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Nosocomial infections are still a major concern in peri-urban polyclinics in Ghana

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The study assessed potential sources of nosocomial infections as well as the knowledge of healthcare workers about these infections in a peri-urban polyclinic of Ghana. Swabs were taken in duplicates from beds in the wards, door knobs, sinks, nurses' desks, taps handles, delivery beds, wound dressing rooms, and door and flashing handles of lavatories. After overnight incubation, the samples were serially diluted two times and the third diluent was used in culturing unto plate counting agar, MacConkey agar, blood agar and incubated at 35±2°C for 24 h. The plates were read for colonies and isolated colonies were identified. A simple random method was used to sample the respondents from the various departments in the Polyclinic. Structured questionnaires were administered to solicit their knowledge or understanding of possible causes of nosocomial infections and their perception of the efficacy of the cleaning processes employed in the facility as well as measures put in place to protect healthcare workers from these infections. Data collected showed that *Bacillus spp.* was the predominant bacterium isolated contributing 64.3% of the total isolate. Out of the 24 pathogenic organisms forming 35.7% of the total organisms isolated, *Staphylococcus aureus* (94.8%) formed the majority and *Pseudomonas aeruginosa* (5.2%) was the least isolated. There was no significant difference between the number of isolates recorded before cleaning and after cleaning (P > 0.05) with almost the same number and type of organisms isolated in both cases. Apart from the orderlies who demonstrated little knowledge on nosocomial infections, all the other healthcare workers exhibited adequate knowledge of nosocomial infections. The seemingly high percentage of pathogenic isolates from our study site indicates a high potential risk of nosocomial infections in peri-urban polyclinics.

Key words: Fomites, infections, *Staphylococcus aureus*, *Bacillus spp., Pseudomonas aeruginosa.*

INTRODUCTION

The spread of nosocomial infections serves as a major source of worry for managers in healthcare practice, particularly in developing countries where the health care system is already overstretched (Bello et al., 2011).

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Although the infection is most prevalent among patients on admission, healthcare workers also tend to act as potential routes for these pathogenic agents. Hospitals provide a favorable transmission pathway for the spread of nosocomial infections, owing partly to poor infection control practices among health workers on one hand and overcrowding of patients in most clinical settings on the other (Samuel et al., 2010). Today, most infections acquired in the hospitals are caused by microorganisms which are common in the general population (*Staphylococcus aureus*, *coagulase negative Staphylococci, Enterococci, Enterobacteriaceae*), in which they cause no or milder disease than among hospital patients (Brooks et al., 2007).

In Ghana, however, a similar study by Tagoe et al. (2011) isolated a high percentage of *S. aureus* and *E. coli* as well as *Bacillus spp*. on fomites at the Volta Regional Hospital which indicated a high potential risk of nosocomial infections in that hospital. The case in peri-urban facilities could be worse due the number of patients visiting such facilities (Tagoe et al., 2011). The study therefore sought to investigate potential sources and knowledge of the nosocomial infections in the Ashaiman Polyclinic, a peri-urban hospital in Ghana.

MATERIALS AND METHODS

This study was undertaken at the Ashaiman Polyclinic, a peri-urban health facility in the Ashaiman Municipality of the Greater Accra Region, Ghana. The Polyclinic provides healthcare services to the people of Ashaiman and surrounding communities. The Polyclinic is also situated near the main transport terminal and a market that serves most of the communities around its environs. The study was undertaken between January, 2015 and May, 2015. Samples were taken from the hospital and bacteriological analysis undertaken in the Microbiology Laboratory of the University of Cape Coast.

Sampling

The experimentation technique was used to isolate organisms from fomites of which taps, nurse's desks, door handles, (from wards and lavatories), various theatres, as well as handles of taps, sinks and lavatories of the female ward, labour ward, Out-Patients Department (OPD), laboratory, Lying-in-Ward (Recovery ward) and the circumcision room. These sites were selected based on their contact frequency with both patients and healthcare practitioners. Swabs were taken in duplicates at different times and in two sections from each sampling site of the hospital (just before routine general cleaning and just after cleaning). This was done to evaluate the effectiveness of cleaning as compared to that of the cleaning agents being used. The sterile swabs were put in an ice-pack and transported to the University of Cape Coast for further investigation.

Isolation of organisms

Standard isolation techniques were employed in isolation of organisms. Swabs were immediately transported to the laboratory and incubated in peptone water overnight at 35 ± 2°C to encourage growth as described elsewhere (Tagoe et al., 2011). The samples were serially diluted three times against a McFarland standard and the third diluent was inoculated unto Plate Counting Agar, MacConkey agar and blood agar after incubating overnight. It was then incubated at 35 ± 2°C for 24 h. The plates were observed for colony growth and isolated colonies were identified.

Identification of organisms

Pure isolated colonies were Gram differentiated and then biochemically identified using indole, catalase, citrate, oxidase, Coagulase, and urease tests (Brooks, 2007).

Assessment of health personnel knowledge on nosocomial infection

In the assessment of knowledge of nosocomial infections, 42 health workers in the Polyclinic were randomly recruited. This comprised 30 nurses (of which 5 were ward heads), 5 orderlies or health aids, 5 laboratory workers and 2 physicians. They were each presented with a questionnaire after they consented, to test their knowledge or awareness of possible sources of nosocomial infections in the hospital, the aseptic techniques they employed in their work as well as their impressions and perceptions on the policies put in place to protect them and their patients against nosocomial infection. Responses were categorized as "Good", "Little" and "No knowledge".

