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COMPARISON OF PEDIATRIC SURGERY WARD AND HOSPITAL WIDE ANTIBIOGRAM IN A UNIVERSITY HOSPITAL

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Abstract:

Objective: *The aim of this study was to develop the antibiograms of pediatric surgery unit and to compare it with other departments of Mayo hospital.*

Methods: *This comparative cross sectional study was carried out in Mayo hospital Lahore over a period of 3 months from January 2018 to March 2018, after ethical approval. 326 samples of inpatients from different departments were selected by simple random sampling. Antimicrobial susceptibility testing for all bacterial isolates was performed using the Kirby-baur disc diffusion method according to CLSI 2018. Results of antimicrobial susceptibility tests were recorded and reported on day 5. Comparison of two group's antibiogram was done using chi square.*

Results: *Wound swab was the commonest source of microbes (135 in group A and 84 in group B). Staphylococcus aureus was isolated in 81(49.7%) samples of group A and in 38 (23.3%) samples of group B. Pseudomonas was isolated in 49 (30.1%) samples of group A and in 41(25.1%) samples of group B. Escherichia coli was seen in 18 (11%) samples of group A and in 46 (28.2%) samples of group B. Staphylococcus aureus was less susceptible to Amoxicillin in group A (p=0.008). Pseudomonas was less susceptible to Tazobactam in group B (p=0.04). E coli was more resistant to Vancomycin in group B (p=0.04) and resistant to Ampicillin and Cefotaxime in group A (p=0.007).*

Conclusions: *We found susceptibility differences to be unit specific and recommend implementation of unit specific antibiograms for effective empirical therapy.*

Keywords: *Antibiograms, antibiotic resistance, antimicrobial, pediatric, intensive care unit.*

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INTRODUCTION:

Antibiotic resistance is a serious global threat leading to prolonged hospital stay, repeated visits to health care facilities, increased expenditures, disabilities and death. In United States alone, more than 2 million people every year develop antibiotic resistance and over 23 thousand mortalities are reported due to it [1]. Single most important factor leading to antibiotic resistance is inappropriate use of antibiotic and its rampant prescription. In developing countries, consumption of antimicrobials is more than 20% as compared to the developed countries and highest rates of resistance are also noted in these countries [2,3].

Generating antibiograms is one of the essential measures to avoid antibiotic resistance and has been in use practice in many hospitals for decades and many guidelines recommend updating the data on yearly basis. Antibiograms are table generated data after bacteria are isolated from the cultures which show susceptibility to different antimicrobial agents. In order to avoid antibiotics resistance it is imperative to generate antibiograms and base empirical therapy accordingly [4-6]. Antibiograms differ with patient specific and unit specific factors and effective empirical therapy focuses on these aspects too [5-8].

Objective of this study was to develop the antibiogram of pediatric surgery unit and to compare it with other departments of Mayo hospital. Rationale of this study was to reduce overall morbidity and mortality in hospitalized patients by selecting unit specific antimicrobial therapy and ultimately avoid antibiotic resistance.

METHODS:

This comparative cross sectional study was carried out in Mayo hospital Lahore over a period of 3 months from January 2018 to March 2018, after ethical approval.

Sample size of 326 patients (163 antibiograms in each group) was estimated by using 95% confidence level, 5% absolute precision with expected percentage of susceptibility of pseudomonas aeruginosa in surgical ICU as 100% and hospital wide as 88%.[6]

$$\eta = \frac{z^2_{1-\alpha/2}[p_1(1-p_1)+p_2(1-p_2)]}{d^2}$$

$z^2_{1-\alpha/2}$ = confidence level 95%=1.96

p_1=population proportion I =100%

p_2 = population proportion II = 88%

d= absolute precision 5%

Simple random sampling technique was used. Indoor patients admitted in pediatric surgery, pediatric medicine, surgery and medicine intensive care units (ICU) were included, while patients admitted through emergency were excluded. Samples were taken from anatomical sites like blood, urine, pus and wound. These samples were tested in central clinical microbiology laboratory for bacterial isolates. Group A consisted of 163 antibiograms from pediatric surgery department and Group B had 163 antibiograms from surgery and medicine ICU and pediatric medicine departments.

