *E. coli*, and 8 of 11 (72.7%) *Proteus* spp. Two of 6 (33.3%) *P.aeruginosa* strains were ceftazidime resistant, and 4 of 78 (5.1%) enterobacteriaceae isolates were carbapenem resistant. No imipenem resistant *P.aeruginosa* strains were detected.

One study by Stoesser *et al.*, [21] detected two of three (66.7%) *S. aureus* isolated were MRSA and 11 of 13 (85%) *K. pneumonia* isolates were ESBL producers and there was one imipenem-resistant *P. aeruginosa* isolate. Another study conducted at the National Public health laboratory, Kathmandu, Nepal reported that (31.57%) of *E. coli* were confirmed as ESBL producers.[30]

A lower detection rate for ESBL-GNB by a study done at a tertiary hospital in Mwanza, Tanzania, the overall prevalence of ESBLs in all GNB (377 clinical isolates) was (29%). The ESBL prevalence was 64% in *K. pneumonia* but (24%) in *E. coli*.[31]Fatemeh *et al.*, found that (26.5%) of *E. coli* and (43%) of *K. Pneumoniae* were ESBL positive in a study conducted at the Imam Reza hospital of Mashhad, IR Iran. They indicated the high prevalence of ESBL producing Enterobacteriaceae family especially in inpatients.[32]

Supportive to our result by a study conducted in Egypt showed that 61% of *E. coli* produced ESBLs[33]and also many other studies reported high incidence of ESBL-*E.coli* and ESBL-*K.pneumonie*[34-37]

Ceftazidime-resistant was detected in (33.3%) of *P.aeuroginosa*. However, Hidron and colleagues reported lesser percentage of *P. aeruginosa* pathogenic isolates resistant to ceftazidime as (12.6%) with cases of catheter associated UTI, and (18.7%) with cases of central line associated BSI.[38]

The differences between these studies could be related to several factors including the different geographical area, the country, the hospital, the sample size and the strict adherence to infection control guidelines.

Risk factors for HAI vary according to the type of health-care facility and to the care area where the patient is admitted, and are partially different in developing countries. We found that, the most common risk factors associated with HAIs occurrence were: age >65 years; invasive device utilization (vascular or urinary catheters); neutropenia, abdominal paracentesis and hospital stay longer than seven days (Table 5).[39-43]

In this study, abdominal paracentesis was significantly associated with SBP. This is supported by another study which found that invasive procedures such as paracentesis, may introduce bacteria into the blood or directly into the peritoneal cavity and is a factor that may predispose a patient to the risk of developing SBP infection. [44]

Our results indicated that, the risk factors significantly associated with infection with MDR pathogens were multiple antibiotic therapy, beta lactam use, invasive device utilization (vascular or urinary catheters) and hospital stay longer than seven days (Table 6).

Table.1 Rate of HAIs.

Total admission No.	7063
Total patient days No.	33124
Total cultures No.	1658
Positive cultures No.	168
Infected patients No.	121
HAIR / 100 admissions	2.4
HAIR/1000 patient days	5.07
PIR / 100 admissions	1.7
PIR/1000 patient days	3.65

HAIR: Health care associated infection rate
PIR:patient infection rate

Table.2 Distribution of Nosocomial Pathogens in relation to the type of infection.

