

RESEARCH ARTICLE

Quaternary Ammonium Compound Disinfectant Efficacy Test on The Patients' Environment in dr. Cipto Mangunkusumo General Hospital

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Abstract

The increasing prevalence of hospital-acquired infection continues to be a global concern until today. The purpose of this study is to determine the efficacies of Caviwipe® and 70% alcohol tissue in the prevention of hospital-acquired infection. This experimental study was conducted on 36 equipment samples in dr. Cipto Mangunkusumo Hospital during April–August 2015. A total of 144 surface samples were collected before and after the disinfection process by both the disinfectants. The sample equipment used and placed in the agar plate for a short period of time; the plates were then incubated. The colony numbers of grown bacteria and fungi were calculated. The data were numerically reported as the microbial colony count. Data were analyzed by using SPSS for Windows. Paired t-test was used for the statistical analysis. The mean colony counts before disinfection by 70% alcohol tissue and Caviwipe® were 11.75 and 17.58, respectively. Meanwhile, the average colony counts after disinfection with 70% alcohol tissue and Caviwipe® were 0.138 and 0.222, respectively. Statistical analysis showed no significant difference between the mean of the colony count before and after disinfection with both disinfectants ($p > 0.05$). Separately, a significant difference of colony count between before and after the disinfection process for each disinfectant was seen ($p < 0.05$). The mean reduction in the colony counts after disinfection by both disinfectants indicates that there is no significant difference ($p > 0.05$) in the efficacies between the Caviwipe® and 70% alcohol tissue in reducing the amount of bacteria and fungi present on the surfaces of the equipment placed close to the patients in a hospital environment.
Keywords: disinfectant, environment, hospital, alcohol, Caviwipe®.

Uji Efikasi Disinfektan Quaternary Ammonium Compound Disinfectant di Lingkungan Pasien di RSUPN dr. Cipto Mangunkusumo

Abstrak

Peningkatan prevalensi infeksi yang didapat di rumah sakit masih menjadi perhatian hingga saat ini. Penelitian ini bertujuan membandingkan efektivitas Caviwipe® dan tisu alkohol 70% dalam upaya pencegahan infeksi yang didapat di rumah sakit. Penelitian eksperimental ini dilakukan pada bulan April–August 2015 dengan 36 sampel peralatan di rumah sakit dr. Cipto Mangunkusumo (RSCM). Terdapat 144 titik pengambilan sampel permukaan lingkungan dan peralatan, sebelum dan sesudah disinfeksi dengan kedua disinfektan. Sampel diambil dengan contact agar lalu diinkubasi, kemudian dihitung jumlah koloni bakteri dan jamur yang tumbuh. Data jumlah koloni mikroba dilaporkan sebagai data numerik dan dianalisis dengan perangkat lunak SPSS untuk Windows. Analisis statistik menggunakan paired-t-test. Hitung koloni sebelum disinfeksi dengan tisu alkohol 70% dan Caviwipe® adalah 11,7 dan 17,58. Rerata jumlah koloni sesudah disinfeksi dengan tisu alkohol 70% dan Caviwipe® adalah 0,138 dan 0,222. Analisis statistik menunjukkan tidak ada perbedaan bermakna antara rerata jumlah koloni sebelum dan sesudah disinfeksi dengan kedua jenis disinfektan ($p > 0,05$). Masing-masing disinfektan menunjukkan perbedaan bermakna antara jumlah koloni sebelum dan sesudah disinfeksi ($p < 0,05$). Penurunan rerata jumlah koloni sesudah disinfeksi antara kedua disinfektan tidak berbeda bermakna ($p > 0,05$). Efikasi antara Caviwipe® dan tisu alkohol 70% dalam menurunkan jumlah bakteri dan jamur di lingkungan rumah sakit yang dekat dengan pasien juga tidak berbeda bermakna.

Kata kunci: disinfektan, lingkungan, rumah sakit, alkohol, Caviwipe®

Introduction

The increased prevalence of hospital-acquired infection continues to be a global concern until today.¹ Several studies have showed an association between hospital environment and some pathogens, such as methicillin-resistant *Staphylococcus aureus* (MRSA), *Klebsiella pneumoniae*, *Clostridium difficile*, and *Acinetobacter baumannii*.² The organism could show resistance in a healthcare environment, but there is evidence that suggests a relationship between bacterial sensitivity with cleaning and disinfection.³ Environmental cleaning and disinfection of equipment is one of the prominent methods to reduce the risk of spreading multi-drug-resistant organisms in a hospital.⁴⁻⁶

It is easy to isolate *Acinetobacter* from hospital environments, such as inanimate, which are frequently touched and located close to patient.⁷ It is known that some clinical strains from environment attach to the material surface and live up to two weeks; some strains are known to persist longer.⁸ The importance of cleaning *Acinetobacter* spp. during an infection outbreak was reported in a previous study.^{9,10} In a previous report, an outbreak of a resistant *Acinetobacter baumannii* strain was reported; this outbreak involved more than 30 patients in two intensive care units (ICUs) of a hospital. Environment contamination was recognized as the reservoir of epidemic and outbreak strain. It only lasted until both ICUs were closed for terminal cleaning and disinfection.¹⁰

Cleaning is the process of removing the visible dirt (e.g., organic and inorganic materials) on the object and surface. Disinfection is the process of removing microorganisms, except bacterial spores, on inanimate objects. Intermediate level disinfectants can kill *Mycobacterium* sp., vegetative bacteria, most viruses and fungi. Intermediate level disinfectants, such as alcohol and Caviwipe®,¹¹⁻¹⁴ are used in dr. Cipto Mangunkusumo General Hospital (CMGH). Alcohol is cheaper, but it has a strong smell and is not available in the form of tissue wipes. CMGH can produce alcohol wipes, but it needs more staff in the Pharmacy Unit to cover it. Caviwipe® has soft odor and is readily available as wipes; however, it is more expensive.