Data analysis

The data obtained was analyzed with Microsoft Excel, (2010 version) and presented as graphs showing the relationships between subjects and their frequencies. The MINITAP software version 13 was also used to find the significant difference between the values and the organisms isolated on the various surfaces.

RESULTS

Figure 1 shows bacterial counts at the various sites at the OPD before and after cleaning. The mean bacterial counts were reduced after cleaning of the swab site. Figure 2 illustrates bacterial count at the various sites at the Laboratory before and after cleaning. As shown, the mean bacteria were reduced after cleaning of the swab sites except at the door knob where the mean bacterial count increased after cleaning the swab sites in the laboratory. Figure 3 indicates bacterial counts at the various sites of the labour ward before and after cleaning. As shown, the mean bacterial counts were increased after cleaning of the swab sites in the labour ward. Figure 4 shows bacterial counts at the various sites of the female ward before and after cleaning. As shown, the mean bacterial counts were reduced after cleaning of the swab sites in the female ward. Figure 5 indicates Bacterial counts at the various sites of the Recovery ward before and after cleaning. The mean bacterial count at the various sites of the recovery ward were reduced after cleaning except for the beds where the mean bacterial counts were increased after cleaning in the recovery ward. Figure 6 shows bacterial counts at the various sites of the circumcision room before and after cleaning. The