Nosocomial pathogen	LRTI No. (%)	BSI No. (%)	UTI No. (%)	SBP No. (%)	GE No. (%)	Wound infection No. (%)	Total No. (%)
Candida spp.	10 (33.3)	0 (0.0)	20 (66.7)	0 (0.0)	0 (0.0)	0 (0.0)	30 (17.8)
S. aureus	8 (27.6)	10 (34.5)	2 (6.9)	5 (17.2)	0 (0.0)	4 (13.8)	29 (17.3)
MRSA	4 (50.0)	0 (0.0)	0 (0.0)	4 (50.0)	0 (0.0)	0 (0.0)	8 (4.8)
S. epidermidis	0 (0.0)	2 (100)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (1.2)
Klebsiella spp.	2 (11.1)	6 (33.3)	10 (55.6)	0 (0.0)	0 (0.0)	0 (0.0)	18 (10.7)
P. aeruginosa	0 (0.0)	0 (0.0)	6 (100)	0 (0.0)	0 (0.0)	0 (0.0)	6 (3.6)
E. coli	0 (0.0)	4 (8.5)	26 (55.3)	17 (36.2)	0 (0.0)	0 (0.0)	47 (27.9)
Proteus spp.	0 (0.0)	0 (0.0)	8 (72.7)	3 (27.3)	0 (0.0)	0 (0.0)	11 (6.5)
Enterococci	0 (0.0)	0 (0.0)	4 (100)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.4)
Streptococcus pneumonia	2 (28.6)	2 (28.6)	0 (0.0)	3 (42.8)	0 (0.0)	0 (0.0)	7 (4.2)
Streptococcus viridans	0 (0.0)	0 (0.0)	0 (0.0)	4 (100)	0 (0.0)	0 (0.0)	4 (2.4)
Salmonella spp.	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100)	0 (0.0)	2 (1.2)
Total	26 (15.5)	24 (14.3)	76 (45.2)	36 (21.4)	2 (1.2)	4 (2.4)	168 (100)

LRTI: lower respiratory tract infection, BSI: blood stream infection, UTI: urinary tract infection, SBP: spontaneousbacterial peritonitis, GE: gastroenteritis, MRSA: methicillin resistant *Staphylococcus aureus*

Table.3 Frequency of MDROs.

Type of MDROs	No. of MDRO/total No. of same species	(%) of MDRO
MRSA	8/37	21.6
ESBL-GNB	42/76	55.3
• ESBL klebsiella spp.	14/18	77.8
• ESBL *E. coli*	20/47	42.6
• ESBL Proteus spp.	8/11	72.7
Ceftazidimeresistant *pseudomonas aeruginosa*	2/6	33.3
CRE	4/78	5.1
Total	56/138 (MDRO/total bacterial isolates)	40.6

MDRO: multidrug resistant organisms, MRSA: methicillin resistant *S. aureus*, ESBL: extended spectrum beta lactamase, CRE: carbapenem resistant enterobacteriaceae.

Table.4 Distribution of MDROs among Bacterial Isolates and Clinical Specimens.

Bacterial isolates No. (%)	MRSA	8/37 (21.6%)
	ESBL GNB(N=42)	*E. coli*: 20/42 (47.6%)
		Klebsiella spp.: 14/42 (33.3%)
		Proteus spp.: 8/42 (19.1%)
	CRE(N=4)	*E. coli*: 4/4 (100%)
	Ceftazidime resistant *Pseudomonas aeruginosa* (N =2)	*Pseudomonas aeruginosa:* 2/2 (100%)
Type of specimen No. (%)	MRSA (N=8)	LRT: 4/8 (50.0%)
		SBP: 4/8 (50.0%)
	ESBL GNB (N=42)	Urine: 24/42 (57.1%)
		Blood: 6/42 (14.3%)
		Peritoneal fluid: 10/42 (23.8%)
		Sputum: 2/42 (4.8%)
	CRE(N=4)	Urine: 4/4 (100%)
	Ceftazidime resistant *Pseudomonas aeruginosa*(N=2)	Urine: 2/2 (100%)

ESBL GNB: extended spectrum beta lactamase producing Gram negative bacilli, CRE: carbapenem resistant enterobacteriaceae, MRSA: methicillin resistant *Staphylococcus aureus*, LRTI: lower respiratory tract infection, SBP: spontaneous bacterial peritonitis.

