

JOURNAL OF RADIOGRAPHY



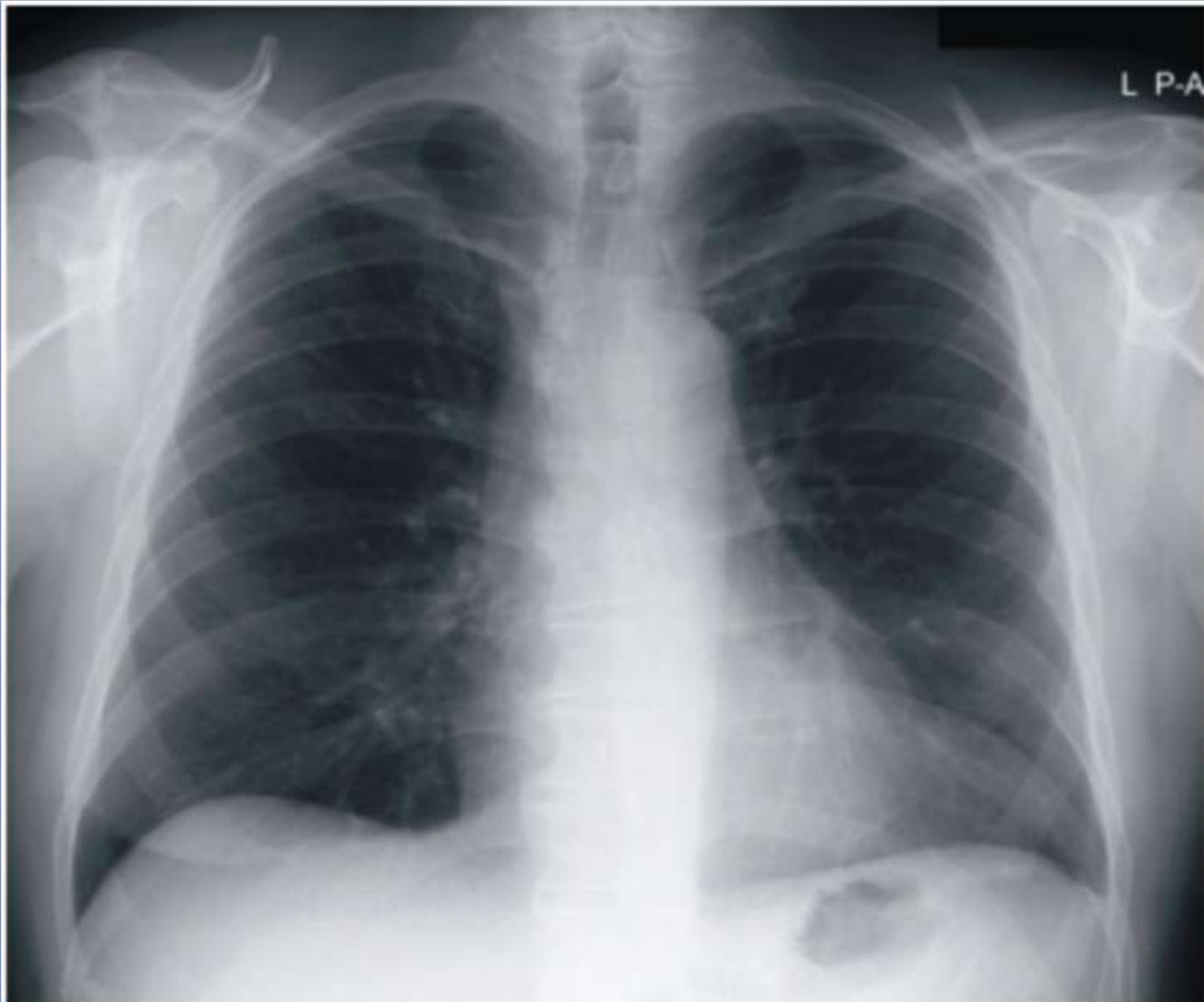
& RADIATION SCIENCES

ISSN: 1115- 7976

Vol 32, Issue 1, May 2018

The Official Journal of The Association of Radiographers of Nigeria

J
R
R
S



Journal homepage: www.jarnigeria.com

Disinfection of Ultrasound Transducers Using Non-Sterile Tissue Paper in Some Low-Cost Private Ultrasound Centres in Nigeria – Implications for Nosocomial Infection Management