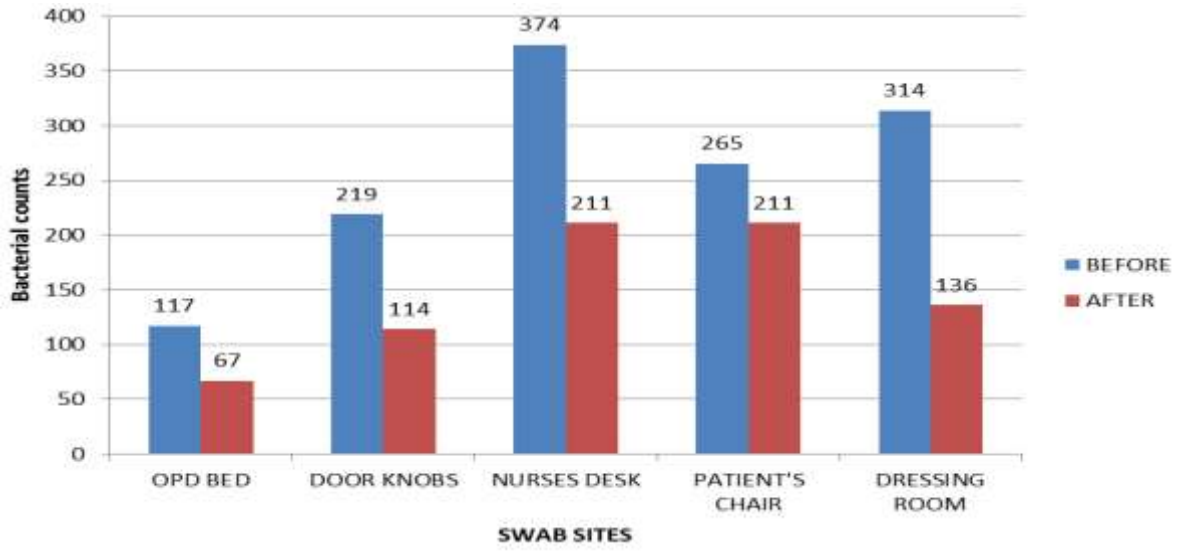

Figure 1. Enumeration of organisms before and after cleaning of the OPD**.**

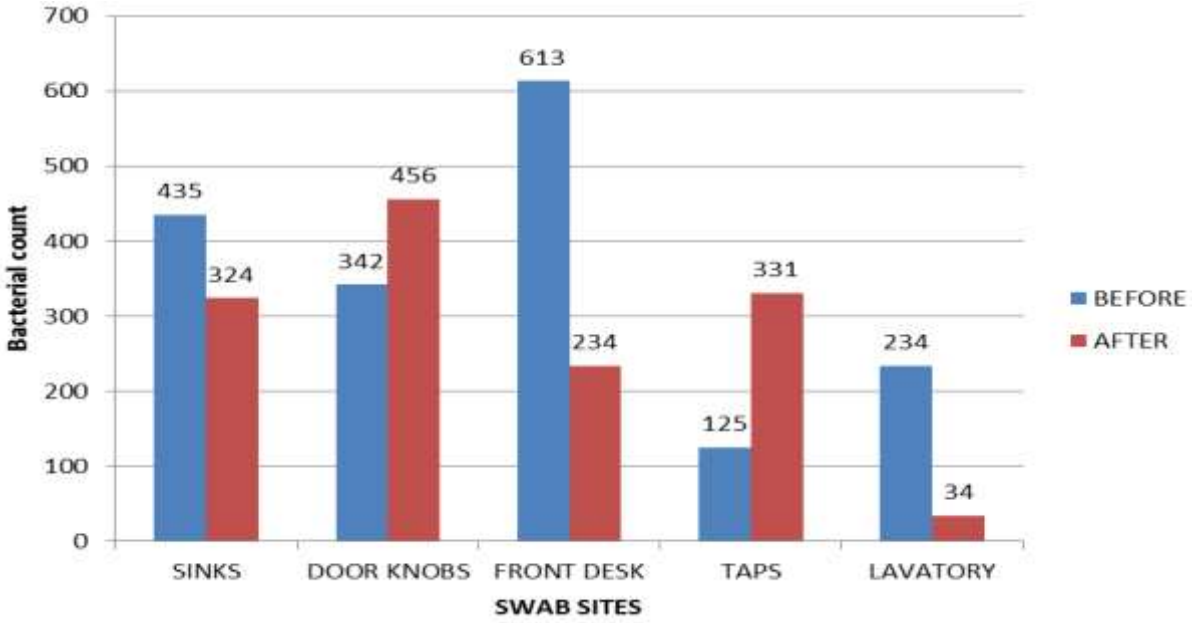

Figure 2. Enumeration of organisms at the various surfaces of the laboratory before and after cleaning

mean bacterial count was almost the same in the various swab sites after cleaning. Figure 7 shows the distribution of pathogenic and non-pathogenic bacteria at the various wards before cleaning. No pathogenic bacteria were recorded in the Out patients' department (OPD) and the laboratory before cleaning. The female and recovery ward recorded equal frequency of pathogenic organisms (*S. aureus*). The labour ward recorded the highest rate of pathogenic infection (*S. aureus* and *P. aeruginosa*). Figure 8 shows the frequency of distribution of isolates in the various wards before and after cleaning of the various swab sites. The frequency of the organisms isolated with the predominant isolate *Bacillus spp.* non-pathogenic (64.3%) and *S. aureus* pathogenic (33.7%) and *P. aeruginosa* (2%) with a significant equal frequency of distribution before and after cleaning. The predominant bacteria in the OPD and laboratory before and after cleaning was *Bacillus* whereas the wards recorded high amount of *S. aureus* before and after cleaning. Figure 9 illustrates the rating of health care workers on the

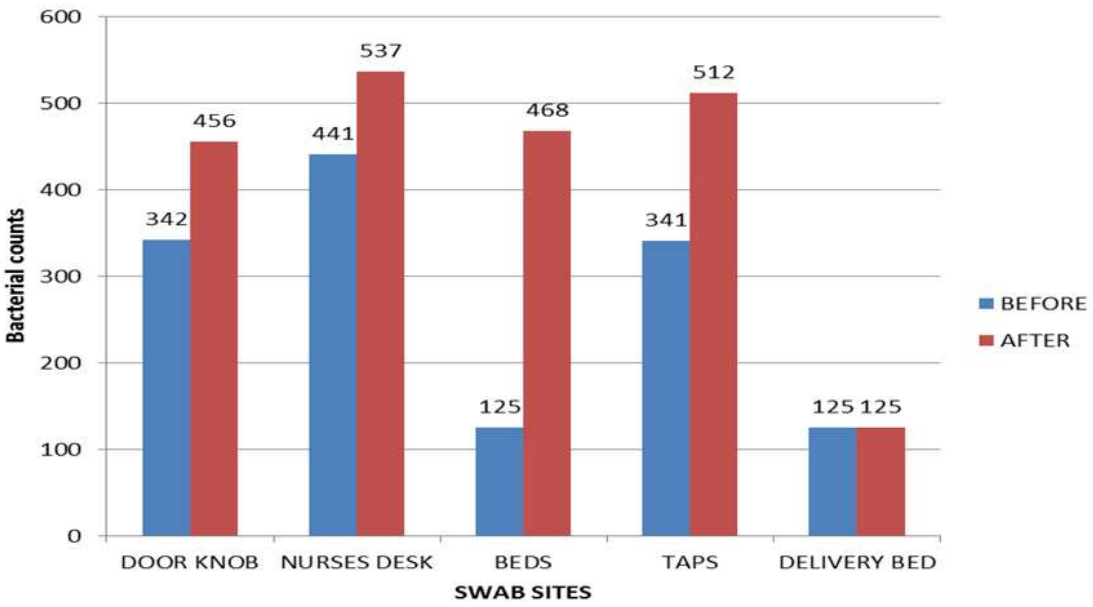

Figure 3. Enumeration of bacteria in the various surfaces of the labour ward before and after cleaning.

