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Potential pathogenic bacterial contaminants of shared utility devices in a university setting at Al-Hofuf, Saudi Arabia

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The microbial contamination of shared devices in work places could serve as potential sources for community acquired infections. This study investigated the potential bacterial pathogens in a university work place. Swab samples collected from office and toilet doors handles/knobs, washroom tap heads, elevator buttons and computer keyboards were plated out and isolates were identified using the Vitek 2 compact automated system. Antibiotic susceptibility test as well as the minimum inhibitory concentrations (MICS) were also determined using the Vitek 2 system. The results obtained showed all objects from which samples were collected had microbial contamination. The isolates constituted of *Staphylococcus aureus* (4.02%), *Staphylococcus haemolyticus* (18.59%), *Staphylococcus epidermidis* (21.10%), other *Staphylococcus* spp. (51.76%), *Enterococcus faecalis* (2.01%), *Enterococcus* spp. (1.51%), *Klebsiella pneumoniae* (0.50%), *Streptococcus sanguins* (0.50%), *Pseudomonas aeruginosa* (14.03%), *Pseudomonas stutzeri* (3.5%), *Pseudomonas luteola* (10.53%) and *Pantoea* spp. (72%). Multidrug resistance to antibiotics was observed by the isolates to major groups of antibiotics. The results therefore indicated the presence of Multi-antibiotic resistant bacterial strains among shared items in a work place setting and this could be a source of potential infection in the university community.

Key words: Pathogenic isolate, bacterial contamination, Vitek, University, community infection.

INTRODUCTION

The problem caused by nosocomial infections in healthcare settings has received much attention in recent years. However, the environment we live and work could also contribute in playing major roles in human-microbe contamination relationship. A relationship that could sometimes lead to the transmission and spread of pathogens as is seen through community acquired infections. The significance of contamination of shared

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Table 1. The microbial contamination of sampled objects.

Object	Total number of collected swabs	Microbial contamination (%)	Degree of growth
Office door handles	85	100	+++
Toilet door handles	30	100	+++
Toilet tap heads	24	100	++++
Computer keyboards	68	100	++++
Elevator buttons	6	100	++
Total	213	100	

++, Scanty growth; +++, moderate growth; ++++, dense growth.

objects in communal areas by pathogenic organisms is also an important public health problem as such pathogens could be possible sources of infection transmission. Gabriel (2008) and Dougherty (2006) defined microbial contamination as the non-intended or the accidental introduction of infectious material like bacteria or their toxins and by-products while Ranjit Singh et al. (2011) commented on the importance of pathogenic microbes in public utility devices. These devices they said, include public telephones, ATM center, computer keyboards amongst others. They were of the view that as these devices are not routinely disinfected, that they were potential sources for pathogen transmission. Al-Ghamdi et al. (2011) also, were of the view that 80% of infections are spread through hand to hand contacts as well as hands to other objects. The presence of viable pathogenic bacteria on inanimate objects such as door handles, phones, fabrics and computer keyboards has been reported by researchers such as Burke (2003), Oluduro et al. (2011), Al-Ghamdi et al. (2011), Enemuor et al. (2012), and Wala'a et al. (2013). The ability to identify the potential sources of pathogen in a work setting such as a university cannot be overlooked as this could lead to a reduction in loss of gross domestic product (GDP) due to the number of absence from work caused by ill health (Burke, 2003).

Information on the bacterial contamination in communal areas of a work place is of importance as this would help in identifying the sources of an infection with the view of taking preventive measures. The present investigation, carried out at the Microbiology division of the College of Medicine, King Faisal University, aimed at looking at the nature of bacterial contaminants isolated from communal areas and some shared equipment at a University setting in Al Asha region as literature is silent on any such assessment.

MATERIALS AND METHODS

Sample collection

Samples were collected from office and toilet door handles and knobs, washroom tap heads, elevator buttons and computer keyboards using moistened sterile cotton swabs. Each swab was inoculated into nutrient broth and incubated aerobically at 37°C for 24 h after which they were plated out on Blood agar, MacConkey agar, Nutrient agar and Salmonella/Shigella agar and then incubated at 37°C for 24 h under aerobic conditions.