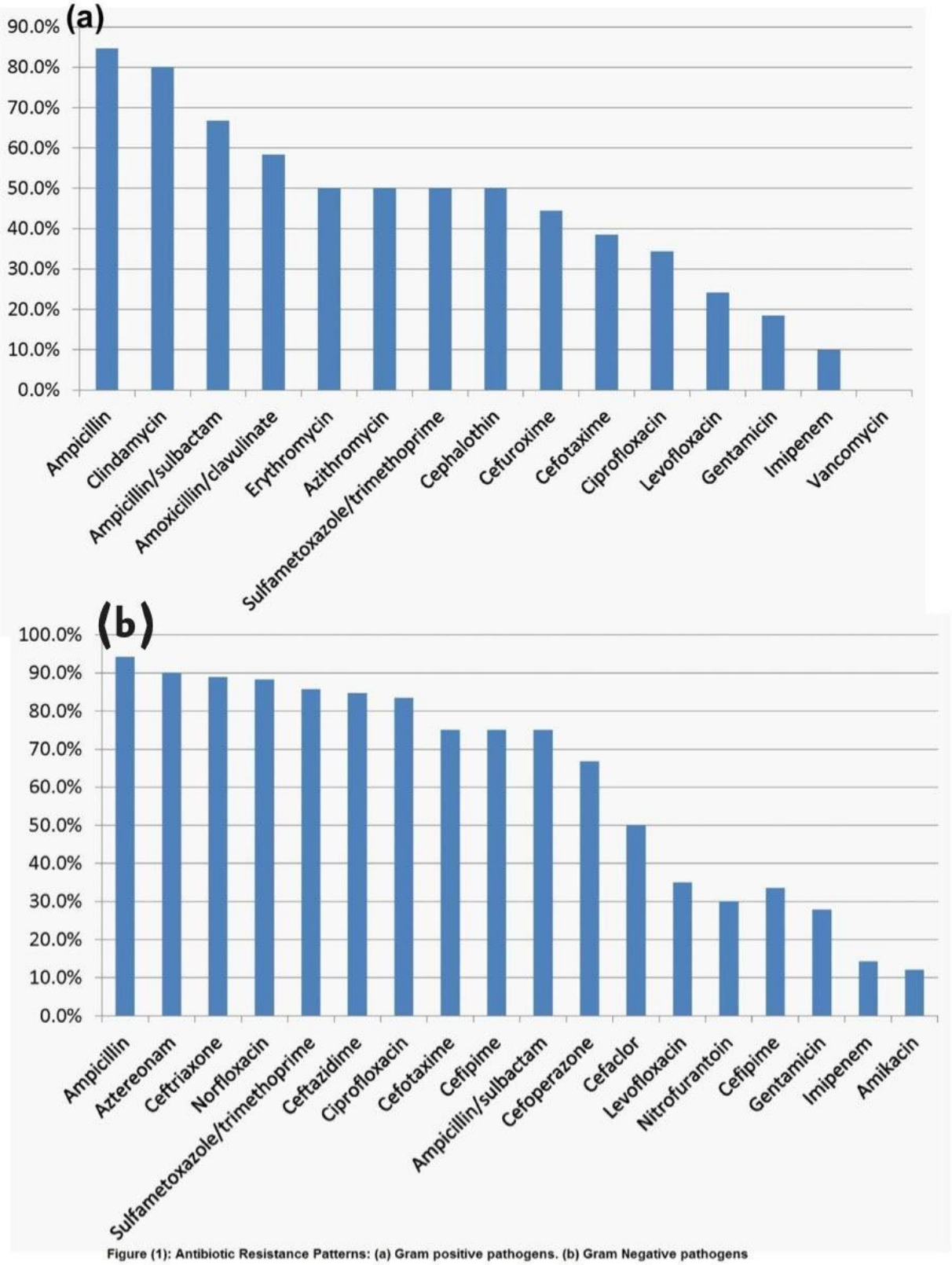

Figure (1): Antibiotic Resistance Patterns: (a) Gram positive pathogens. (b) Gram Negative pathogens

Table.5 Risk Factors Associated with HAIs.