Antimicrobial susceptibility testing for all bacterial isolates were performed using the Kirby-baur disc diffusion method according to CLSI 2018. 0.5 Mcfarland's solution was used to dilute the collected sample and then sample was inoculated on Muller Hinton agar and then applied to antibiotic disc through disc diffusion method, according to the organism isolated. After 24hours of incubation at 37 C the zone of inhibition around the disc was studied and sample was reported.

Results of antimicrobial susceptibility tests were recorded and reported on day 5.

Collected data was entered on SPSS version 23 and was analyzed. Quantitative data like age was described in means and standard deviation. Qualitative variables like bacterial isolates and sensitivity outcome was described as percentages and proportions. Comparison of two group's antibiograms was done using chi square and p value of less than 0.05 was taken as significant.

RESULTS:

Figure 1: Gender distribution among different groups/ department

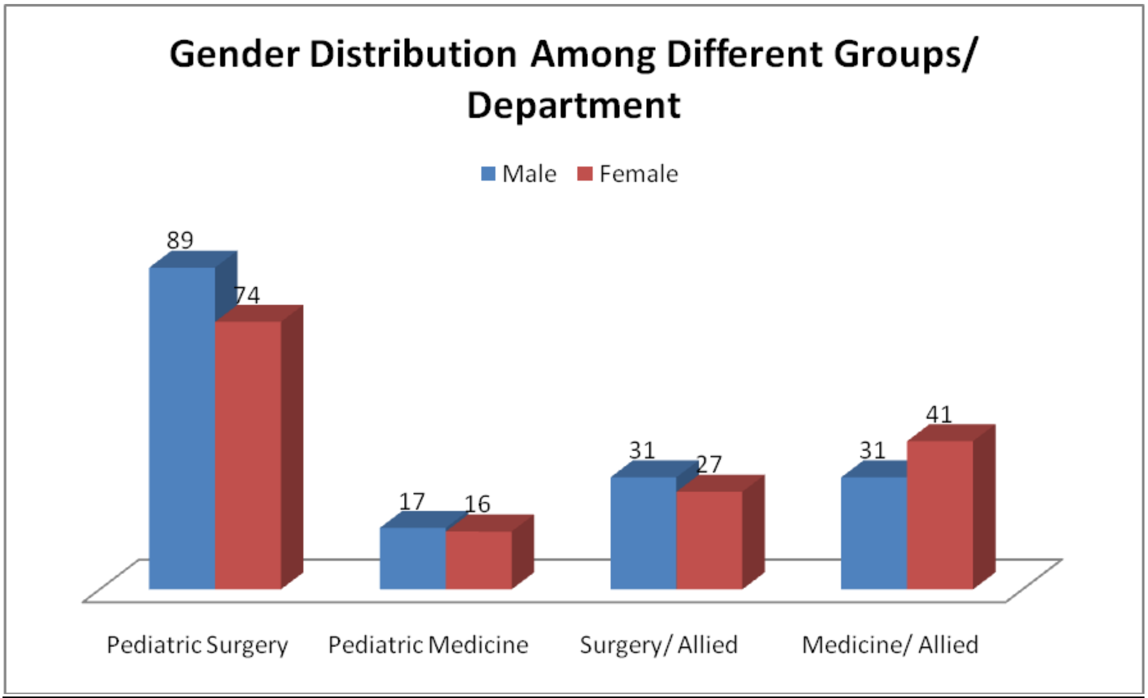

Figure 2: Types of Samples from Different Departments

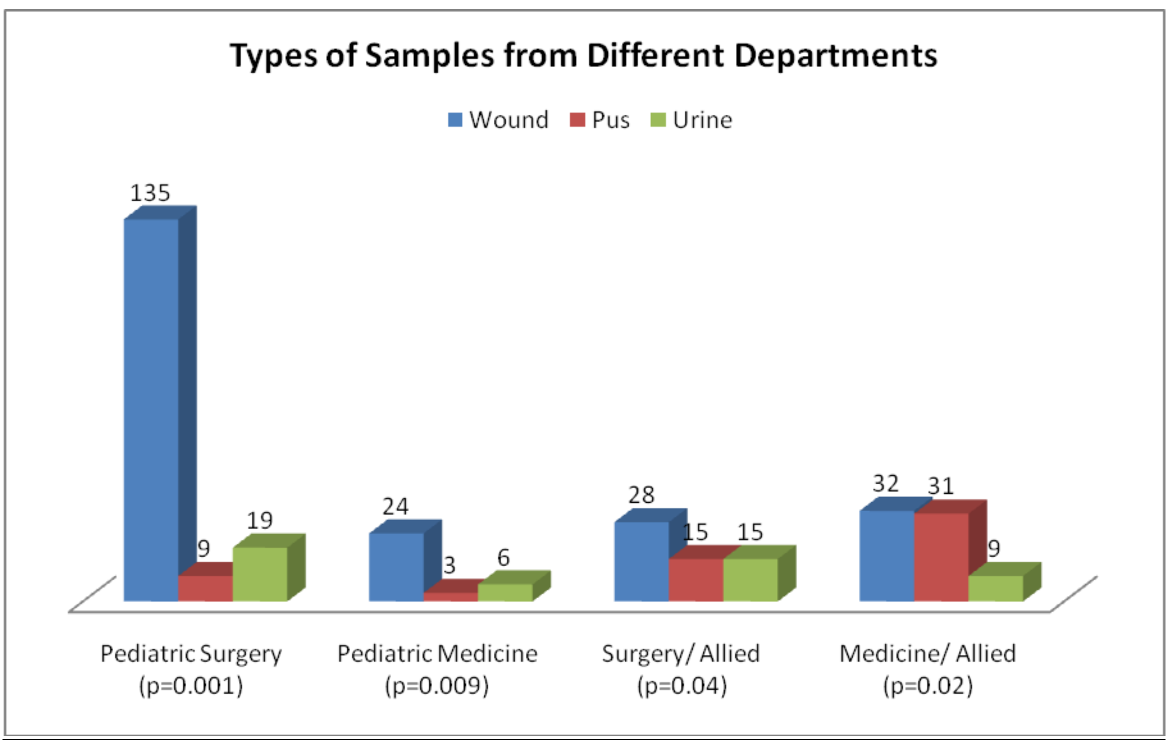

Figure 3: Most Common Microbes (in percentages) Isolated from Samples of Different Departments