Identification and characterization of isolates

Pure culture isolates were identified using the Vitek 2 compact automated system (BioMerieux, Marcy L'Etoile, France). A sterile applicator stick was used to transfer a sufficient number of colonies of pure culture of the microorganism and suspended in a 3 mL sterile saline test tube. The appropriate turbidity was determined based on the manufacturers' guidelines (GN, 0.50 – 0.63; GP, 0.50 – 0.63) by using the turbidity meter, DensiChek^{TM}, according to the manufacturers' guidelines. Identification cards were then inoculated with the suspension of the microorganism and placed the cassette with the identification card in the neighboring slot. The GN cards were used for the identification of Gram negative isolate while the GP was used for the Gram positive cocci and non-spore forming bacilli, bacteria isolates. The minimum inhibitory concentrations (MICs), antibiotic susceptibility and resistance patterns were determined with the Vitek 2 compact automated system using the AST-P586 and AST N204 cards.

Statistical analysis

Results were expressed as mean ± SD. All analysis were done using Microsoft excel 2013.

RESULTS

A total of two hundred and thirteen (213) samples were collected. This was made up of 85 office door handles, 30 toilet door handles, 24 toilet tap heads, 68 computer key boards and 6 elevator buttons. The obtained results showed that all (100%) had microbial contamination. The degree of microbial growth as shown in Table 1 indicates that the elevator buttons had the least microbial contamination in terms of colony count while the computer keyboards and the heads of toilet taps had the most microbial contamination. The results on the isolated Gram positive and Gram negative bacteria and their percentage of prevalence are shown in Figure 1. The isolated Gram positive bacteria constituted of *Staphylococcus aureus* (4.02%), *S. haemolyticus* (18.59%), *S. epidermidis* (21.10%), other co-aggulase negative *Staphylococcus* spp. (51.76%), *E. faecalis* (2.01%), *Enterococcus* spp. (1.51%) and *Streptococcus*

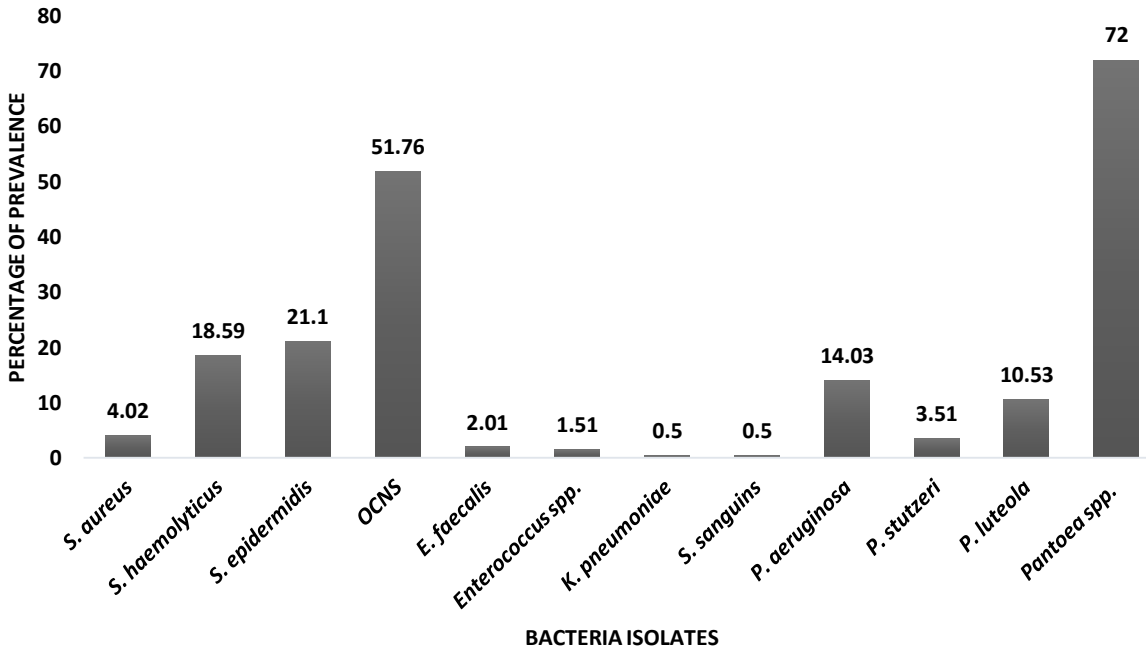

Figure 1. Percentage of prevalence of isolated Gram positive and Gram negative bacteria sampled from different surfaces.

sanguins (0.50%). *Pantoea* and *Pseudomonas aeruginosa* were the most frequently encountered gram negative bacteria, with a percentage of 72 and 14.03% respectively (Figure 1). Other isolates included *P. stutzeri (*3.51%) *P. luteola (*10.53%) and *K. pneumoniae* (0.50%).