*Onwuzu Sobechukwu W. I., Eze Charles U., ¹Ike Anthony,
Abonyi Obinna E., Asogwa Kingsley

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

¹Department of Microbiology, University of Nigeria, Nsukka, Enugu State, Nigeria.

*Correspondence: sobechukwu.onwuzu@unn.edu.ng; +2348039557214

Received: 4 February, 2018. Received in revised form: 7 April 2018. Accepted: 19 April, 2018

ABSTRACT

Background/Aims: The incidence of disease outbreaks in clinical settings arising from ultrasound examinations is well documented, and is a source of worry. The ultrasound transducers and the coupling gel are potential sources of these infections since they come in direct contact with the patient's skin. In this study, we examine the efficacy of the widespread practice of the use of plain non-sterile tissue paper in some low cost private ultrasound centres in our locality as a method of disinfecting ultrasound transducers after each use. Its potential impact on nosocomial infection management in clinical practice is also examined.

Methods: Swab samples from convex ultrasound transducers before and after transabdominal scanning of three consecutive patients were obtained from 10 different ultrasound centres in urban and rural areas of Enugu state. Ultrasound coupling gel samples were equally obtained, and all samples cultured for bacteria growth which was quantified in colony forming units per ml (cfu/ml) and reported in 1000/ml. Paired sampled t-test was used to check for significance in reduction in bacterial load before and after the transducer was cleaned.

Results: Nine different bacterial strains were isolated. *Staphylococcus aureus* and *Klebsiella* spp had the highest percentage of occurrence in all centres. Significant bacteria growth was recorded in the morning before the examination, and plain tissue paper significantly reduced the bacteria load in the ultrasound transducer.

Conclusion: Even though disinfecting ultrasound transducers with non-sterile plain tissue paper alone is statistically effective and has the potential to minimize nosocomial infection, it is however not clinically effective and hence not advised.

Keywords: Nosocomial infection, contaminated gel, ultrasound transducers, Klebsiella, Nigeria

Introduction

The ultrasound equipment, coupling gel and some ultrasound guided procedures have been identified in several studies as potential sources of

nosocomial infection [1–4]. Disease outbreaks in some hospitals have been reported following some ultrasound procedures [5].

A recent report on the outbreak of Burkholderia cepacia complex (BCC) among adults and neonates in the intensive care unit of a hospital was traced to a common source which was a contaminated ultrasound gel[6]. Considering the human and financial resources ploughed into the management of nosocomial infections[7], it is of utmost importance that best clinical practices are maintained in the radiology department, with adequate emphasis laid on the ultrasound suite since the ultrasound transducers come in direct contact with the patient skin.

Ohara and colleagues [8] have demonstrated the susceptibility of the ultrasound equipment to infection by the bacterial load in the patient's skin, and is higher when admitted patients attend sonographic examinations[9]. An interesting study has reported that a contaminated ultrasound transducer contained more bacterial load than toilet seats or public bus poles [10].

Various methods of preventing contamination and disinfecting ultrasound transducers, which includes high and low-level disinfection, use of plain tissue, alcohol impregnated tissue wipes, soap, and physical barriers have been tested with varying degrees of efficiency [11, 12]. Some of the efficient methods are time-consuming and may not be practicable in a busy and low-cost ultrasound centre. Apart from increased patient waiting time and running costs, adverse long term effects on the ultrasound transducer may be encountered [13].