Risk factor for nosocomial infections	No. of Patients with nosocomial infection (N=121)	Odd's ratio (95% CI)	*P value*
Age above 65 years	74 (61.2%)	2.9 (2.04-4.18)	< 0.001*
Invasive device utilization (vascular or urinary catheters)	82 (67.8%)	3.3 (2.2-4.79)	< 0.001*
Neutropenia	33 (27.3%)	1.64 (1.01-2.47)	0.021*
Haemodialysis	10 (8.3%)	1.01 (0.53-2.01)	0.87
Abdominal paracentesis	73 (60.3%)	1.51 (1.01-2.22)	0.034*
Upper GIT endoscopy	56 (46.3%)	1.03 (0.48-1.7)	0.89
Liver biopsy	28 (23.1%)	1.12 (0.62-1.92)	0.64
hospital stay longer than 7 days	84 (69.4%)	1.93 (1.3-2.84)	<0.001*

P value< 0.05 is significant*

Table.6 Risk Factors Associated infection with MDROs.

Risk factor for infection with MDROs	No. of infected patients with multidrug resistant pathogens (N=42)	Odd's ratio (95% CI)	*P value*
Multiple antibiotic therapy	28 (66.7%)	3.46 (1.4-8.65)	< 0.001*
Beta-lactam use (cephaolosporins, penicillins, and carbapenems)	22 (52.3%)	2.57 (1.05-6.34)	0.023*
Invasive device utilization (vascular or urinary catheters)	30 (71.4%)	2.34 (0.94-5.92)	0.045*
Haemodialysis	10 (23.8%)	1.03 (0.37-2.85)	0.96
Hospital stay longer than 7 days	34 (81.0%)	2.64 (0.96-7.46)	0.037*

P value< 0.05is significant*

In agreement with our results, other studies reported that, patients at high risk for developing colonization or infection with ESBL-producing organisms are often seriously ill patients with prolonged hospital stays and in whom invasive medical devices are present (urinary catheters, endotracheal tubes, central venous lines) for a prolonged duration.[16] The median length of hospital stay prior to isolation of an ESBL producer has ranged from 11 to 67 days, depending on the study. [45-47]

Our results are also supported by other studies that found a relationship between third-generation cephalosporin use and acquisition of an ESBL-producing strain. [48-50]

In contrast to our results, other studies detected hemodialysis[46],asa risk factor for MDROs acquisition. These differences could be explained by differences in study populations, selection of cases, selection of controls, and sample size.This study has a

number of important limitations. It is a retrospective study that relies on previous data records for which accuracy and completeness cannot be validated. Data on the use of all devices over the study period were not available and so rates of nosocomial infection associated with specific device utilization over time could not be calculated. The data on outcome were also incomplete.

In conclusion, the result of this study revealed that HAIs represent a substantial threat for patients at the tropical medicine department in Mansoura University Hospital. The overall incidence rate of HAI was lower than in hospitals from other developing countries. A particular high risk of nosocomial UTI was found. Thus, interventions to decrease UTI by compliance to infection control guidelines during urinary catheter insertion and maintenance should start here. Many of the identified pathogens, particularly the GNB have developed resistance to commonly prescribed antibiotics. Therefore, interventions to reduce the rate of multi-resistant pathogens have to be taken by appropriate use of antibiotic medications in the hospital setting. We also showed that surveillance of nosocomial infections is mandatory to reduce HAI and improve patient outcome.