The results on the resistance pattern of the isolates to the main groups of antibiotics are presented in Table 2. For the Gram positive isolates, the table shows that all (100%) of *S. aureus* isolates were resistant to the Penicillins, Cephalosporins, Macrolides, Lincosamides and Sulfonamides. Also, resistance was high at 88% for the Carbapenems. 100% of *S. epidermidis* isolates were resistant to the Penicillins, Cephalosporins and Carbapenems. However for the *S. haemolyticus* isolates, resistance was below 50% for all the major groups of antibiotics shown in Table 2, the highest of 43% resistance seen in this group was for the macrolides. *E. faecalis* isolates exhibited a 100% resistant to the Aminoglycosides, Cephalosporins and Nitrofurantoin. Figure 2 also shows that none of the other co-aggulase negative *Staphylococci* species exhibited complete resistance to the major groups of antibiotics. However, for this group of isolates, resistance was high at 86% for the Penicillins, Cephalosporins and Carbapenems, 66% were resistant to Macrolides while 64% showed resistance to Lincosamides.

For the Gram negative isolates, *K. pneumoniae* was completely resistant to the Penicillins, Nitrofurantoin, Aminoglycosides, Quinolones and Fosfomycin. *P. aeruginosa* were also completely resistant to the Penicillins, Cephalosporins, Nitrofurantoin, Sulfonamides and Fosfomycin. For the other Gram negative isolates, *P. stutzeri* showed 100% resistance to the Penicillins, Nitrofurantoin and Fosfomycin while for *P. luteola* there was 100% resistance to Penicillins and Fosfomycin as well as a 66.67% resistance to Nitrofurantoin. However *P. agglomerans* isolates showed complete resistance only to the Carbapenems and a 67% resistance to Nitrofurantoin as in Table 2.

The minimum inhibitory concentration (MIC) values by Gram positive isolates to the various test drugs is shown in Figure 2.The results show that Teicoplanin and Linezolid produced the highest zones of inhibition for all the Staphylococcal isolates. Zones of inhibition were lowest for Tigecyclin and Levofloxacin. However, the results for the MIC values for the Gram negative isolates are variable as shown in Figure 3. Approximately MIC zone was lowest for Ciprofloxacin.

DISCUSSION

The isolation of pathogenic bacteria contaminants in a work place setting as seen in the present study is not unexpected. Workers such as Bright et al. (2010) reported that frequent or heavily used fomites were most likely contaminated and thus carried higher bacteria load. However, the results highlight the fact that bacterial contamination in our work place could serve as a source for potential nosocomial infections. Among the organisms isolated in the present study were, multidrug resistant *S. aureus, K. pneumoniae, P. aeruginosa* and *E. faecalis*.

Table 2. Percentage of resistance of Gram positive and Gram negative bacterial isolates to the major groups of antibiotics.

Bacterial isolates	Penicillin	Cephalosporins	Carbapenems	Nitrofurantoin	Sufonamides	Aminoglycoside	Quinolones	Tetracycline	Macrolides	Lincosamides	Fosfomycin
SA	100	100	88	0	100	0	(-)	50	100	100	(-)
SE	100	100	100	0	0	0	(-)	31	26	33	(-)
SH	27	23	23	6	0	0	(-)	19	43	30	(-)
EF	0	100	0	100	0	100	(-)	0	0	87	(-)
OCNS	86	86	86	0	15	0	(-)	31	66	64	(-)
P. agglo.	0	0	100	67	0	0	0	(-)	(-)	(-)	0
P. luteo.	100	0	(-)	67	0	0	0	(-)	(-)	(-)	100
P. aeru.	100	100	(-)	100	100	0	0	(-)	(-)	(-)	100
K. pneu.	100	0	(-)	100	0	100	100	(-)	(-)	(-)	100
P. Stutz.	100	0	(-)	100	0	0	0	(-)	(-)	(-)	100

(-) = no readings; SA=*Staphylococcus aureus*; SE=*Staphylococcus epidermidis*; SH=*Staphylococcus haemolytica*; EF=*Enterococcus faecalis*; OCNS=other co-aggulase negative *Staphylococcus*. P. agglo = Pantoea agglomerans. P. luteo= *Pseudomonas luteola*. P. aeru. = *Pseudomonas aeruginosa*. K. pneu= *Klebsiella pneumoniae*. P. Stutz= *Pseudomonas stutzeri*.

