

Brief Communication

Distribution of various pathogenic bacteria from pediatric ward settings

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ABSTRACT

Objectives: To test various items in hospital environment as reservoirs of bacteria.

Methods: This simple descriptive study was conducted between June and December 2014. Pediatric wards of 4 different hospitals of Faisalabad, Pakistan were selected and 8 different items per hospital were sampled (n=160). Poisson regression analysis was carried out with R software and using lme4 package.

Results: There were no differences between the hospitals regarding total number of bacterial isolates or bacterial isolates per sample source or prevalent bacterial species. Utensile tables were significantly the least contaminated source when comparing all sample sources from all hospitals ($p=0.05$). When testing if the bacterial species differed significantly between sample sources, *Escherichia coli* ($p=0.05$) and *Bacillus* ($p=0.04$) were found significantly high on utensils, while *Pseudomonas* was found significantly less on curtains ($p=0.03$) and doors ($p=0.02$).

Conclusion: Due to unhygienic practices in hospitals children are exposed to pathogens steers to life threatening infection. A good control strategy should be implemented to avoid health care-associated infection.

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Health care-associated infections (HAI) are a concern of huge importance around the globe, and it is one of the definite source of morbidity and mortality of patients.¹ Endogenous flora of the patient plays a vital role in nosocomial infection (NI). According to an estimation approximately 20-40% of NIs are due to the cross infection through working staff. Nosocomial infections are the persisting problem, especially in developing countries like Pakistan. Poor hygienic measures in hospitals and lack of proper management of the patient further aggravate the situation. In special circumstances, NIs may lead to death.^{2,3} Globally, various bacteria especially antibiotic-resistant bacteria are associated with NI.^{4,5} The duration of patient's stay in hospital is directly associated with

certain complications, such as; antibiotic resistance, patient morbidity, and mortality. To combat these problems, a number of measures have been adopted, these include hand hygiene, environmental cleanliness, and quarantine measures. Regardless of the fact that cleanliness helps to get better surgical results, there are certain apprehensions regarding contaminated environmental surfaces, whether they have any role in transmission of NI.⁶ Numerous predisposing factors which amplify the peril of NI include the pathogen viability, frequent use of contaminated surface, and stratum of contamination.⁷ It has been established that contaminated environmental surfaces may perform a vital role in the transmission of NI.^{4,8} Different objects of contaminations include clothing, such as white coats, masks, towels, and so forth, commodities of personal use for example; pens, stethoscopes, and cell phones may have significant levels of contamination.⁹ Since pathogen viability is a significant factor in NIs, both methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *enterococci* (VRE) are competent enough to survive for weeks on various environmental surfaces in hospital facilities. Several findings have established the role of healthcare workers in the transmission of bacterial pathogen to patients. Direct contamination may also be another route of transmission of pathogen from contaminated surfaces to susceptible patients. Children are more prone to NIs due to their weak immune system. Infants treated in neonatal intensive care units are at high risk of hospital acquired infections due to their immature immune system.^{1,10} Nosocomial infections are a major cause of illness and death in children.¹¹ Developed countries have minimized NI.¹ This is proved to be a cost of several lives and economy losses. Since Pakistan is a developing country it faces agonizing economic losses due to NIs. Although most of the contributing factors of NIs are known in the developed world, the studies regarding these factors are very less in number in the developing countries including Pakistan. Current study is mapped to reveal how different items of hospital environment, especially the pediatric wards may perform a role of

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reservoir for bacterial contaminants that may be the possible cause of NIs in children.

Methods. This simple descriptive study was carried out in the pediatric wards of different public and private Hospitals of Faisalabad, Pakistan between June-December 2014. The hospitals under study were district head quarter hospital, general hospital, national hospital, and allied hospital. Pediatric wards were randomly visited on daily basis and various sources were sampled for isolation of bacteria. Since all the samples during the study were collected from the inert sources except staff hands so no ethical rules were breached in the study. All the staff members showed their willingness for the sampling.

Eight sources were selected for sampling in each hospital, namely bed sheets, utensils, floor, curtains, tables, apparatus, door, and staff's hands. Inclusion and exclusion criteria for the sources of samples was their vulnerability to the contaminants, as they are completely exposed surfaces to the environment. The sampling was randomized and carried out by employing the technique of convenient sampling. A sum of 160 samples were collected having 20 samples from each source. Standardized aseptic protocols were followed for the collection of samples.⁶ Collected samples were transported in brain heart infusion broth. The collected samples were transported immediately to the Microbiology Laboratory of the Department

of Microbiology, Government College University, Faisalabad, Pakistan. For further proceeding with microbiological examination of collected samples, brain heart infusion broth containing samples were incubated at 37°C for 24 hours.

All samples were then streaked on selective media culture plates (Staph110 agar, *Pseudomonas agar*, Blood agar and MacConkey's agar), which were again incubated at 37°C for 24 hours. Morphological examination was carried out by using Gram staining. Biochemical characterization was carried out through API 20 (bioM'erieux SA, Marcy l'Etoile, France). Statistical testing was performed with R software and using lme4 package.¹²

We used Poisson regression in all the statistical tests. It was tested if there was any statistically significant difference between the hospitals for total number of bacteria isolated per hospital. It was tested if the number of isolates per source depended on hospital. Also, if the species of bacteria depended on hospital. In all other statistical models described we used hospital as a random factor in the model. It was tested, whether the isolates per source depended upon sample source, and if the species of bacteria depended upon sample source.