Reference

1. Ontario Agency for Health Protection and Promotion (Public Health Ontario), Provincial Infectious Diseases Advisory Committee. Best practices for surveillance of health care-associated infections in patient and resident populations. 3rd ed. Toronto, ON: Queen's Printer for Ontario; 2014.
2. Allegranzi B, Bagheri Nejad S, Combescure C *et al.*, "Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis" The Lancet,2011; 377,pp.228–241.
3. Nejad SB, Allegranzi B, Syed SB, Ellis B, and Pittet D, Health-care-associated infection in Africa: a systematic review," Bulletin of the World Health Organization,2011; 89,pp.757–765.
4. Pittet D, Tarara D, and Wenzel R P, "Nosocomial blood stream infection in critically ill patients. Excess length of stay, extra costs and attributable mortality, Journal of American Medical Association,1994;271, pp.1598–1601.
5. Rosenthal D, Lynch P, Jarvisetal W R. "Socioeconomic impact on device-associated infections in limited-resource neonatal intensive care units: findings of the INICC, Infection,2011; 39 (5) pp. 439–450.
6. Lipalosaari P Y, Ala-Kokko T I, LaurilaJ, Ohtonen P, and SyrjalaH, "Intensive care acquired infection is an independent risk factor for hospital mortality: a prospective cohort study", Critical Care, vol.10, article R66,2006.
7. Rosenthal V D, Udwadia F E, Mu˜ noz H J *et al.*, International Nosocomial Infection Control Consortium: Time dependent analysis of extra length of stay and mortality due to ventilator-associated pneumonia in intensive-care units of ten limited-resources countries: findings of the International Nosocomial Infection Control Consortium (INICC),"Epidemiology &Infection,2011; 139 (11)pp.1757–1763,.
8. Schwaber MJ, Carmeli Y. Mortality and delay in effective therapy

associated with extended spectrum b-lactamase production in Enterobacter-iaceae bacteremia: a systematic review and meta-analysis. J Antimicrob Chemother 2007; 60:913–920.
9. Chambers HF. Community-associated MRSA-resistance and virulence converge. N Engl J Med 2005; 352:1485–1487 .
10. Deshpande LM, Fritsche TR, Moet GJ, Biedenbach DJ, Jones RN. Antimicrobial resistance and molecular epidemiology of vancomycin-resistant enterococci from North America and Europe: a report from the SENTRY antimicrobial surveillance program. Diagn Microbiol Infect Dis 2007; 58:163–170.
11. Lewis JS, Herrera M, Wickes B, Patterson JE, Jorgensen JH. First report of the emergence of CTX-M-type extended-spectrum b-lactamases ESBLs) as the predominant ESBL isolated in a U.S. health care system.Antimicrob Agents Chemother 2007; 51:4015–4021 .
12. Moland ES, Hanson ND, Black JA, Hossain A, Song W, Thomson KS . Prevalence of newer b-lactamases in gram-negative clinical isolates collected in the United States from 2001 to 2002. J ClinMicrobiol 2006; 44:3318–3324
13. Lockhart SR, Abramson MA, Beekmann SE, *et al.,* Antimicrobial resistance among gram-negative bacilli causing infections in intensive care unit patients in the United States between 1993 and 2004. J ClinMicrobiol2007; 45:3352–3359.
14. Koneman's Color Atlas and Text Book of Diagnostic Microbiology: Winn W.J., Allen, S., Koneman,E., Procop, G., Schreckerberger, P. and Woods, G.6TH ed.(2006). Lippincott, Williams &Wilkins.
15. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing; sixteenth informational supplement. CLSI document M100-S16 (ISBN 1-56238-588-7). Clinical and Laboratory Standards Institute, 2006; 940 West Valley Road, Suite 1400, Wayne, Pennsylvania 19087-1898 USA.
16. Mehta M,Bhardwaj S and Sharma, J. Prevalence and antibiotic susceptibility pattern of multi drug resistant *E.coli* isolates from urinary tract infection (UTI) patients. International journal of life siences and pharma research, 2012: 2 (4): L6-L11.
17. Paterson DL, Bonomo RA. Extended spectrum β-lactamases: a clinical update. Clin Microbiol Rev. 2005; 18(4):657–86.
18. Bates DW et al Global priorities for patient safety research British Medical Journal,200; 338:b1775.
19. Burke JP Infection control - a problem for patient safety New England Journal ofMedicine,2003; 348:651–656.
20. Scherbaum M, Kösters K, Mürbeth R E, Ngoa U A, Kremsner P G, Lell B, and Alabi A. Incidence, pathogens and resistance patterns of nosocomial infections at a rural hospital in Gabon.BMC Infectious Diseases201414:124.
21. Stoessera N, Emary K, Soklin S, An KP, SophalS, Chhomrath S, Day NPJ, Limmathurotsakul D, NgetP, Pangnarith Y, SonaS, KumarV, Moore CE, ChanpheaktraN, and Parry CM. The value of intermittent point-prevalence surveys of healthcare-associated infections for evaluating infection control interventions at