In our locality, privately-owned low-cost centres are major providers of ultrasound services, as government-owned ultrasound centres in secondary and tertiary health care facilities are few, far apart, and experience lengthy equipment down times [14]. A pilot study by the authors identified the use of non-sterile plain tissue paper as the commonest method of transducer disinfection. It is therefore pertinent to assess the efficacy of this method and project the role it plays in nosocomial infection management.

Additionally, results from this study would be indispensable when region-specific guidelines for standard sonographic practices are to be considered.

Materials and methods

This is a prospective, cross-sectional non-experimental study involving 10 randomly selected, privately-owned ultrasound centres in Enugu state, Nigeria, using optimal allocation stratified sampling technique. Ethical clearance was obtained from the University of Nigeria Teaching Hospital (reference number: NHREC/05/01.2008B-FWA00002458-IRB00002323).

The basis for selection include ultrasound centres operated by a qualified sonographer with current practising licence. The study of private centres gave a better representation of ultrasound practice as government-owned centres were few, some non-operational, and were concentrated only in the urban areas. Informed consent of patients to be scanned were obtained.

The transabdominal convex transducer was used for the study in each centre as only obstetrics cases were scanned during the study period. Following previously described procedures for collecting swab samples from ultrasound probes [15], sterile cotton swabs were dipped in distilled water and carefully swiped against the contact surface of the ultrasound transducer, describing a zigzag line from one edge of the surface to the other, while rotating the swab slowly to ensure that all parts of the swab adequately made contact with the ultrasound transducer surface. For each ultrasound centre, the first swab was taken before the transducer was put to use in the morning, to determine the level of overnight bacterial growth. The second swab was taken after scanning the first patient and before the transducer was cleaned. The third swab was taken after the transducer was cleaned with non-sterile tissue paper. The fourth swab was taken after scanning the second patient and before cleaning the transducer. The fifth swab was taken after cleaning the transducer.

Onwuzu, et al.; Disinfection of ultrasound transducers

The sixth swab was taken after scanning the third patient and before cleaning the transducer. The seventh and final swab was taken after cleaning the transducer, making a total of seven different swabs for each centre. After each swab was taken, the swab stick was carefully placed back in its receptacle and covered immediately, ensuring that it did not make contact with any other surface. A sample of the ultrasound gel closer to the orifice of the ultrasound gel cup was also taken for culturing.

All swab samples obtained were taken to the microbiology laboratory on the same day. Culturing was performed by a microbiologist with > 20 years of laboratory experience. The culture media used include Sabouraud Dextrose Agar and broth (ANTEC diagnostics, England), Tryptone soya broth (Oxoid, England), Nutrient agar TM 341, MacConkey Agar (Fluka Biochemika, Germany), Kligler Iron agar (BIOTECH, United Kingdom) and Eosin Methylene Blue Agar (LAB M, United Kingdom). These media were prepared, each according to manufacturer's instructions, and poured into 100 mm diameter sterile Petri dishes (Borosil®, China). The culture media were then inoculated with the different swabs and incubated at 37°C for 24 hours. The number of colony forming units (CFU) were reported in 1000/ml.

Data was analyzed using SPSS v 24 (IBM Chicago, 2016). Descriptive statistics were used for data presentation, and paired sample statistics was used to test for differences in bacteria count before and after the scan.

Results

Nine different bacteria strains were isolated in all the centers (Table 1). Out of the 70 swab samples collected from the ultrasound transducers, more than half (58.6%, n = 41) recorded bacteria growth, with a mean bacterium count of 2.4 x 1000/ml CFU. *Staphylococcus aureus* and *Klebsiella* spp had the highest percentage of occurrence (19.6% each) while *Pseudomonas aeruginosa* and *Enterococcus fecalis* had the

lowest occurrence (3.9% each) (Figure 1). Forty percent (n = 4) of the centres studied had their ultrasound gel contaminated with *Escherichia coli*, *S. aureus*, *Klebsiella* spp, and *Proteus* spp (Table 2), while 60% (n = 6) of the ultrasound transducers collectively yielded five different bacteria isolates in the morning of the examination (Table 3). The paper wiping method reduced the bacteria load by 59% after the first patient was scanned, 82% and 68% after the second and third patients respectively were scanned. This is illustrated in Figure 2. Paired-samples test revealed a strong positive and statistically significant changes in bacteria load before and after transducer cleaning (Table 4).