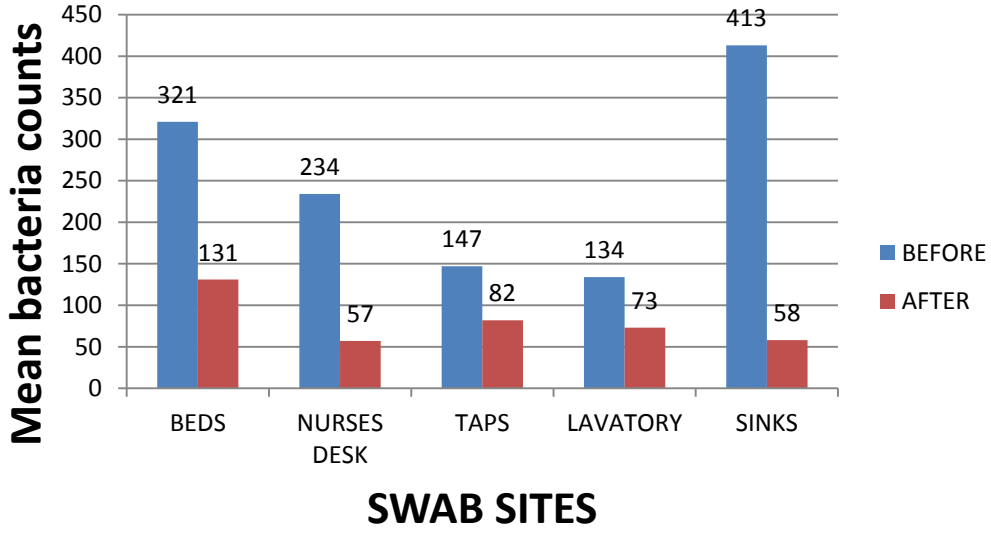

Figure 4. The mean bacterial counts on the surfaces of the female ward before and after cleaning.

knowledge of nosocomial infections. The nurses, laboratory workers, ward heads and physicians had a good knowledge on nosocomial infections whereas the orderlies had no knowledge whatsoever of nosocomial infections.

Figure 10 shows the percentage rating of health workers who have ever acquired nosocomial infection either by suspicion or confirmation by a physician. A greater percentage of the nurses, laboratory workers and orderlies admitted ever acquiring nosocomial infection based on suspicion recording 45, 36 and 30%, respectively whereas a 35, 26 and 30% of the nurses, laboratory workers and orderlies, respectively were confirmed by a physician. None of the doctors reported with nosocomial infection.

Figure 11 shows the rating of the effectiveness of the cleaning sessions by the health workers Majority of the respondents rated the cleaning as either good (40%) or poor (50%). However, 10% of the respondents rated the cleaning as excellent whereas (5%) rated the cleaning as

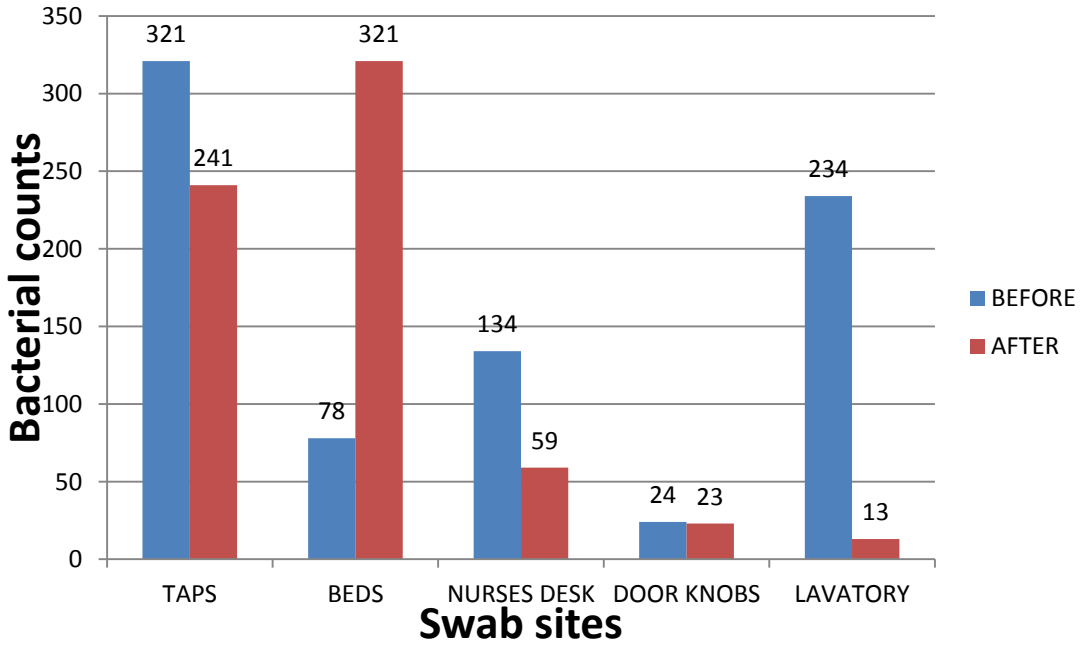

Figure 5. The enumeration of bacteria in the surfaces of the recovery ward before and after cleaning