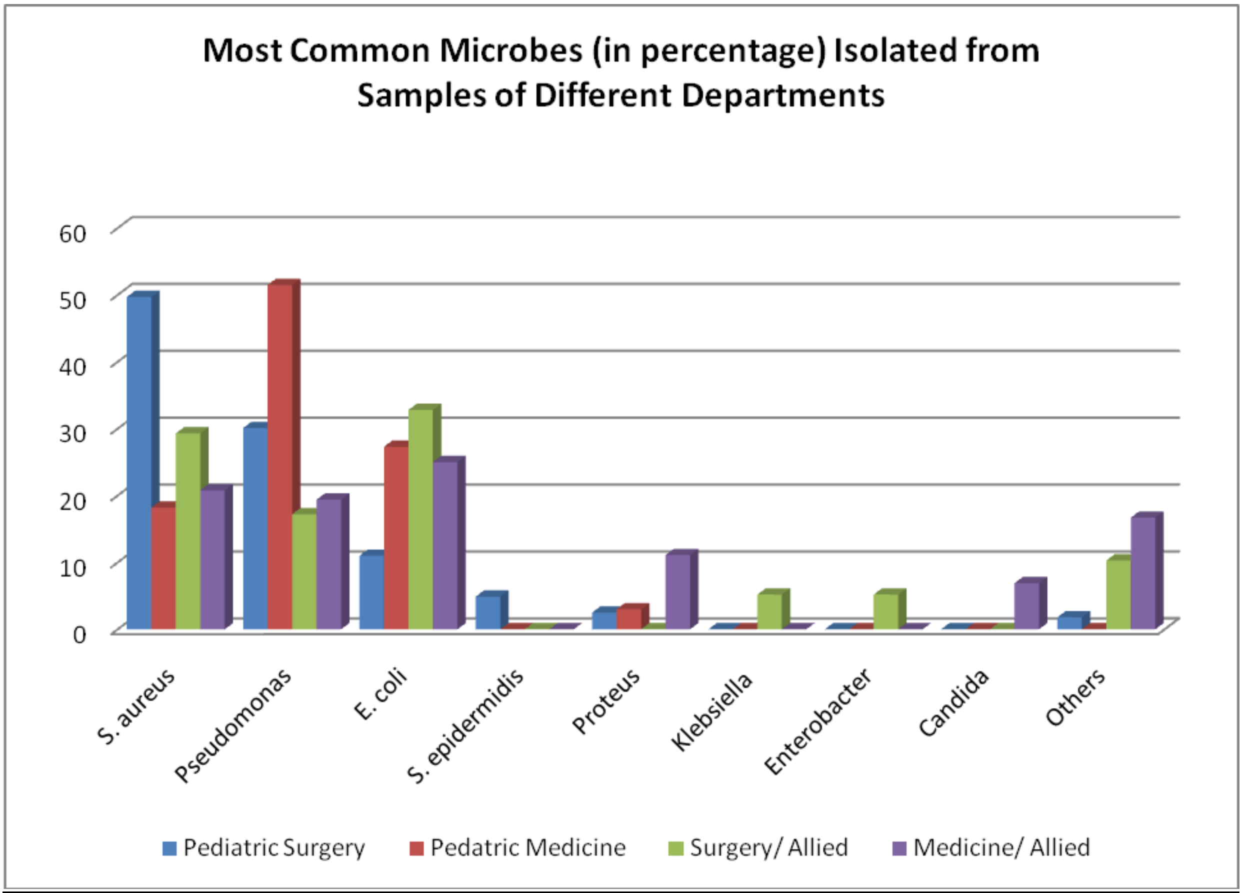

Table 1: Sensitivity and Resistivity of Commonest Antimicrobials for Commonest Microbes (Pediatric Surgery and All other wards)

Antibiotics		Microorganisms, n (% for particular organism)							
		S. aureus	Pseudomonas	E. Coli	S. epidermi.	Proteus	Klebsilla	Enterobac.	Others
Amoxicillin (PSW)	Sensitive	29 (35.8)	NDS	NDS	4 (50.0)	NDS	NDS	NDS	NDS
	Resistant	**52 (64.2)**	NDS	NDS	4 (50.0)	NDS	NDS	NDS	NDS
Amoxicillin (All Other)	Sensitive	24 (63.6)	NDS	NDS	NOD	NDS	NDS	NDS	NDS
	Resistant	14 (36.4)	NDS	NDS	NOD	NDS	NDS	NDS	NDS
P-Value		**0.008**	NA	NA	NA	NA	NA	NA	NA
Tanzo (PSW)	Sensitive	61 (75.3)	40 (81.6)	NDS	5 (62.5)	NDS	NDS	NDS	NDS
	Resistant	20 (24.7)	9 (18.4)	NDS	3 (37.5)	NDS	NDS	NDS	NDS
Tanzo (All Other)	Sensitive	35 (87.5)	26 (63.4)	NDS	NOD	NDS	NDS	NDS	NDS
	Resistant	3 (12.5)	**15 (36.6)**	NDS	NOD	NDS	NDS	NDS	NDS