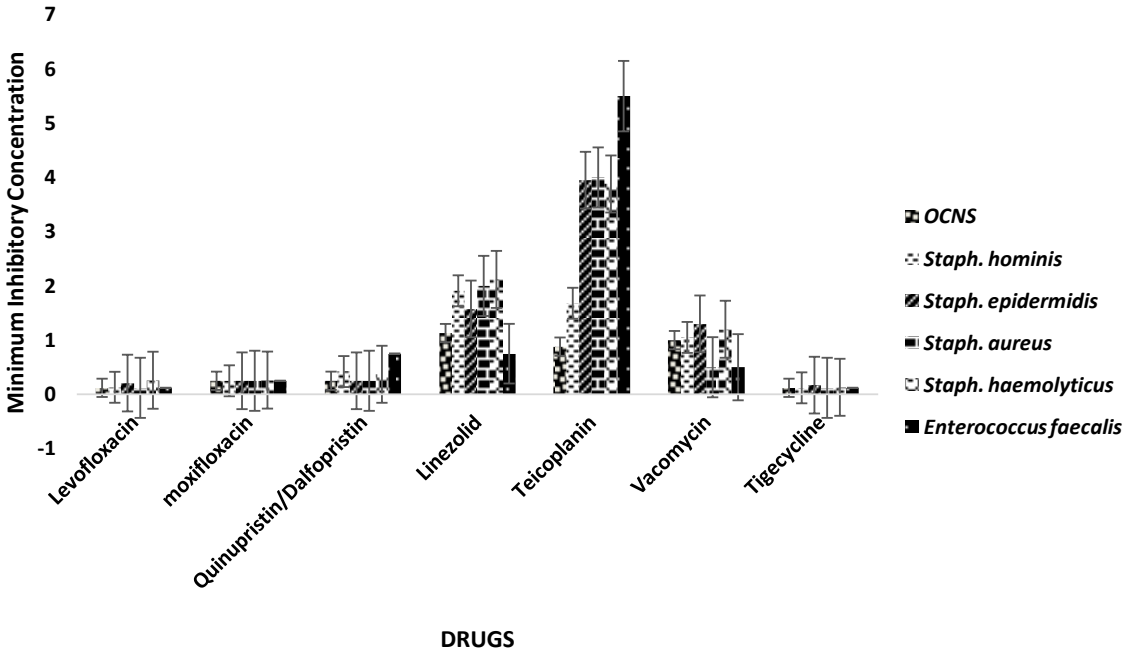

Figure 2. MIC of the Gram positive isolates against tested antibiotics.