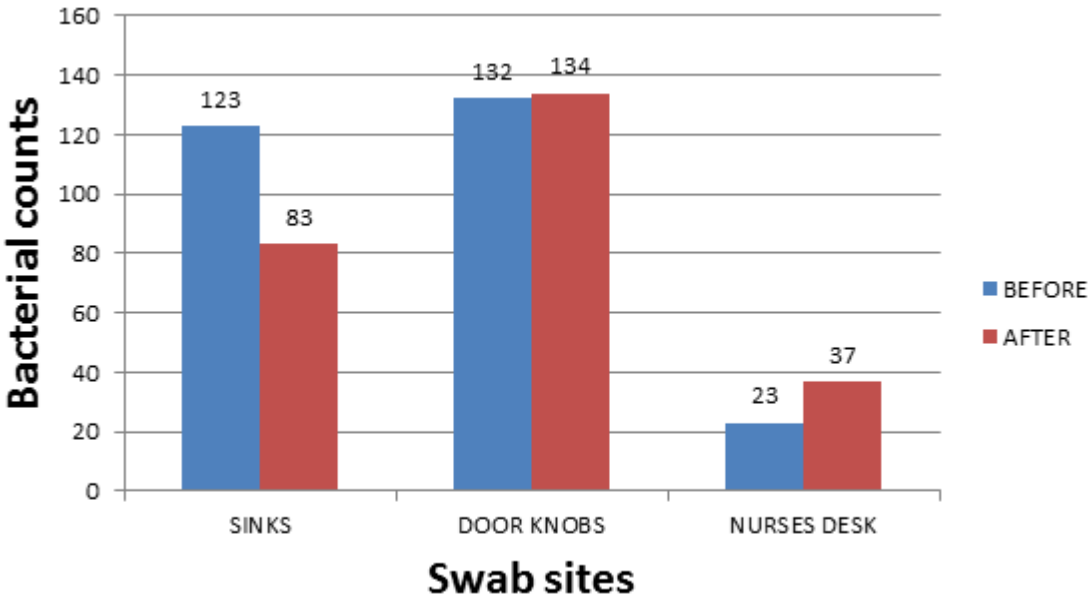

Figure 6. The enumeration of bacteria on the surfaces of the circumcision room before and after cleaning.

very poor. The laboratory workers and the nurses were very much displeased with the cleaning regimes with 60% and 55% rating the cleaning as poor, respectively.

Figure 12 shows the percentage ratings of perception of health workers on protection of nosocomial infection. A majority of the workers forming 60% of nurses, 55% orderlies, 40% of the ward heads do not believe the facility protects them from nosocomial infection.

DISCUSSION

The burden of nosocomial infections in public healthcare facilities cannot be overemphasized (Tagoe et al., 2011), particularly in developing countries. The study therefore

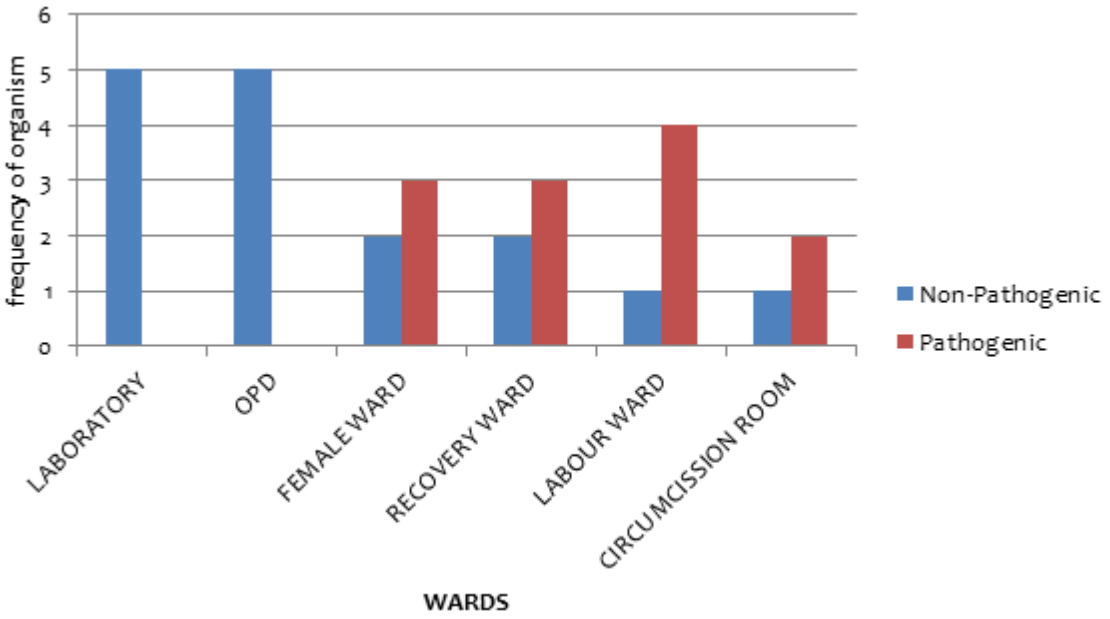

Figure 7. Distribution of pathogenic and non-pathogenic bacteria across the various compartments in the polyclinic