P-Value		0.07	**0.04**	NA	NA	NA	NA	NA	NA
Vanco (PSW)	**Sensitive**	77 (95.1)	39 (79.6)	15 (83.3)	6 (75.0)	2 (50.0)	NOD	NDS	NOD
	Resistant	4 (4.9)	10 (20.4)	3 (16.7)	2 (25.0)	2 (50.0)	NOD	NDS	NOD
Vanco (All Other)	**Sensitive**	34 (89.5)	31 (75.6)	33 (71.7)	NOD	4 (44.4)	3 (100.0)	NDS	13 (72.2)
	Resistant	4 (10.5)	10 (24.4)	**13 (28.3)**	NOD	5 (55.6)	0 (0.0)	NDS	5 (27.8)
P-Value		0.12	0.32	**0.04**	NA	0.43	NA	NA	NA
Mero (PSW)	**Sensitive**	NDS	43 (87.8)	NDS	NDS	NDS	NDS	NOD	NOD
	Resistant	NDS	6 (12.2)	NDS	NDS	NDS	NDS	NOD	NOD
Mero (All Other)	**Sensitive**	NDS	36 (87.8)	NDS	NDS	NDS	NDS	3 (100.0)	18 (100.0)
	Resistant	NDS	5 (12.2)	NDS	NDS	NDS	NDS	0 (0.0)	0 (0.0)
P-Value		NA	0.89	NA	NA	NA	NA	NA	NA
Genta (PSW)	**Sensitive**	NDS	NDS	13 (72.2)	NDS	3 (75.0)	NOD	NOD	NDS
	Resistant	NDS	NDS	5(27.8)	NDS	1 (25.0)	NOD	NOD	NDS
Genta (All Other)	**Sensitive**	NDS	NDS	35(76.1)	NDS	6 (66.7)	2 (66.7)	2 (66.7)	NDS
	Resistant	NDS	NDS	11(23.9)	NDS	**3 (33.3)**	1 (33.3)	1 (33.3)	NDS
P-Value		NA	NA	0.31	NA	**0.05**	NA	NA	NA
Cefotaxime (PSW)	**Sensitive**	NDS	NDS	11 (61.1)	NDS	2 (50.0)	NOD	NDS	NDS
	Resistant	NDS	NDS	**7 (38.9)**	NDS	**2 (50.0)**	NOD	NDS	NDS
Cefotaxime (All Other)	**Sensitive**	NDS	NDS	39 (84.8)	NDS	7 (77.8)	1 (33.3)	NDS	NDS
	Resistant	NDS	NDS	7 (15.2)	NDS	2 (22.2)	2 (66.7)	NDS	NDS
P-Value		NA	NA	**0.007**	NA	**0.01**	NA	NA	NA
Amikacin (PSW)	**Sensitive**	NDS	NDS	NDS	NDS	NDS	NDS	NOD	NOD
	Resistant	NDS	NDS	NDS	NDS	NDS	NDS	NOD	NOD
Amikacin (All Other)	**Sensitive**	NDS	NDS	NDS	NDS	NDS	NDS	1 (33.3)	14 (77.8)
	Resistant	NDS	NDS	NDS	NDS	NDS	NDS	2 (66.7)	4 (22.2)
P-Value		NA	NA	NA	NA	NA	NA	NA	NA

1. *PSW-Pediatric Surgery Ward*
2. *All Other- All Other Clinical Wards of Mayo Hospital except PSW*
3. *P Value for Chi square test to compare difference in resistivity pattern among PSW and All Other wards*
4. *Only shown top 3 antimicrobials sensitive to a particular microbe although all microbes were tested for all top seven antimicrobials (4th common antimicrobial is only shown if that particular microbe is not sensitive to any of the 3 commonest antimicrobials)*
5. *NDS- Not Done or Shown*
6. *NOD- No Microbe Cultured*
7. *NA- Not Applicable to calculate P valve because the comparing variables has no samples*

Total 326 patients' antibiograms were evaluated. Mean age of pediatric surgery patients was 4.0±1.6 years with range from1 to 10 years. Age was fairly comparable with pediatric medicine ward (mean age 3.6±1.5 years). In surgery ICU & allied group, mean age of patient was 49.7±21.2 years with a range from 18 to 87 years. It was comparable to medicine ICU & allied units (mean age 51.2±16.3 years).