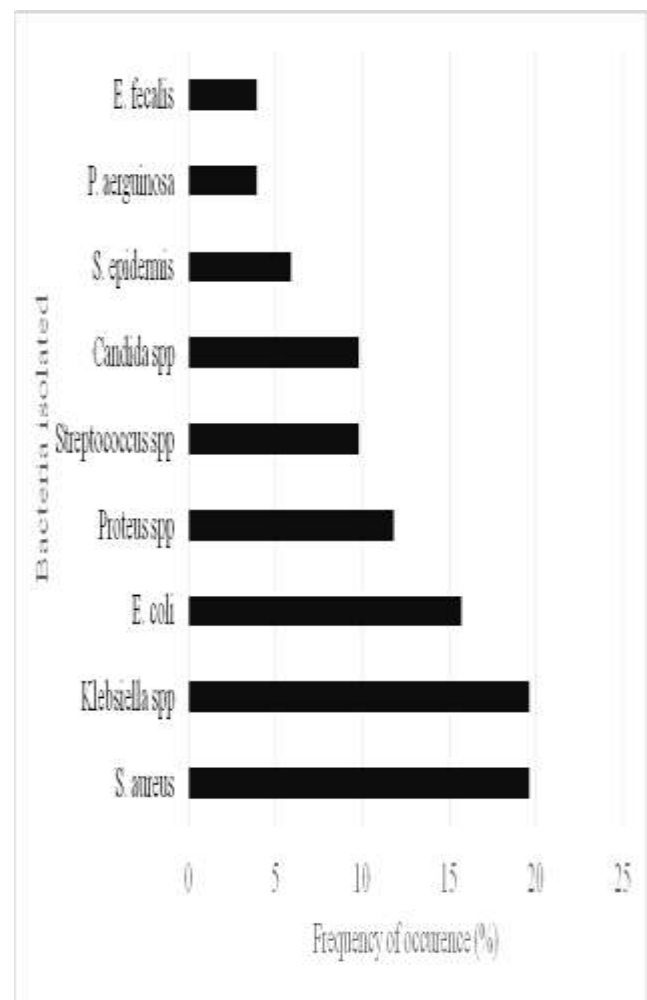


Figure 1: Bacteria isolated from various centres

Table 1: Isolated bacteria strains and their counts

Bacteria isolated	Minimum (1000/ml)	Maximum (1000/ml)	Mean (1000/ml)	SD
Enterococcus fecalis	10.00	12.50	11.25	1.77
Pseudomonas aeruginosa	2.00	7.00	4.50	3.54
Staphylococcus epidermis	5.00	12.50	9.33	3.88
Candida spp	3.75	10.00	7.35	2.43
Streptococcus spp	5.50	17.50	11.10	4.60
Proteus spp	3.50	16.00	10.50	5.03
Escherichia coli	2.00	16.00	7.38	4.27
Klebsiella spp	4.50	21.00	10.03	5.68
Staphylococcus aureus	1.00	12.50	7.50	4.32

Table 2: Ultrasound gel of the various centers that were contaminated with bacteria

Bacteria isolated	No of centers with contaminated gel	Percent
E. coli, S. aureus	1	10.0
Klebsiella spp	1	10.0
Proteus sp	1	10.0
Streptococcus sp, Klebsiella s	1	10.0
None	6	60.0
Total	10	100.0

Table 3: Microbial growth in the ultrasound transducer in the morning before the exam

Bacteria isolated	Frequency	Percent
Klebsiella spp	1	10.0
Proteus sp	1	10.0
S. aureus	1	10.0
S. epidermis	1	10.0
P. aeruginosa	2	20.0
None	4	40.0
Total	10	100.0

Table 4: Paired samples t-test of bacterial load reduction before and after transducer cleaning