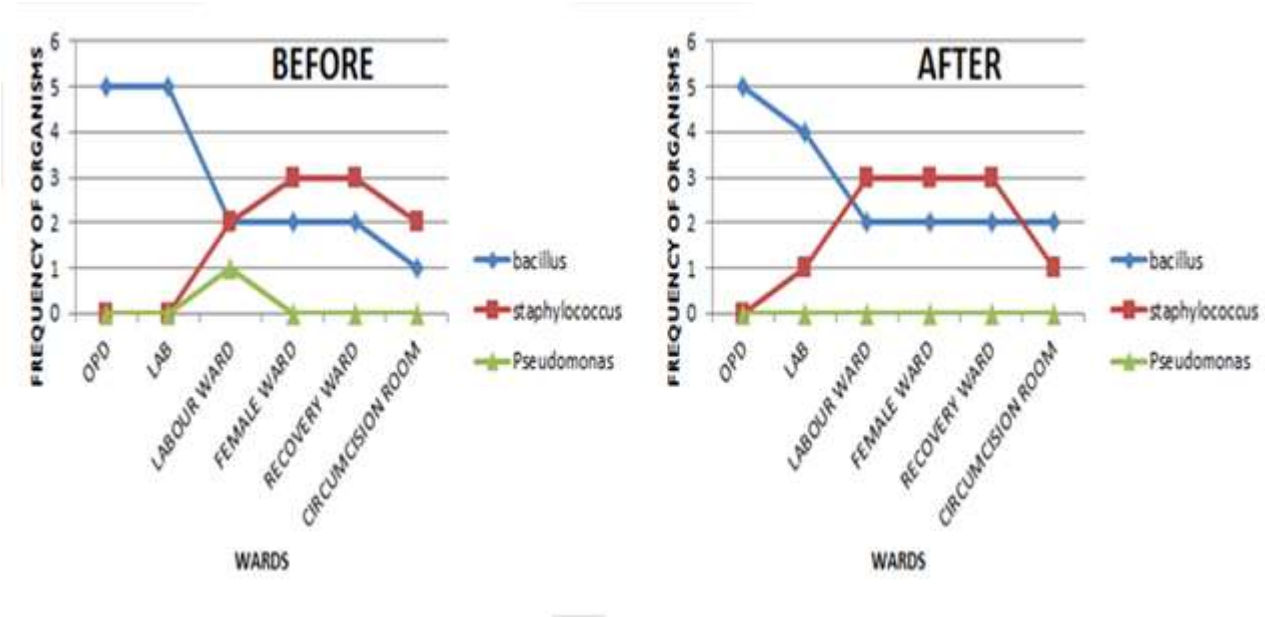

Figure 8. Distribution of isolates in the various wards before and after cleaning.

sought to assess potential sources of nosocomial infections as well as the knowledge of healthcare workers about these infections in a peri-urban polyclinic of Ghana. Results from the study showed that there was a significant growth of bacteria on all the surfaces swabbed (98%). In spite of the fact that majority of the isolated organisms were non-pathogenic (64.3%), it is noteworthy that 35.7% of the pathogenic isolates are of clinical importance and cannot be ignored. In relation to our findings, Ricks et al. (2007) isolated pathogenic bacteria from a hospital ward at a lower percentage of 15%, and this risk had a 10% chance of causing a nosocomial infection (Samuel et al., 2010). Similarly, in this study, the labour ward recorded the highest rate of pathogenic

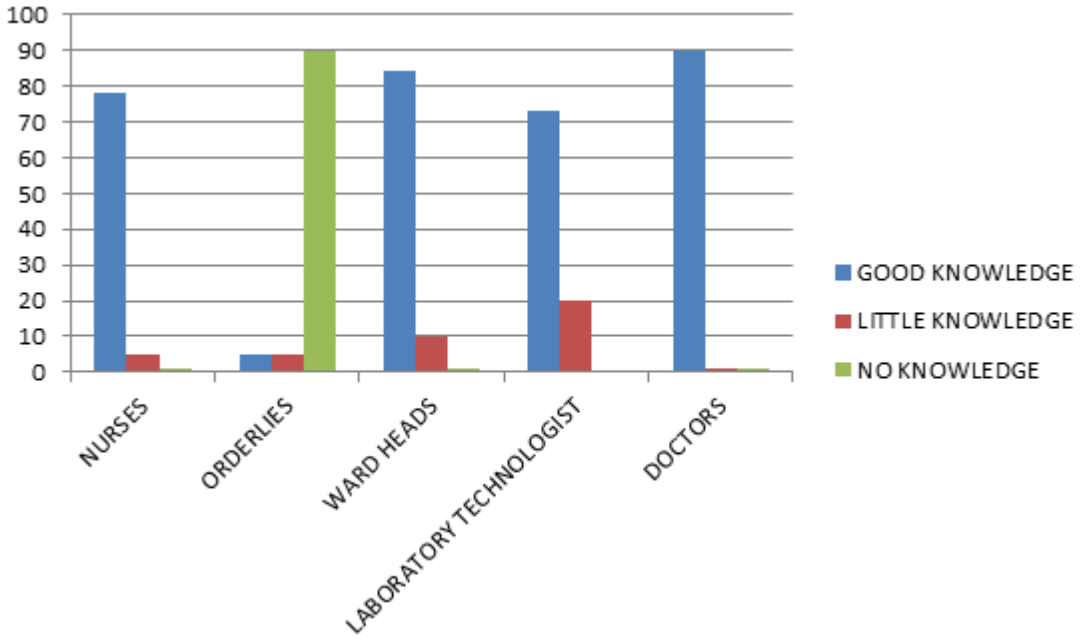

Figure 9. Assessment of the knowledge of health workers on the potential sources of nosocomial infections.