Fig 1 shows gender distribution among different departments. Major samples were wound swabs irrespective of wards. In pediatric surgery ward wound sample (n=135) outnumbered pus (n=9) and urine (n=19) samples which was statistically significant by t test (p=0.001), similar distribution was seen in other departments as well (figure 2).

Among 163 pediatric surgery samples, 81 (49.7%) isolated S. aureus in them and 49 (30.1%) showed Pseudomonas and E. coli were 18 (11.0%). Among 33 samples, most common organism in pediatric medicine ward was Pseudomonas (n=17, 51.5% of total pediatric medicine samples) and E. coli being the second most common isolate (n=9, 27.3%) followed by Staph aureus (n=6, 18.2%). Among 58 Surgery & Allied samples, 19 (32.8%) isolated E. coli in them and 17 (29.3%) showed Staph aureus and Pseudomonas were 10 (17.2%). Among 72 samples of Medicine, most common organism was E. coli (n=18, 25%) and Staph aureus being the second most common isolate (n=15, 20.8%) followed by Pseudomonas (n=14, 19.4%). (Figure 3)

Total cultures of 11 microbes were obtained and first 7 microbes with their sensitivity to top three antibiotics are tabulated in table 1. It might be surprising to see broad spectrum antibiotics like Meropenum, Vancomycin test results are not shown, although microbes were definitely sensitive to them, as the results of these broad spectrum antimicrobials are shown only when resistance to common antimicrobials was noted.

S. aureus

S. aureus was seen in 119 isolates. Out of 81 pediatric surgery samples, only 29 (35.8%) were sensitive to Amoxicillin and 52 (64.2%) were resistant to Amoxicillin. In other ward samples 63.6% (n=24) were sensitive to Amoxicillin and only 14 (36.4%) were resistant. This resistant pattern was highly significant (p value=0.008). Tazobactam was sensitive in both groups, 61(75.3%) in group A and 35(87.5%) in group B. 20 (24.7%) were resistant in group A but difference was not statistically significant when compared to group B (p value=0.07).

Pseudomonas

Pseudomonas was isolated in 90 out of 326 total samples. Out of 49 group A samples, 40 (81.6%) were sensitive to Tazobactam and 9 (18.4%) were resistant to Tazobactam. In group B samples 26 (63.4%) were sensitive to Tazobactam and 15 (36.6%) were resistant. This resistant pattern was highly significant in group B (p=0.04). Thirty nine (80%) isolates were sensitive to Vancomycin in group A samples and 31 (75.6%) were sensitive in group B samples. About 10(20.4%) were resistant to Vancomycin in group A and 10(24.4%) in group B but difference was not statistically significant.

E. coli

E. coli was isolated in 64 samples. Fifteen (83.3%), out of 18 group A samples were sensitive to Vancomycin and 3 (16.7%) were resistant to Vancomycin. In group B samples 33 (71.1%) E. coli were sensitive to Vancomycin and 13 (28.3%) were resistant. This resistant pattern was highly significant among group B (p=0.04). Thirteen (72.2%) E. coli were sensitive to Gentamycin in group A samples and 35 (76.1%) were sensitive in group B samples. Only 5(27.8%) were resistant in group A samples and 11(23.9%) in group B samples but there is no significant association. Eleven (61.1%) E. coli were sensitive to Cefotaxime in group A and 39(84.8%) were sensitive in other ward. 7(38.9%) were resistant to Cefotaxime in group A and this resistance was statistically significant (p=0.007).

S. epidermidis

S. epidermidis was cultured in 8 samples of group A. Four (50.0%) were sensitive to Amoxicillin and 4 (50%) were resistant to Amoxicillin. Five (62.5%) were sensitive to Tazobactam and 3(37.5%) were resistant. Vancomycin sensitivity was noted in 6 (75%) and resistance in 2 (25%).

