EVALUATION OF DISINFECTANTS BY THE IN-USE TECHNIQUE IN HEALTHCARE FACILITIES IN KOGI STATE NORTH CENTRAL NIGERIA

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Abstract: The aim of this research was to evaluate the efficacy of disinfectants by in-use testing and to identify bacterial isolates contaminating disinfectants in different hospitals. Ninety two samples of disinfectants comprising Purit, Izal, Bleach, Spirit and Dettol being used in twenty hospitals in Kogi State were analyzed for efficacy between July and December 2011 by in-use technique. Samples of disinfectant were taken from floor-mop bucket, cleansing buckets, discard jars, disinfectant solution in which instruments, crockery, bed pans, etc., have been rinsed, and closed containers of diluted disinfectants ready for use. Viable counts of bacteria in these in-use samples were determined by cultures. Out of 92 samples of disinfectants in use tested, 47(51.1%) failed the in-use test. Various types of bacterial isolates were identified. *Pseudoinonti> aeruginosa* (36.2%) was the most frequently isolated organism. Purit had 20% failure rate when duration in-use was 7days, Bleach 33% failure rate, Izal 25% failure rate, Dettol 0%, Spirit 16% failure rate all for the same 7days. Other organisms isolated include coagulase Negative staphylococcus (29.8%), Staphylococcus aureus (19.1%) and Proteus spp (14.1%). Disinfectants should be prepared strictly by the manufacturer's instructions and should not exceed 7 days of exposure while in use.

Keywords: Disinfectants efficacy, in-use technique, nosocomial infections.

Introduction

Disinfectants are chemical substances that are applied to non-living objects to destroy microorganisms present on the objects. Disinfection does not necessarily kill all microorganisms, especially resistant bacteria spores (Hugo and Russel, 1983). Various disinfectants are available for use in the hospital environment. Air disinfectants are typically chemical substances capable of disinfecting microorganisms suspended in air. Other agents include Spirits, aldehydes, phenolic compounds, oxidizing agents, quaternary ammonium compounds.

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A disinfectant should be tested to establish the required effective dilution, the time taken to effect disinfection and to periodically monitor its activity. As disinfectants are known to lose their activity on standing as well as in the presence of organic matter, their activity must be periodically tested (Hugo and Russel, 1983).

The routine monitoring of disinfectant in use can be done by the In-use test of Kelsey and Maurer, (1972). This test is intended to estimate the number of living organisms in a vessel of disinfectant in actual use (Joan and Margret, 1991). Several outbreaks of infections associated with in-use contamination of quaternary ammonium compounds solutions have been reported. In those solutions, gram negative bacteria such as *Pseudomonas* spp. and *S. marcescens* were found to survive or grow (Nakashima *et al.*, 1987). Genes conferring resistance to quaternary ammonium compounds have been detected in 6 to 42 of *S. aureus* isolates collected in Japan and Europe (Mayer *et al.*, 2001). Organic matter, anionic detergents (soaps), and materials such as cotton and gauze pads can reduce

the microbiocidal activities of quaternary ammonium compounds.

Stickler and Thomas (1980) found chlorhexidine-resistant bacteria after extensive and long term use of chlorhexidine prior to bladder catheterization. The chlorhexidine resistance to vegetative bacteria was thought to be limited to certain gram negative bacilli such as *P. aeruginosa, Burkhlderia* [*Pseudomonas*] *cepacia, Proteus mirabilis and S. marcescens* (Stickler *et al.*, 1980). However genes conferring resistance to various organic cations, including chlorhexidine have been recently identified in *S. aureus* clinical isolates (Mayer *et al.*, 2001).

The aim of this research was to evaluate the efficacy of disinfectants by in-use testing and to identify bacterial isolates contaminating disinfectants in different hospitals.

Materials and methods

A total of 92 samples of different types of disinfectant being used in twenty randomly selected hospitals in Kogi, east were analyzed in the Microbiology laboratory at the Federal Medical Centre, Lokoja by In-use technique (Kelsey and Maurer 1972) between July and December 2011.

Samples of disinfectants were taken from floor-mop bucket, cleansing buckets, discard jars, disinfectant solution in which instruments, crockery, bed pans, and contaminated equipments have been rinsed, and closed containers of diluted disinfectants ready for use. Viable counts of bacteria in these in-use samples were determined by dilution and cultures (Cruickshank *et al.*, 1980). Bacterial isolates were isolated and identified by standard microbiological methods (Cheesebrough, 1993). These included gram stain morphological characteristics and biochemical tests.

One Milliliter of disinfectant sample was transferred to 9ml of quarter-strength Ringers' solution. Nutrient broth containing 0.5% sodium thiosulphate was used to inactivate the hypochlorite and iodophors in place of quarter-strength Ringers' solution. With a '50ml-dropper' pipette, 10 drops (about 0.02ml) were transferred immediately onto separate areas of the surface of each of two dried agar plates. Incubation was done for 72h for one plate at 37□C and the other at a room temperature. The plates were examined and the growth from each drop scored. Growth from more than 5 out of 10 drops on either plate indicated failure of disinfection. Such a result corresponds to approximately 1000 living organism per ml in a sample of disinfectant. The result was considered satisfactory if only an occasional sample drop shows growth (Kelsey and Maurer, 1972).

The disinfectants tested were as follows; Purit, Bleach, Izal, Spirit and Dettol. Their components and manufacturers are as follows:

- Purit (Manufactured by Sarolite Life Care Ltd.) contains Chlorhexidine gluconate BP 2.4w/v, Cetrimide BP 3.0 w/v
- Spirit (Manufactured by Moko) Isopropyl ethanol 70%
- Bleach(Manufactured by GBC Murphy Ltd) contains Sodium hypochlorite 6%
- Izal (Manufactured by Rekitt and Colman Ltd.) contains Tar Phenol 7%
- Dettol (Manufactured by Reckit & Bencheizer Ltd.) contains Chloroxynol BPC 4.8% w/v

Results

The in-use disinfectant samples of Bleach, Izal, Spirit and Purit were assessed for the 20 hospitals while Dettol was limited to 12 of the 20 hospitals where it was being used.