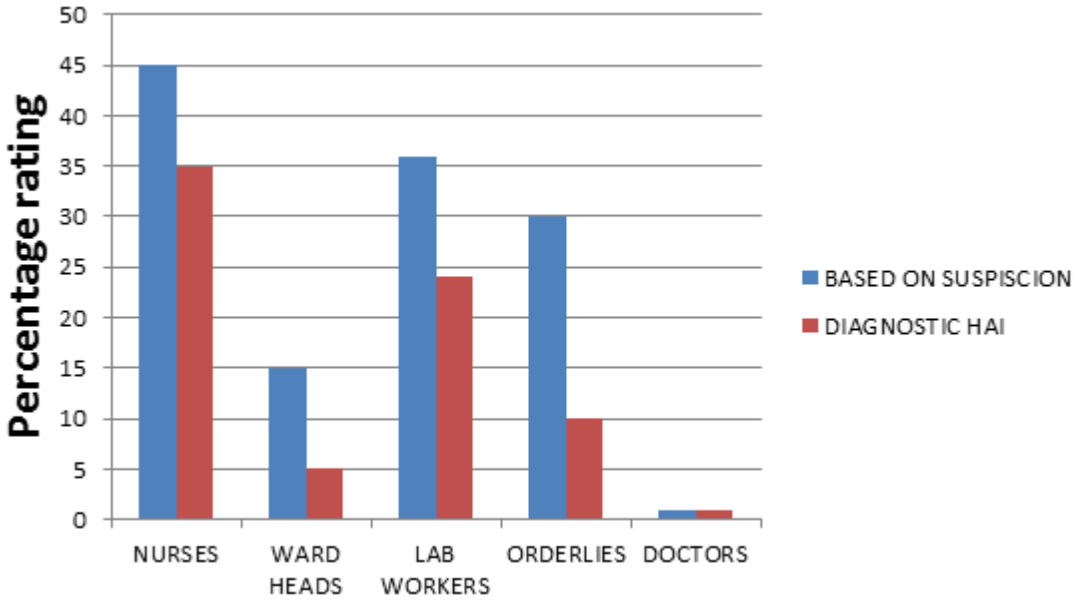

Figure 10. Percentage of workers who have ever acquired a nosocomial infection.

microbes (*S. aureus* and *P. aeruginosa*) before cleaning. This study also discovered that nurses, laboratory workers, ward in-charge's and physicians had a good knowledge about nosocomial infections whereas the orderlies had no knowledge whatsoever of nosocomial infections. Even though about 50% of the respondents rated the effectives of the detergents as good or excellent, there were meaningful bacterial growth at the various swab sites even after cleaning similar to other reports (Alabi and Sanusi, 2012). Interestingly, none of the surfaces recorded "no bacterial growth" before and after cleaning.

The overall distribution of isolates in the various wards before and after cleaning of the various swab sites

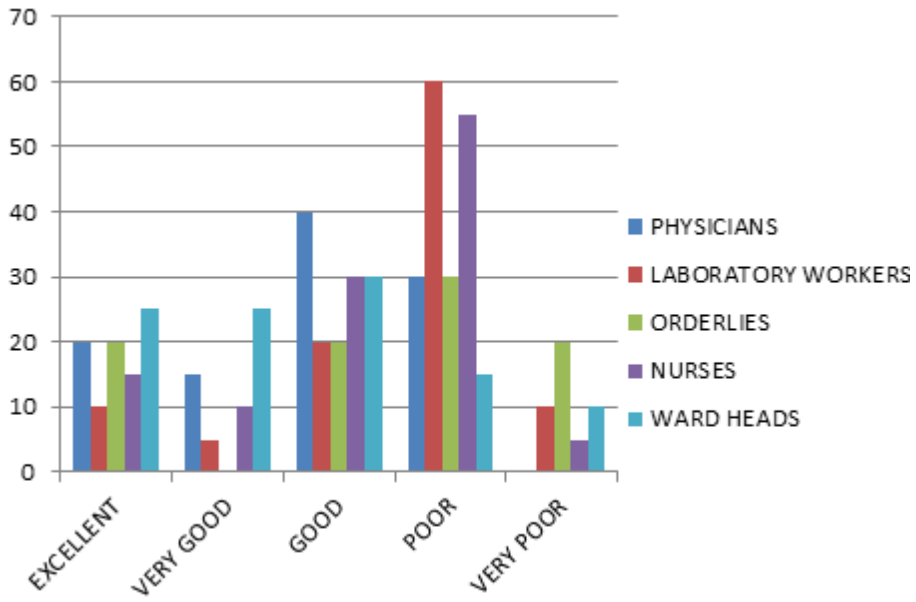

Figure 11. Percentage ratings by various health care workers on the effectiveness of the cleaning in the facility.

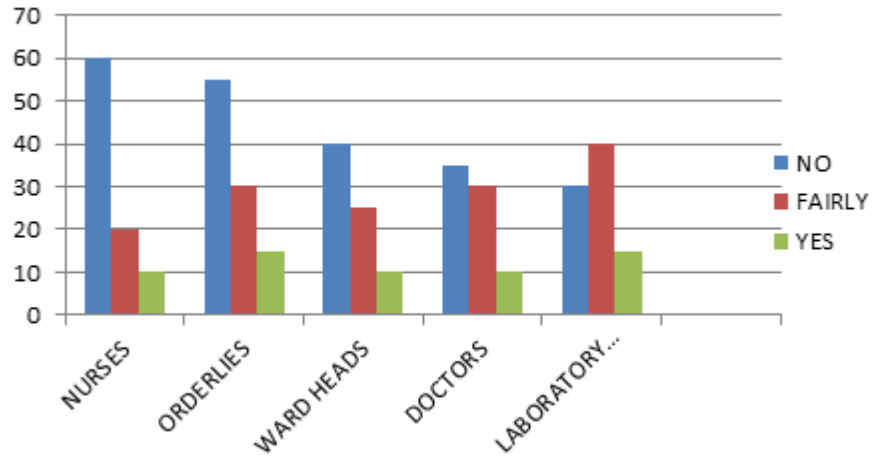

Figure 12. Percentage rating of perception of health care workers on protection from nosocomial infections.