Sample/action	Correlation	Sig.	Significant Reduction?
Pair 1 Transducer swab before scanning & 1st swab after scanning 1st patient	-0.345	.329	No
Pair 2 1st swab before cleaning transducer & 1st swab after cleaning transducer	0.679	.031	Yes
Pair 3 2nd swab before cleaning transducer & 2nd swab after cleaning transducer	0.336	.342	No
Pair 4 3rd swab before cleaning transducer & 3rd swab after cleaning transducer	0.677	.031	Yes

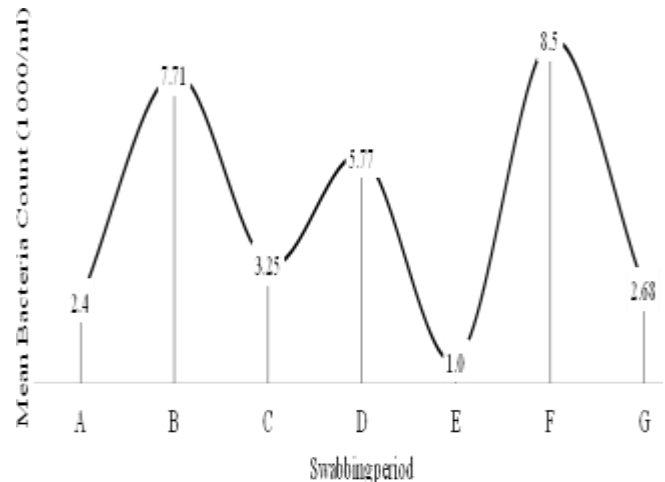


Figure ii: Variation in mean bacterial count at different stages of scan. (A=Probe before scanning; B=1st swab after scanning and before cleaning probe; C=1st swab after cleaning probe; D=2nd swab after scanning and before cleaning probe; E=2nd swab after cleaning probe; F=3rd swab after scanning and before cleaning probe; G=3rd swab after cleaning probe)

Discussion

From our study, we found out that *S. aureus* constituted the highest occurring bacteria strain in the ultrasound gel, ultrasound transducers, and in all the ultrasound centres studied. This is expected as it constitutes the normal flora in the nares and skin of about 30% of the human population[16]. Bello et al¹¹ reported *S. aureus* as constituting 34% of the 44 different bacteria isolates in a recent study.

We also report significant overnight bacteria growth on the ultrasound transducers in the morning. This important finding highlights the necessity of cleaning the ultrasound transducer before its use in the morning. Interestingly, tissue paper alone significantly reduced the bacteria load in the ultrasound transducers and kept it low as the number of patients scanned increased (Figure 2). Our findings are in keeping with the results of similar studies [9, 13]. Ejtehadi and colleagues [15] found out that use of dry, nonsterile paper towel reduced the number of infected ultrasound transducers from 98% (n = 49) to 42% (n = 21). Some other authors, however, hold a contrary opinion [17], and even though the efficacy of nonsterile tissue paper towel is acknowledged, it is not recommended as a standard practice as this may vary with the area of the body being examined, especially the groins, breast, armpits, and small parts[18].

All patients scanned in our study were obstetrics cases, which constitute majority of the cases referred to private centres on any given day. Hence, scans involving other parts of the body like armpits, groin, breasts, and small parts were not included in our study.

A study has demonstrated the efficacy of alcohol impregnated tissue paper or ordinary soap over ordinary tissue paper to clean the ultrasound transducer after such examinations[12]. Though this procedure reduces the level of bacterial contamination of the ultrasound transducer when compared with non-sterile wipes[19], we think

that owners of private setups may be reluctant to put this into practice, as evidenced by responses from personal interactions between the researcher and the sonographers during the course of data collection. All of them were unwilling to use any substance other than dry tissue paper on the ultrasound transducers due to the fear of the transducers deteriorating after a given period. Their fears, however, were not unfounded as a study has hinted on possible adverse long term effects that alcohol wipes and other disinfecting solutions may have on the longevity of ultrasound transducers [20]. We did not come across a study that has satisfactorily demonstrated this possible deterioration, so we think that this is an area of further study.