Angkor Hospital for Children, Siem Reap, Cambodia Trans R Soc Trop Med Hyg; 2013;107: 248– 253.
22. Gould CV, Umscheid CA, Agarwal RK, et al., Guideline for prevention of catheter-associated urinary tract infections 2009. Infect Control Hosp Epidemiol 2010; 31:319.
23. Strauss E, Caly WR. Spontaneous bacterial peritonitis: a therapeutic update. Expert Rev Anti Infect Ther 2006; 4:249–260.
24. Hörner R; Salla A; de Oliveira L O; Frasson Dal Forno NL; Righi RA; Domingues VO; Rigatti F; Mayer LE. Spontaneous bacterial peritonitis caused by Streptococcus bovis: case report and review of the literature, 2010; Braz J Infect Dis 14 (3).
25. Naidu K, Nabose I, Ram S, Viney K, Graham S M, and Bissell K. A Descriptive Study of Nosocomial Infections in an Adult Intensive Care Unit in Fiji: 2011-12, Journal of Tropical Medicine 2014, pp1-5.
26. Ghadiri H, Vaez H, Khosravi S, and Soleymani E. The Antibiotic Resistance Profiles of Bacterial Strains Isolated from Patients with Hospital-Acquired Bloodstream and Urinary Tract Infections Critical Care Research and Practice 2012, pp. 1-6.
27. TayebiZ, Seyedjavadi SS, Goudarzi M, Rahimi MK, Boromandi S, Bostanabad SZ, Mirzaii A, Mahdiyoun M. Frequency and antibiotic resistance pattern in gram positive uropathogenes isolated from hospitalized patients with urinary tract infection in Tehran, Iran Journal of Genes, Microbes and Immunity 2014 (2014) 1-9.
28. Christoff J, Tolentino J, Mawdsley E, Matushek S, Pitrak D, Weber SG. Optimizing empirical antimicrobial therapy for infection due to gram negative pathogens in the intensive care unit: utility of a combination antibiogram. Infect Control HospEpidemiol;2010; 31:256–61.
29. Veena Kumari HB, Nagarathna S and Chandramuki A. Antimicrobial Resistance Pattern Among Aerobic Gram negative Bacilli of Lower Respiratory Tract Specimens of Intensive Care Unit Patients in a Neurocentre, The Indian Journal of Chest Diseases & Allied Sciences; 2007; 49, pp19-22.
30. Thakur S, Pokhrel N, Sharma M. Prevalence of multidrug resistant enterobacteriaceae and extended spectrum β lactamase producing *Escherichia coli* in urinary tract infection. R.J.P.B.C.S; 2013. 4 (2), 1615–1624.
31. Mshana SE, Kamugisha E, Mirambo M, Chakraborty T, Lyamuya EF. Prevalence of multi resistant gram-negative organisms in a tertiary hospital in Mwanza, Tanzania. BMC Res. Notes, 2009; 26 (2), 49.
32. FatemehA, Emran A, Elnaz K, Mohammad JGS, Mahboubeh N. The frequency of extended spectrum beta lactamase (ESBL) in *Escherichia coli* and *Klebsiella pneumonia*e: a report fromMashhad, Iran. J. Med. Bacteriol, 2012;1 (3), 12–19.
33. Al-AgamyM.H. Mohamed, El-Din Ashour MS, Wiegand I.First description of CTXM beta-lactamase-producing clinical *Escherichia coli* isolates from Egypt. Int. J. Antimicrob. Agents, 2006; 27(6), 545–548.
34. Rupinder B, Geeta W, Shikha J. Prevalence of extended spectrum β-lactamases in multidrug resistant strains of gram negative bacilli. J. Acad. Indus. Res. 2013; 1 (9), 558–560.

