Vol. 3(1), pp. 164-168, June 2021
Article Number: 5177D3F69072
ISSN: 2805-4202

http://www.academicjournals.org/AJHST

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African Journal of Health Sciences and Technology

Full Length Research Paper

The Contribution of X-Ray Equipment Control Panel Design Type to the Control of Nosocomial Infection: Soft Touch Button versus Knob Design

Sobechukwu W.I. Onwuzu; Julius A. Agbo; Uloma B. Nwogu; Israel C. Onoh; Ikechukwu G. Onu, Ifunanya S. Onwuzu

Department of Medical Radiography and Radiological Sciences, University of Nigeria Enugu Campus, Nigeria

Received 12 March, 2021; Accepted 26 April, 2021

The control panel of x-ray equipment is exposed to contamination from the radiographer during routine use, hence the need for constant disinfection. Older x-ray equipment designs have a control knob design (CKD), while newer designs have soft touch buttons or touch screens (STB). The aim of this study is to evaluate the rate at which nosocomial infection accumulates in each control panel design type by taking swab samples during routine working hours of the control panel and tube handle of CDK and STB type of equipment. This may be helpful in determining which design type is prone to nosocomial infection transmission. A prospective and experimental study of two different hospitals with similar workflow but with the two different equipment design types that were conveniently. Before the commencement of radiographic examinations for the day, the control panel and x-ray knob were disinfected, and the first swab was taken. After a patient was attended to, the second swab was taken, and the equipment disinfected. The procedure was repeated for a total of 15 patients, making a total of 30 swabs. Data obtained were analysed using descriptive and Fisher's exact test at $\alpha = 0.05$. Sixty swab samples were taking in total out of which 63.3% ($n = 38$) showed significant bacterial growth. Staphylococcus aureus was the commonest bacteria isolated. With progressive use, STB equipment accumulated bacterial infection at a significantly higher rate than CKD equipment. The STB equipment is prone to accumulating infection at a higher rate when compared to the CKD. This may be due to the larger surface area of the FPD. Though adequate disinfection procedures need to be observed when using both STB and CKD type of control panel and tube handle types, the radiographer should increase disinfection procedures for STB type of equipment.

Keywords: Nosocomial infection, equipment design, Staphylococcus aureus, disinfection, radiography

*Corresponding author. E-mail: julius.agbo@unn.edu.ng

INTRODUCTION

Nosocomial infections account for about 10% of freshly reported infections (Afolabi et al., 2011), and there is a constant effort in the hospital to prevent the spread of nosocomial infection with the radiography department not left out (Ochie and Ohagwu, 2009; Eze, 2013; Suleiman Dauda et al., 2015). Materials that can easily be infected include the x-ray cassettes, markers, control panels, buttons, couch, and control knobs (Tugwell and Maddison, 2011), and the accumulation of bacterial and other infective organisms on these surfaces increases steadily with use, despite standard disinfection procedures (Onwuzu et al., 2018). Several factors that determine the rate at which this infection occurs include the admission state of patients being attended to (in-patient or outpatient), the type of radiographic examination, the work pattern of the radiographer vis-a-vis attention to aseptic procedures, disinfection, and equipment handling. Studies have established that the control panel and control buttons of x-ray equipment are major sources of nosocomial infection since they are the most handled part of the equipment (Ochie and Ohagwu, 2009), and several strains of bacteria have been isolated following laboratory culture, the commonest of which include Staphylococcus aureus, Klebsiella spp, and Escherichia coli (Totsika et al., 2012).

In a study by Ochie and Ohagwu (2009) on the common bacterial isolates that can be found in radiography equipment, they observed that Klebsiella spp was the commonest isolated bacteria, and it was found mainly in the x-ray cassette. Disinfection of the surfaces is often carried out by wiping the surfaces with hospital disinfectants. However, a factor that may determine how efficient this method will be is the design type: whether it is of a control knob design (CKD) or soft-touch button (STB) design. It is expected that disinfection would be less effective if the control panel had several crevices that would not be appropriately cleaned. In this study, the x-ray equipment is broadly divided into two types: the CKD (Figure 1) soft touch button design (FPD) (Figure 2).The aim of this study is to determine contribution of the equipment design type on the rate at which nosocomial infection accumulates in the x-ray tube handle and the control console.