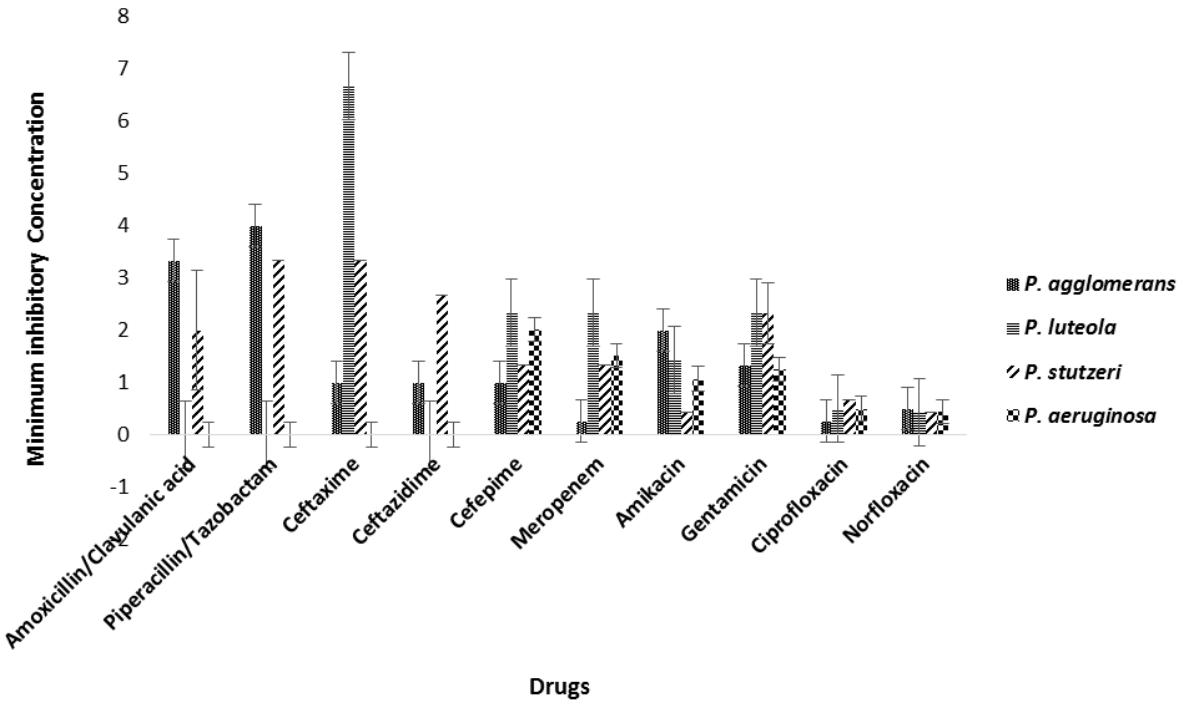

Figure 3. MIC of the Gram negative isolates against tested antibiotics.

Similar findings had been reported by Nworie et al. (2012), who isolated the same listed pathogens from door handles/knobs in public conveniences and commented that they pose as potential health hazards to an ever growing population. The results from the present investigation shows that this public health threat still exists in our work places. The source from which nosocomial infections originate in the work places might not be ascertained except when there is probably a disease outbreak and recorded reports tracing such to the origin of the infections. The high level of multi-antibiotic resistance exhibited by *S. aureus* and *S. epidermidis* (Table 1), highlights the possibility of their being potential etiological agents in pyrogenic infections. *S. aureus*, and coagulase negative Staphylococci have been implicated in a variety of infections, from superficial to deep wound and septicemia (Komolade and Adegoke, 2008).

Other potential pathogenic isolates encountered in the present investigation included *P. agglomerans* (formerly known as *Enterobacter agglomerans*), *P. stutzeri* and *P. luteola.*

P. agglomerans, an environmental organism has been associated with outbreaks of infection in ICU (Maria et al., 2009) as well as being identified as a potential candidate in powdered infant milk formula-borne opportunistic pathogen in Neonatal ICU by Jalal et al. (2013). This therefore suggests that the encountering of this organism in the present study and at a high percentage of 72%, indicates the possibility of it becoming an opportunistic pathogen. Earlier reports by Andrea et al. (2007) linked *P. agglomerans* to being a plant pathogen causing diseases in humans. Whether or not the organism has been linked with disease in a work environment is not clear as Andrea et al. (2007) were of the view that spontaneously occurring bacteremia by this organism has rarely been reported.

P. stutzeri was also one of the isolates encountered in the present investigation. This organism reported by Lalucat et al. (2006) to be a saprophyte has been linked to infections in immunocompromised patients with underlying diseases or those with pervious surgery by Noble and Overman (1994). Also, Naiel et al. (2012), reported *P. stutzeri* to be the cause of bacteremia in 18 patients in a hospital setting, 10 of whom died with two of the deaths attributed to the infection. In the present investigation, all (100%) of *P. stutzeri* isolates were resistant to the Penicillins, nitrofurantoin and fosfomycin, but highly susceptible to the cephalosporins, sulfonamides, aminoglycosides and the quinolones. This susceptibility pattern is similar to those of Naiel et al. (2012) who reported the organism to be invariably susceptible to aminoglycosides, Quinolones and Carbapenems. However, contrary to the present findings they reported *P. stutzeri* to be sensitive to the Penicillins and this could be either attributed to geographical differences in isolates or the emergence of new strains as well as where they had been isolated from.

Another Gram negative bacteria encountered in the present study was *Pseudomonas luteola*. Reports by Benoit et al. (2010) indicate this organism to be an

unusual pathogen implicated in rare but serious infections in humans. The *P. luteola* isolates in the present study showed this organism to be resistant to the penicillins and fosfomycin. However, of great concern is the isolation of multidrug resistant *P. aeruginosa* and *K. pneumoniae*, in the present investigation. Results presented in Figure 3, shows 100% *P. aeruginosa* isolates to be resistant to the Penicillins, Cephalosporins, Nitrofurantoin, Sulfamides and Fosfomycin while *K. pneumoniae* was resistant to the Penicillins, Aminoglycosides, Quinolones, Nitrofurantoin and Fosfomycin thus suggesting the presence of multi-antibiotic resistance potential nosocomial pathogens in the work environment under consideration. Similar findings had been reported by researchers such as Rusin et al. (2002), Kennedy et al. (2005) and Nworie et al. (2012). Nworie et al. (2012), were of the view that such isolates portends a good health hazard to an ever growing populace.

Conclusion

The results from the present findings shows that microbial contamination in our work places could serve as sources of pathogenic community acquired infections. It would however be important to trace work place infections to their origins.

Conflict of interests

The authors did not declare any conflict of interest.

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