35. Sankar S, Narayanan H, Kuppanan S, Nandagopal B. Frequency of extended spectrum beta-lactamase (ESBL)-producing Gram-negative bacilli in a 200-bed multi-specialty hospital in Vellore district, Tamil Nadu, India. Infection 40 (4), 425–429.
36. Nasa P, Juneja D, Singh O, Dang R, Singh A. An observational study on bloodstream extended-spectrum beta-lactamase infection in critical care unit: incidence, risk factors and its impact on outcome. Eur. J. Intern. Med. 2012; 23 (2), 192–195.
37. Majda Q, Najma A, Summyia B. Evaluation of extended spectrum beta-lactamase mediated resistance in *Escherichia coli* and *Klebsiella* in urinary tract infection at a tertiary care hospital. Biomedica, 2013; 29, 78–81.
38. Hidron AI, Edwards JR, Patel J, Horan TC., Sievert DM., Pollock DA., and Fridkin SK. Antimicrobial-Resistant Pathogens Associated With Health care-Associated Infections: Annual Summary of Data Reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007infection control and hospital epidemiology November 2008; 29 (11) 996-1011.
39. Gravel D et al Point prevalence survey for healthcare-associated infections with in Canadian adult acute-care hospitals Journal of Hospital Infection,2007; 66:243–248.
40. Maugat S, Carbonne A, Astagneau P.Significant reduction of nosocomial infectious : stratified analysis of prevalence national studies performed in 1996 and 2001 in French North Interegion Pathologie Biologie (Paris), 2003; 51: 483-489.
41. Kritsotakis EI et al Case-mix adjustment approach to benchmarking prevalence rates of nosocomial infection in hospitals in Cyprus and Greece Infection Control and Hospital Epidemiology, 2008, 29:685–692
42. Klavs I et al Prevalence of and risk factors for hospital-acquired infections in Slovenia results of the first national survey, 2001Journal of Hospital Infection, 2003, 54:149–157
43. Lanini S et al Healthcare-associated infection in Italy: annual point-prevalence surveys2002-2004 Infection Control and Hospital Epidemiology,2009, 30:659–665.
44. Montserrat A, Sola R, Sitges-Serra A, *et al.,* Risk factors for spontaneous bacterial peritonitis in cirrhotic patients with ascites. Gastro-enterology.1993;104:1133–1138
45. Bisson, G, FishmanNO, PatelJB, Edelstein PH, and Lautenbach E. Extended-spectrum beta-lactamase-producing *Escherichia coli* and *Klebsiella* species: risk factors for colonization and impact of antimicrobial formulary interventions on colonization prevalence. Infect. Control Hosp. Epidemiol. 2002; 23:254–260
46. D'Agata, E, Venkataraman L, DeGirolami P, Weigel L, Samore M, and Tenover F.The molecular and clinical epidemiology of enterobact-eriaceae-producing extended-spectrum beta-lactamase in a tertiary care hospital. J. Infect. 1998; 36:279–285.
47. Lautenbach E, Patel JB, BilkerWB, EdelsteinPH, and Fishman NO. Extended-spectrum beta-lactamase-producing *Escherichia coli* and *Klebsiella pneumoniae:* risk factors for infection and impact of resistance on outcomes. Clin. Infect. Dis.2001; 32:1162–1171.
48. Du B, Long Y, Liu H, Chen D, Liu D, Xu Y, and Xie X. Extended spectrum

beta-lactamase-producing *Escherichia coli* and *Klebsiella pneumonia* bloodstream infection: risk factors and clinical outcome. Intensive Care Med.2002; 28:1718–1723.

49. Eveillard M, SchmitJL, and EbF. Antimicrobial use prior to the acquisition of multiresistant bacteria. Infect. Control Hosp. Epidemiol. 2002; 23:155–158.

50. Kim YK, PaiH, LeeHJ, ParkSE, ChoiEH, KimJ, KimJH, and KimEC. Bloodstream infections by extended-spectrum beta-lactamase-producing *Escherichia coli* and *Klebsiella pneumonia* in children: epidemiology and clinical outcome. Antimicrob. Agents Chemother.2002; 46: 1481–1491.

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