METHODS

This is a prospective and experimental study. Two different hospitals with similar workflow but with the two different equipment design types were conveniently selected for the study, and consent was obtained from the management of both hospitals. Before the commencement of radiographic examinations for the day, the control panel and x-ray knob were disinfected using standard departmental procedures, and the first swab was taken. After a patient was attended to, the second swab was taken, and the equipment disinfected. The procedure was repeated for a total of 15 patients, making a total of 30 swabs. The swab samples were labelled appropriately and taken to a microbiology laboratory for culturing according to previously described procedures (Onwuzu et al., 2018). After 24 hours of incubation, the culture plates were examined macroscopically under a bright light to identify the isolated microorganisms based on their colonial characteristics. Data were analysed using Statistical Package for Social Science (SPSS) version 24 and Microsoft Excel 2016, descriptive and inferential statistics were used for data presentation, while Fisher's exact test was used to compare the difference in the rate of accumulation of nosocomial infection between the two equipment types, using 0.05 as the value for the level of significance.

RESULTS

A total of sixty swab samples were taken from both centres. 63.3% of the swab samples ($n = 38$) demonstrated bacterial growth, with the STB equipment contributing more than half of the bacterial growths recorded (Table 1). The bacteria strains identified include Staphylococcus aureus, Klebsiella spp, and Escherichia coli (Table 2).

The contribution of equipment design to the overall significant bacterial infection was analysed using Fisher's exact test, which did not demonstrate any significant difference between the two equipment designs ($p = 1.00$). However, a time series graph on the rate of increase of nosocomial infection as shown in Figure 3 and Figure 4 reveals that despite disinfection procedures, the STB accumulated infection at a higher rate than the CPD equipment design type.

DISCUSSION

From the findings of our study, it was revealed that more than half of the swab samples taken demonstrated bacterial growth, with staphylococcus aureus being the commonest bacterial strain isolated from both parts of the equipment. Of all the samples taken, 26.7% ($n = 16$) recorded significant growth from the CKD while 36.6% ($n = 22$) of the swabs recorded growths from the STB equipment design type. Hence, the STB had more swabs with bacterial growths than the CKD. Previous studies on nosocomial infections in x-ray equipment only reported the percentage of swab samples that recorded bacterial growth. Getu (2018) took 178 swab samples from various parts of an x-ray equipment at the radiology department in Ethiopia and

(a) (b)

Figure 1: Control knob x-ray equipment design control panel (a) and tube handle (b)

(a) (b)

Figure 2: Flat button x-ray equipment design control panel (a) and tube handle (b)

Table 1: Bacterial growth of swab samples from the two equipment

Equipment type	Bacterial growth	Equipment part					
		Tube handle		Control panel		Total	
Knob design	None	9	15.0%	5	8.3%	14	23.3%
	Significant	6	10.0%	10	16.7%	16	26.7%
Flat panel	None	6	10.0%	2	3.3%	8	13.3%
	Significant	9	15.0%	13	21.7%	22	36.7%
Total	None	15	25.0%	7	11.7%	22	36.7%
	Significant	15	25.0%	23	38.3%	38	63.3%

Table 2: Significant Bacteria strains isolated from various parts of the equipment

	Control knob	Flat panel	Total
Control panel			
No. of Significant Samples	n = 3	n = 4	n = 7
Staphylococcus	3 (100.0%)	2 (50.0%)	5 (71.4%)
Staphylococcus & Klebsiella spp	-	2 (50.0%)	2 (28.6%)
Tube handle			
No. of Significant Samples	n = 7	n = 10	n = 17
Staphylococcus	5 (71.4%)	3 (30.0%)	8 (47.1%)
Staphylococcus & Klebsiella	2 (28.6%)	5 (50.0%)	7 (41.2%)
Staphylococcus, Klebsiella & E. coli	0 (0.0%)	2 (20.0%)	2 (11.7%)