Results. Different bacterias were isolated from district head quarter hospital (n=60), general hospital (n=55), allied hospital (n=50), and national hospital (n=44). On the basis of isolates, there was no statistically

Table 1 - The number of total isolates and different bacterial species isolated from different sources of all the 4 hospitals.

Sample source	Total no. of bacterial isolates per sources	Combined No. of different bacteria isolated from different sources of all the four hospitals tested						
		MRSA	VISA	<i>Pseud</i>	<i>E. coli</i>	Bacillus	Morexlla	<i>Acinetobacter</i>
Table	16*	2	0	0	11	3	0	0
Utensils	29	5	3	0	13*	8*	0	0
Curtains	25	5	4	2*	0	0	9	5
Floor	28	8	4	7	0	0	7	2
Bed Sheet	32	8	7	9	0	0	7	1
Apparatus	29	7	7	10	5	0	0	0
Door	28	14	7	1*	5	1	0	0
Hands	22	6	0	4	8	4	0	0

MRSA - methicillin-resistant *Staphylococcus aureus*, VISA - Vancomycin-intermediate *S. aureus*, *Pseud* - *Pseudomonas agar*, *E. coli* - *Escherichia coli*, The significant results are shown with asterisk (*)

Table 2 - Detailed description of statistical models of significant results

Dependent variable	Independent variable	Significant source	Estimate	Standard error	Z value	P-value
<i>Escherichia coli</i>	Sample source	Utensil	0.9555	0.5262	1.816	0.05
Bacillus	Sample source	Utensil	2.079	1.061	1.961	0.04
<i>Pseudomonas</i>	Sample source	Curtains	-1.6094	0.7746	-2.078	0.0377
<i>Pseudomonas</i>	Sample source	Door	-2.3026	1.0488	-2.195	0.0281

significant difference between different hospitals. It was found that the number of isolates per source did not differ significantly between different hospitals. Moreover, the number of bacterial species also did not differ significantly between hospitals. However, there was a significant difference between sample sources for total number of isolates per source (Table 1 shows the lowest number of isolates [estimate=-0.5947, standard error=-0.3114, z value=-1.910, $p=0.05$]). During the testing of difference between different samples sources for the bacterial species, significantly high number of *Escherichia coli* (*E. coli*) ($p=0.05$) and *Bacillus* ($p=0.04$) were isolated from utensils. While *Pseudomonas* was isolated significantly less in number from curtains ($p=0.03$) and door ($p=0.02$) (Tables 1 & 2).

A total of 20 samples per source were collected, that is 160 samples in total from all the 8 sources per hospital. Statistical testing was performed to test whether the total number of isolates per source differed significantly between the sources of sampling, and to test whether different isolated bacterial species differed significantly between different sources. The significant results are shown in Table 1, while the details of the models and statistical parameters of these significant results are shown in Table 2. We tested whether the number of isolates per bacterial species differed significantly between sample sources. The results from models are shown for significant bacterial species for which number of isolates differed between sample sources (Table 2).

Discussion. During the last decade, NIs became an area of interest in most health care facilities worldwide. These infections not only adversely affect the health of the population, but they also result in a financial burden on the health care system. One of the vital implications for NI control is the prevalence of pathogenic bacteria in a hospital environment. There are various evidences on bacterial contamination in the community, which are comparable with hospital settings.¹³ The significance of the current study is to draw attention towards various reservoirs of pathogen in pediatric wards. We studied the distribution of different bacteria on various items present in ward premises. Pediatric wards were selected since children are more prone to get infection from the hospital environment due to their naive immune system. Four different hospitals were included in the study to check if the results would vary among hospitals due to the possibility of different practices in wards. We did not find a difference between hospitals for total number of bacterial isolates. Furthermore, there was no difference among hospitals regarding number of isolates per source and bacterial species. This could be due to the possible reason that all the hospitals situated in same

area of the city and all the hospitals seemed to follow the same hygienic practices. When we tested whether the total number of bacteria isolated differed significantly between sample source, tables were found to contain significantly low number of bacteria. This could be due to the reason that tables' surfaces are sprayed with a disinfectant routinely. Same was suggested by Boyce,⁴ he stated that the use of proper disinfectants on environmental surfaces surely reduces the risk of transmission of the bacterial contaminants.

When testing if different bacterial species differed between sample sources, *E. coli* and *Bacillus* were found to be significantly high in number in utensils (trays, and so forth). This could be due to the reason that *E. coli* is ubiquitous in nature, and it was also found in high numbers on tables and hands after utensils. Similarly, *Bacillus* was also found in high numbers on hands and tables after utensils. Overall, utensils (total number of isolates 29) were among highly contaminated sources after bed sheets (total number of isolates 32) and apparatus (total number of isolates 29). It could be due to the reason that utensils are mostly overlooked items for using disinfectants to remove contaminants. Significant number of isolates from various sources revealed that bacteria may survive on different surfaces. A previous study¹⁴ observed the same, that various bacterial contaminants may survive up to 6 months on dried blood, cotton, and other surfaces of hospital settings.

In conclusion, findings of the present study revealed that hospital settings are exposed to various contaminants and may be one of the potential risk factor associated with NIs. Proposed study highlighted issues, which are usually overlooked. Although having the present study we may depict the problem, but to access the complete magnitude of the issue some future comprehensive epidemiological studies should be designed, which would be very helpful in revealing the various neglected risk factors and diseases associated with this subject. A comprehensive and detailed prospective plan should be adopted to investigate the issue, which will ultimately minimize the risk of patient to patient transmission of these pathogens. Thus, stringent hospital hygiene policies should be adopted to reduce the risk of these contaminants.

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