In our clime where most of the ultrasound centres are low-cost and privately-owned, and standard disinfection procedures as advised by the manufacturers on the ultrasound transducers are hardly adhered to, our studies show that the unconventional disinfection methods practised by these centres studied will keep the likelihood of nosocomial infection via ultrasound transducers low. Forty percent of the centres had ultrasound gels that were contaminated, as has been reported [2], and this could be a potential source of worry considering documented outbreaks of nosocomial infections via contaminated gels [3, 5, 6].

The strength of our study lies in the fact that this may be the first of its kind addressing this issue in our locality. Also, ultrasound practices both in the urban and rural areas were equally represented. The weakness, however, was that the patients attended to were outpatients, and examinations involving inpatients, the groin, or armpit with higher chances of increased bacterial infection of the ultrasound transducer were not studied.

Abdullah [11] has suggested that for this category of examinations, simple paper wipe would be inadequate for satisfactory cleaning of the ultrasound transducer.

Perhaps further work could be done in our population to assess the effectiveness of paper wipe on these ultrasound examinations.

Additionally, we could not apply other cost-effective methods of cleaning ultrasound transducers like alcohol wipe and use of soap[17], to compare their effectiveness with simple paper wipe because the owners of the centres were reluctant to allow that. The researchers could only scan a few number of patients while taking the swab samples in each ultrasound center due to the minimal cooperation offered by the sonographers as they claimed the study disrupted their normal workflow and increased their patient waiting time. This could make them loose patients to nearby centres. Finally, there was no way we could blind the sonographers to our study, so they could have put more care in thoroughly wiping the ultrasound transducer, thereby introducing an element of bias.

Conclusion

In obstetric scans, use of non-sterile tissue paper alone as a means of transducer disinfection significantly reduces the bacteria load in the ultrasound transducer and appears to keep the possibility of nosocomial infection at a minimum. With no nationally recognized sonography standard of practice available in Nigeria at present, there is a need to review practices and come up with standard guidelines on disinfection procedures to improve disinfection practices and avoid the possibility of nosocomial infection outbreak arising from the ultrasound room. We further advocate that at the end of the day, the transducer should be either cleaned with alcohol or soap at the end of work so as to reduce the bacteria build up on the transducer in the morning of the exam.

Acknowledgement

We wish to thank the manager of Adonai Laboratories for his assistance in bacteria count, culture, and analysis, and Mr Ugwuda Roland for help in data collection.

Conflict of interest: None declared.

References

1. Mattar EH, Hammad LF, Ahmad S, El-Kersh TA. An investigation of the Bacterial contamination of ultrasound equipment at a university hospital in Saudi Arabia. *J Clin Diagn Res* 2010; 4:2685–2690.
2. Lawrence M, Blanks J, Ayala R, Talk D, Macian D, Glasser J, et al. Hospital-wide survey of bacterial contamination of point-of-care ultrasound probes and coupling gel. *J. Ultrasound Med.* 2014;33:457–62.
3. Cervini P, Hesley GK, Thompson RL, Sampathkumar P, Knudsen JM. Incidence of infectious complications after an ultrasound-guided intervention. *Am. J. Roentgenol.* 2010;195:846–50.
4. Gillespie JL, Arnold KE, Noble-Wang J, Jensen B, Arduino M, Hageman J, et al. Outbreak of *Pseudomonas aeruginosa* Infections After Transrectal Ultrasound-Guided Prostate Biopsy. *Urology* 2007;69:912–4.
5. Gaillot O, Maruejols C, Abachin E, Lecuru F, Arlet G, Simonet M, et al. Nosocomial outbreak of *Klebsiella pneumoniae* producing SHV-5 extended- spectrum beta-lactamase, originating from a contaminated ultrasonography coupling gel. *J. Clin. Microbiol.* 1998;36:1357–60.
6. Nannini EC, Ponessa A, Muratori R, Marchiaro P, Ballerini V, Flynn L, et al. Polyclonal outbreak of bacteremia caused by *Burkholderia cepacia* complex and the presumptive role of ultrasound gel. *Brazilian J. Infect. Dis.* 2015;19:543–5.
7. Jones TH, Steane DA, Jones RC, Pilbeam D, Vaillancourt RE, Potts BM. Effects of domestication on genetic diversity in *Eucalyptus globulus*. *For. Ecol. Manage.* 2006;234:78–84.