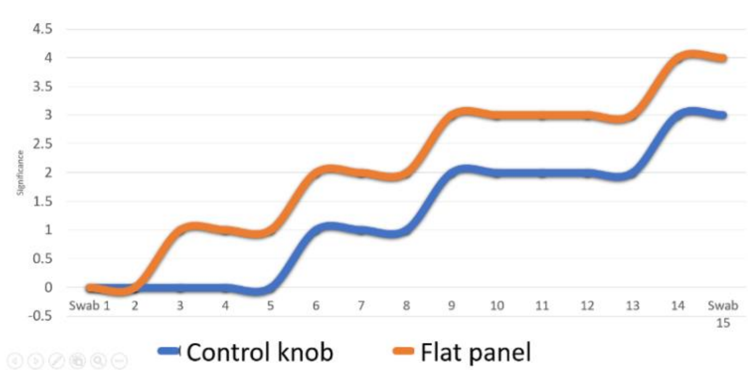

Figure 3: Graph of nosocomial infection accumulation in tube handle

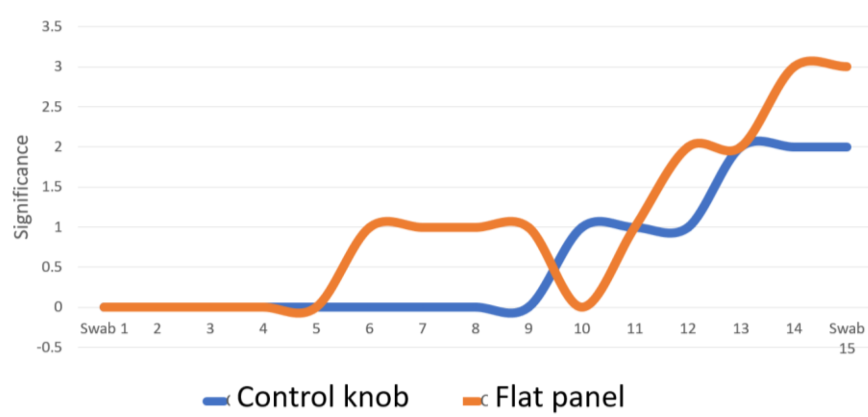

Figure 4: Graph of nosocomial infection accumulation in control panel

noted that 84.8% of the swabs yielded significant bacterial growth, 41.6% of which was Staphylococcus aureus.

Giacometti et al (2014) took samples from the control panel and imaging plates of various x-ray units and noted infection rate much above recommended standards in 91.7% of the units. Eze (2013) in his study investigated whether x-ray equipment and accessories harboured nosocomial pathogens and noted that out of 200 samples taken, bacteria isolates were seen in 182 samples (86%) with Staphylococcus aureus being the commonest. Even though these studies recorded higher percentage of swab samples when compared to ours, they were only taken instantaneously with no interlude for disinfection. Hence it is expected that fewer swab samples from our study will record bacterial growth, but that was not the case as progressive rise in infection was observed. Findings from the time series graph indicated that the FPD equipment accumulated infection at a faster rate when compared to the CKD type. Interestingly, no nosocomial infection was noted till between 2 and 5 patients were attended to. For the tube handle of the FPD, the bacterial infection began to rise after the first patient was attended to, while for the CKD, the bacterial infection began to be noticeable from the 5th patient. There were plateaus in the graph, which probably indicated the periods of disinfection before the swab was taken and another patient attended to. A similar finding was noted in the time series graph for the control panel.

The infection did not become noticeable for the FPD equipment design till after the 5th patient was attended to, while for the CKD, it became significant after the 9th person was attended to. The CKD equipment afterwards maintained a steady increase while the FPD dropped at the 10th patient before spiking again to a level higher than the CKD. In general, it could be assumed that the disinfection process became progressively inadequate as number of patients increased, with the FPD equipment accumulating more infection progressively with use when compared to the CKD. We are of the opinion that the reason why FPD equipment accumulated infection at a faster rate was because its control panel and tube handle offered a larger surface area, hence the operator’s hand could touch wider surfaces as against the CKD where handling was limited to the knobs being operated. An exhaustive literature search did not come up with any similar study that documented the progressive variation of nosocomial infection with x-ray equipment use. The closest study was the one we carried previously (Onwuzu et al., 2018) on time dependent variations in infection on the ultrasound probe. In the study, we reported an increase in infection with progressive use of the ultrasound probe with each patient. We therefore suggest that similar studies should be carried out to determine how the x-ray equipment accumulates infection with progressive use, as well as comparing different equipment designs and their propensity to accumulate infection. This would help in buttressing/refuting the findings of this study.

The strength of this study lies in the use of a time series method to determine the rate of accumulation of nosocomial infection in the equipment. Areas that need to be improved in this study is to increase the number of equipment that was used in order to have more robust results, since the study was affected by unavailability of unserviceable equipment at the time of this study.

CONCLUSION

In conclusion, we have determined that equipment design affected the rate of accumulation of nosocomial infection, with FPD equipment accumulating infection at a faster rate than CKD equipment. This may be due to the increased surface areas offered by the FPD.

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