indicated *Bacillus spp.* as the predominant non-pathogenic organism colonizing the sampled surfaces. The colonization of most of the surfaces ditto could be attributed to the fact that *Bacillus spp.* an aerobic, spore-forming gram positive rod bacteria is ubiquitous in nature with their spores able to withstand environmental changes, dry heat and certain chemical disinfectants for moderate periods (Brooks et al., 2007). The high colonization of *Bacillus spp.* is therefore justified especially before cleaning in our study site which is also situated by the main transport terminal and market.

Studies have shown that most hospitals in developing countries have no effective infection control programme due to lack of awareness of the problem, lack of personnel, poor water supply, erratic electricity supply, ineffective antibiotic policies with emergence of multiple antibiotic resistant microbes, poor laboratory backup, poor funding and non-adherence to safe practices by health workers (Samuel et al., 2010; Ismail, 2015). This study however discovered that after cleaning, the number of colonies counted were almost the same as the colonies before cleaning, supporting other findings (Alabi

and Sanusi, 2012). This raises lots of concerns especially when the efficacy of the cleaning processes is compromised by healthcare workers reconstituting detergents before usage.

The fomites at the OPD and the laboratory recorded the highest number of *Bacillus spp.* at the various swab sites recording 62.5% of the *Bacillus spp*. and this is comparable to another study (Weinstein and Hota, 2004) which reported that taps usually have the most pathogenic isolates but the least total bacterial colonization. In a similar study in an urban hospital in Ghana, Tagoe et al. (2011) reported that the predominant isolates in the laboratory was *Bacillus spp*. except for the lavatory. Their finding associated the laboratory's periodic disinfection of the working benches and tables as part of daily quality control measures even after cleaning as a contributing factor to the colonization of these surfaces. Interestingly the present data also reports a similar finding in our setting. The predominant pathogenic organism isolated were *S. aureus* (94.8%) and *P. aeroginosa* (5.2%). This finding is confirmed by Ducel *et al (*2002) who grouped *E. coli,* and *S. aureus* among the predominant organisms that are isolated in the hospitals and among the leading causes of nosocomial *infection*. We report that across the wards, the predominant isolate was *S. aureus* recording 40%, *P. aeroginosa* 10% and *Bacillus spp.* 50%. The labour ward recorded 60% of *S. aureus on* the door knobs and beds and 5.55% of *P. aeroginosa* on the delivery bed. Findings from our study reveal that the labour ward in comparison to other areas posed the highest risk of nosocomial infection. This situation is quite alarming since the labour ward supports women in child delivery and even expectant mothers are housed for some time prior to delivery; so *S. aureus* colonizing the surfaces of beds and door knobs could be detrimental to the health of the mother, baby and healthcare workers as well.

The recovery ward recorded *S. aureus* as the predominant and only pathogenic bacteria. These isolates were found on the taps, nurse desks and the lavatories comparable to the sites swabbed in the female ward. In 2004, Hota found out that taps usually have the most pathogenic isolates but the least total bacterial colonization. This is because the handles of the taps come into contact with detergents most often hence the sites are being washed. These sites are likely to contain bacteria that are resistant to the detergent or one that was left before the swabbing was done. Knowledge on nosocomial infections by the professionally trained health care workers (nurses, doctors, ward managers and biomedical scientist) in our study was generally high as reported in a similar study (Parmeggiani et al., 2010). As expected, it was also observed that orderlies who are least trained amongst the array of health care workers, demonstrated little or no knowledge of nosocomial infections and this situation is worrying especially since they are chiefly involved in routine cleaning processes.

There is evidence that contaminated surfaces contribute to the spread of nosocomial infections (Otter et al., 2013). Similarly, in our study, the efficacy of cleaning regimes in the polyclinic were deemed to be poor as about half of our respondents rated the effectiveness of the cleaning as poor, showing their dissatisfaction with the cleaning regimes in the polyclinic. The nurses and the laboratory workers were particularly most dissatisfied (55 and 60%, respectively) amongst our study participants. Interestingly, similar observations were also made in the respondent's perception of whether they were protected against nosocomial infections. Again, about half of the participants reported they believe they have little or no protection against nosocomial infections from this study.

Conclusion

This study shows clearly that the main non-pathogenic organism present on fomites at the polyclinic is *Bacillus spp.* whereas the main pathogenic organism present were *S. aureus* and *P. aeruginosa* with *S. aureus* forming majority of the pathogenic bacteria isolated. The cleaning sessions at the polyclinic had no meaningful difference in the number of bacteria isolated before and after cleaning was done. Apart from the orderlies who demonstrated little knowledge on nosocomial infections, all the other healthcare workers exhibited adequate knowledge of nosocomial infections. In this wise, it is recommended that orderlies be given special and adequate training especially on nosocomial infections so as to keep them well informed and educated on issues concerning hospital acquired infections for the benefits of the patients, facility and the workers as a whole.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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