Proteus

Proteus was isolated in 13 out of 326 samples. Out of 4 pediatric surgery samples, 2 (50%) were sensitive to Vancomycin and Cefotaxime and 2 (50%) were resistant to Vancomycin and Cefotaxime, while sensitive to Gentamycin in 3 (75%) samples. In other ward samples 4 (44.4%) Proteus were sensitive to Vancomycin and 5 (55.6%) were resistant, while 6 (66.7%) were sensitive to gentamycin. Cefotaxime was sensitive in 7 (77.8%) and only 2 (22.2%) were resistant. There was a significant difference in resistant pattern of Cefotaxime in both groups (p value=0.01).

Klebsiella

Klebsiella (n=3) was isolated from group B and sensitive to Vancomycin, Gentamycin, Cefotaxime. Resistance was noted to Gentamycin in 33.3% and to Cefotaxime in 66.7%.

Enterobacter

Enterobacter (n=3) was sensitive to Meropenum, Gentamycin and Amikacin. All enterobacter were isolated from group B wards and no resistance was noted towards Meropenum.

Others

Other 18 microbes out of 326 were mix up of 4 bacteria. These were only isolated from group B wards and were either sensitive to Vancomycin, Meropenum or Amikacin.

DISCUSSION:

We identified the differences and similarities in antimicrobial susceptibility among bacteria isolated from inpatient of pediatric surgery and other departments. Antibiograms generated in our study will help in selection of empirical antibiotics till availability of definitive culture report. Different surveys have shown that access to antibiograms improve prescriptions and reduce antibiotic resistance, which is a biological response of bacteria [9-11]. In our study, age range in group A was from 1 to 10 years, while in group B the range was 18-87 years. It is similar to Jessina C. Mcgregor et al study. We had almost equal male and female samples (168 from male to 158 from female) and this is in contrast to other studies in which female preponderance was noted.[7] The main source of microbes was wound swab (135 from pediatric surgery and 84 from other departments). This suggests a potential bias as there was a high chance of contamination at time of sample collection. In our study, we have isolated 23different microbes and only top 5 were seen in pediatric surgery ward and rest were from other wards.

The commonest microbe isolated from pediatric surgery was Staph Aureus (49.7%), followed by Pseudomonas (30.1%) and E coli (11.04%). From other departments, gram negative isolates were more. E coli (28.2%) was the commonest, followed by Pseudomonas (25.1%). Staphylococcus aureus was only noted in 23.3% samples. David Kaufman et al found Pseudomonas and Staph aureus to be commonest bacteria, while Binkley et al reported Staph aureus and E coli to be more common.[5,6] Almost all studies show Staph aureus, Pseudomonas and E coli to be the most common bacterial pathogens.[1,4-7] Staphylococcus epidermidis was isolated in group A and may show colonization or contamination instead of actual infection. Enterobacter, Klebsiella and mixed pathogens were obtained from other wards only. In our study, there was difference between susceptibility of Pediatric surgery ward and other wards. Major differences were noted in susceptibility of Staphylococcus aureus, Pseudomonas, Escherichia coli and Proteus. We noted Staph aureus increased resistance to amoxicillin and ampicillin in pediatric surgery ward (p value 0.008). Similar results were shown by another study done by David Kaufman et al. [6].

Our study also showed Pseudomonas is less susceptible to Tazobactam-pipercillin in other wards as compared to group A (p value 0.04). Kaufman et al and Binkley et al found Pseudomonas to be less susceptible to Imipenem and more susceptible to Ticarcillin-Clavulanic acid.[5,6] In our study, gram negative bacteria like Proteus and E coli were more resistant to Ampicillin and Cefotaxime in Pediatric surgery ward; whereas E coli was less susceptible to Ampicillin and Vancomycin in group B (p value 0.04). This is similar to Boggan et al study in which pediatric isolates of E coli were resistant to Ampicillin.[8] In contrast, Kaufman et al found E coli isolates to be more sensitive to penicillin derived antibiotics.[6] Our study fails to address patient specific factors like diagnosis, need of mechanical ventilation, procedures underwent, duration of hospital stay and antibiotic consumption.

CONCLUSIONS:

We found susceptibility differences to be unit specific and recommend implementation of unit specific antibiograms for effective empirical therapy.

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