Onwuzu, et al.; Disinfection of ultrasound transducers

8. Ohara T, Itoh Y, Itoh K. Ultrasound instruments as possible vectors of staphylococcal infection. *J. Hosp. Infect.* 1998;40:73–7.
9. Bello TO, Taiwo SS, Oparinde DP, Hassan WO, Amure JO. Risk of nosocomial bacteria transmission: Evaluation of cleaning methods of probes used for routine ultrasonography. *West Afr. J. Med.* 2005;24:167–70.
10. Sartoretti T, Sartoretti E, Bucher C, Doert A, Binkert C, Hergan K, et al. Bacterial contamination of ultrasound probes in different radiological institutions before and after specific hygiene training: do we have a general hygienical problem? *Eur. Radiol.* 2017;27:4181–7.
11. Abdullah BJ, Mohd Yusof MY, Khoo BH. Physical methods of reducing the transmission of nosocomial infections via ultrasound and probe. *Clin Radiol* 1998;53:212–4.
12. Fowler C, McCracken D. US probes: risk of cross infection and ways to reduce it--comparison of cleaning methods. *Radiology* 1999;213:299–300.
13. Koibuchi H, Fujii Y, Kotani K, Konno K, Matsunaga H, Miyamoto M, et al. Degradation of ultrasound probes caused by disinfection with alcohol. *J. Med. Ultrason.* 2011;38:97–100.
14. Okeji MC, Onwuzu SW, Eze JC, Ayogu E. An Assessment of Equipment procurement and management policies in Radiology Centres in Nigeria. *J. Assoc. Radiogr. Niger.* 2012;26:28–34.
15. Ejtehadi F, Ejtehadi F, Teb JC, Arasteh MM. A safe and practical decontamination method to reduce the risk of bacterial colonization of ultrasound transducers. *J. Clin. Ultrasound* 2014;42:395–8.
16. Gorwitz RJ, Kruszon-Moran D, McAllister SK, McQuillan G, McDougal LK, Fosheim GE, et al. Changes in the Prevalence of Nasal Colonization with *Staphylococcus aureus* in the United States, 2001–2004. *J. Infect. Dis.* 2008;197:1226–34.
17. Mirza WA, Imam SH, Kharal MSA, Aslam M, Ali SA, Masroor I, et al. Cleaning methods for ultrasound probes. *J. Coll. Physicians Surg. Pakistan* 2008;18:286–9.
18. Nyhsen CM, Humphreys H, Koerner RJ, Grenier N, Brady A, Sidhu P, et al. Infection prevention and control in ultrasound - best practice recommendations from the European Society of Radiology Ultrasound Working Group. *Insights Imaging* 2017;8:523–35.
19. Schabrun S, Chipchase L, Rickard H. Are therapeutic ultrasound units a potential vector for nosocomial infection? *Physiother. Res. Int.* 2006;11:61–71.
20. Koibuchi H, Kotani K, Taniguchi N. Ultrasound probes as a possible vector of bacterial transmission. *Med. Ultrason.* 2013;15:41–4.

How to cite: Onwuzu SWI, Eze CU, Ike A, Abonyi OE, Asogwa K. Disinfection of Ultrasound Transducers Using Non-Sterile Tissue Paper in Some Low-Cost Private Ultrasound Centres in Nigeria – Implications for Nosocomial Infection Management. *J Rad & Radiat Sci*, 2018; 32 (1): 39 - 45