The results of Table 1 are shown below:

Testing for purit: Five out of the 20 samples were in use for 1-7 days 1(20%) failed the In-use test. Further examination shows that eight samples had been in use for 8-14 days and five (62%) failed the in-use test, while the rest which had been in use for 15 days and above six (85%) sample failed.

Testing for Bleach: Six samples were in use for 1-7 days, 2(33.3%) failed the test. Nine samples were in use for 8-14 days, 4(44.4%) failed. For the five samples already in use for 15 days and above, 4(80%) samples failed the test.

Testing for Izal: Four samples were in use for 1-7days, 1(25.0%) failed the test. Eight samples were in use for 8-14 days which 4(50.0%) samples failing the test, while another eight samples were in use for 15 days and above with 6(75.0%) samples failed the test.

Testing for Dettol: Two samples were in use for 1-7 days, 0(0%) failed the In-use test. Four samples were in use for 8-14 days with 1(25.0%) sample failing the test. Six samples were in use for 15days above with 4(66.7%) samples failing the in-use test.

Testing for spirit: Six samples were in use for 1-7 days, 1(16.7%) failed the test. Four samples were already in use for 8-14days with 2(50.0%) samples failing the test. Ten samples were in use for 15 days and above with 6(60.0%) samples failing the test.

The various types of bacterial isolates found in the failed samples is shown in table 2. Out of 92 samples of disinfectant in use tested, 47(51.1%) samples failed the In-use test. *Pseudomonas aeruginosa* 17(36.2%) was most frequently isolated, followed by Coagulase Negative *Staphylococcus* (COANS) 14(29.8%), *Staphylococcus aureus* 9(19.1%) and *Proteus* spp. 7(14.9%)

Table 1: In-use tests for disinfectants tested and the failure rates

Disinfectant	Total sample	Duration in use (Days)	Number of sample	Failure (%)
Purit	20	1-7	5	1(20)
		8-14	8	5(62.5)
		15 &Above	7	6(85.7)
Bleach	20	1-7	6	2(33.3)
		8-14	9	4(44.4)
		15 &Above	5	4(80)
Izal	20	1-7	4	1(25)
		8-14	8	4(50)
		15 &Above	8	6(75)
Dettol	12	1-7	2	0(0)
		8-14	4	1(25)
		15 &Above	6	4(66.7)
Spirit	20	1-7	6	1(16.7)
		8-14	4	2(50)
		15 &Above	10	6(60)

Table 2
Types and frequency of bacteria isolates seen in in-use test for disinfectants evaluation

Bacteria	Frequency	Percentage
Pseudomonas aeruginosa	17	36.2
Coagulase Negative Staphylococcus	14	29.8
Staphylococcus aureus	9	19.1
Proteus spp	7	14.9
	47	

Discussion

There was no policy about the In-use disinfectants in the hospitals where we carried out this study. It was also observed after review of other literature that there was no clear documentation of how long disinfectants should be in use before discarding to be replaced with a new one. This may have informed why different hospitals adopted their own approach.

In the present study, it was observed that disinfectants used in discard solutions of mop buckets and other containers in various departments in the hospitals were discarded and disinfectants replaced at the discretion of the workers. The efficacy of the disinfectant was reduced with time while infected materials for decontamination were regularly introduced. Some of the disinfectants were observed to be contaminated. The contaminating organisms were mainly *Pseudomonas aeruginosa,* Coagulase Negative *Staphylococcus, S. aureus* and *Proteus* spp. this finding was in agreement with an earlier report (Prince and Ayliffe, 1972).

Although the concentration of the disinfectants tested were said to have been diluted and used according to the manufacturer's instructions the concentrations were not determined in the present study and no prior information of the testing was given to the healthcare workers concerned. However cultures made from the diluted disinfectants before use did not yield any significant bacteria. Some researchers (Awodele *et al.*, 2007; Okesola *et al.*, 2011) showed that antimicrobial activities of disinfectants were concentration dependent. This observation will mean that if appropriate concentrations are not used even in the In-use testing there will be contaminations of disinfectants. Some other workers (Atoyebi *et al.*, 1999; Niemogha, 2003) all confirmed contamination of disinfectants in their different studies.

Disinfectants in constant and prolonged use gradually become contaminated thus raising the microbial load. The need to prevent this has been emphasized by some researchers (Shigeharu and Akira, 1996). The results in this study clearly show that all the disinfectants tested have varying degrees of failure following in-use for 1 to 7 days. This degree of failure increase for all tested disinfectants as the in-use days increased, with the highest degree of failure occurring at beyond two weeks of the disinfectants use. This finding clearly underscores the need to periodically check the effectiveness of in-use disinfectant solutions for the purpose of early detection of the threat of disinfectant failure. After literature search as mentioned earlier, it appears that there is no WHO recommended number of days before discarding disinfectants in the in-use procedure. This actually informed the justification for this research so that based on the findings from these results, the hospitals can be advised for future purposes.

The implication of disinfection failure in clinical practice could create

problems in surgical and immunocompromised patients admitted in healthcare facilities as the risk of nosocomial infection would be higher. However, a laboratory test cannot reproduce the wide range of conditions which exist when the disinfectant is in use, and therefore we advise just as Prince and Ayliffe (1972) had done earlier to carry out in-use tests for bacterial contamination when a new disinfectant is introduced into a hospital and at intervals afterwards.

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