The purpose of this study is to determine the effectiveness of chemical disinfectants tissue containing quaternary ammonium compound (Caviwipe®) compared with 70% alcohol disinfectant tissue made by CMGH for the disinfection of hospital equipment and environment. This study will serve as a guide for the prevention

of infection and control committee to recommend and approve the required disinfectant which will be better used in CMGH.

Methods

This is an experimental study that was conducted on 36 equipment samples in CMGH during April–August 2015. The samples of equipment surfaces were collected by the contact agar. The surface of the equipment in the hospital was exposed to contact agar (figure 1). Contact agar has two surfaces, which consisted of sheep blood agar on one side and sabouraud agar on the other.

The samples were taken from the inpatient units of surgery department, pediatric intensive care unit (PICU), ICU, emergency room (ER), neonatal intensive care unit (NICU), and obstetrics and gynecology department in the hospital. The total number of equipment surfaces sample taken were 72. Of the 72 samples, 36 samples were tested with Caviwipe® and 36 samples were tested with CMGH's 70% alcohol tissue.



Figure 1. Syringe Pump as One of Sampling Spot in This Study

The sample area of each surface was tested before and after the disinfection process. Hence, a total of 144 surface samples were examined. The pre-disinfection sample was a sample taken on each surface before the process of disinfection. The

surface samples were collected by exposed it with contact agar for 1 minute. Then, the surfaces were disinfected using the alcohol tissue or Caviwipe®. Exactly 5 minutes after disinfection, the post-disinfection samples were taken and exposed to a new contact agar for 1 minute. The samples were

immediately transported to the clinical microbiology laboratory and incubated at 37°C for 72 hours. Then, the grown bacteria and fungi colonies were counted and documented. The study algorithm is shown in Figure 2.

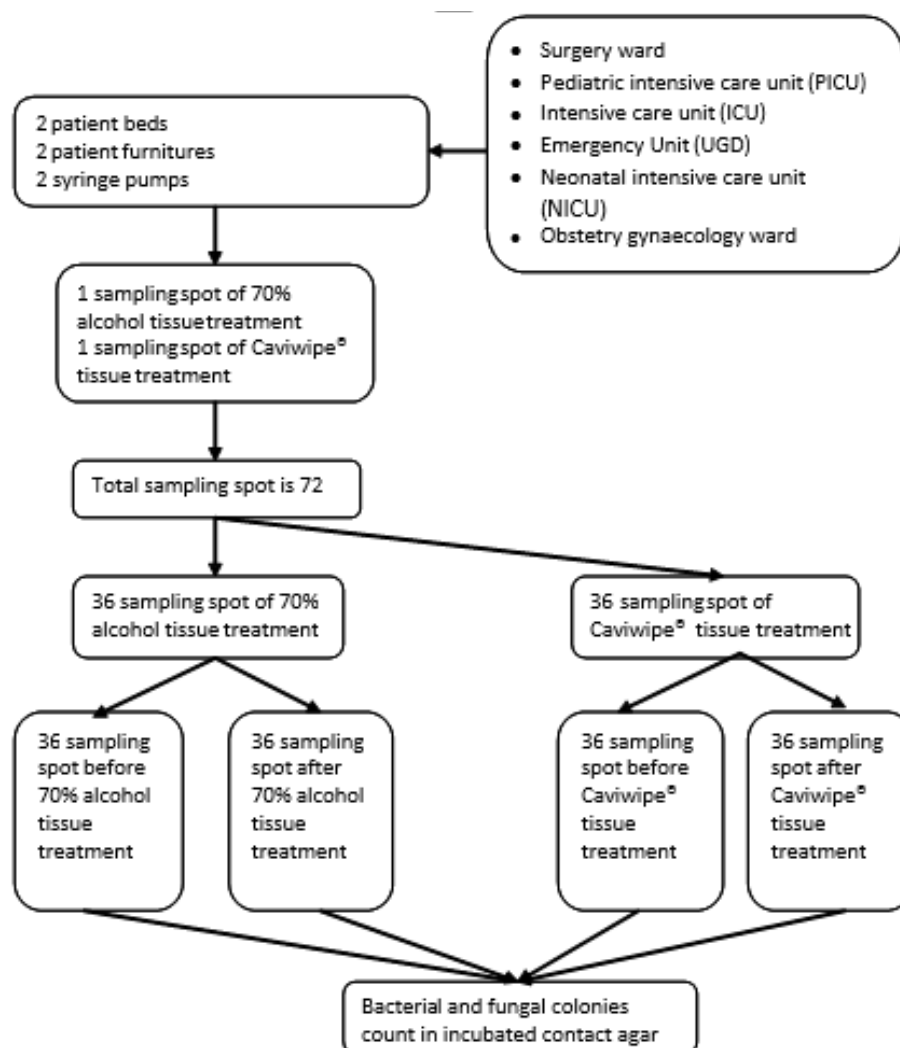


Figure 2. Study Algorithm

Two disinfectants in this study are Caviwipe® tissue, contains Cavicide® disinfectant (quaternary ammonium compound disinfectant) from Metrex and 70% alcohol tissue made by the pharmaceutical department of CMGH. The procedure of disinfection was similar in both cases.

Data were analyzed using SPSS software for Windows. The microbial colony counts were numerically calculated. The average colony counts of the surfaces before and after disinfection for

each disinfectant and the comparison between the average declines in the colony counts were statistically calculated. If the data distribution was normal, then paired t-test was used for the statistical analysis.

Results

Growth of bacterial and fungal colonies was observed in the contact agar after an incubation period of 72 hours. These colonies are shown on figure 3.

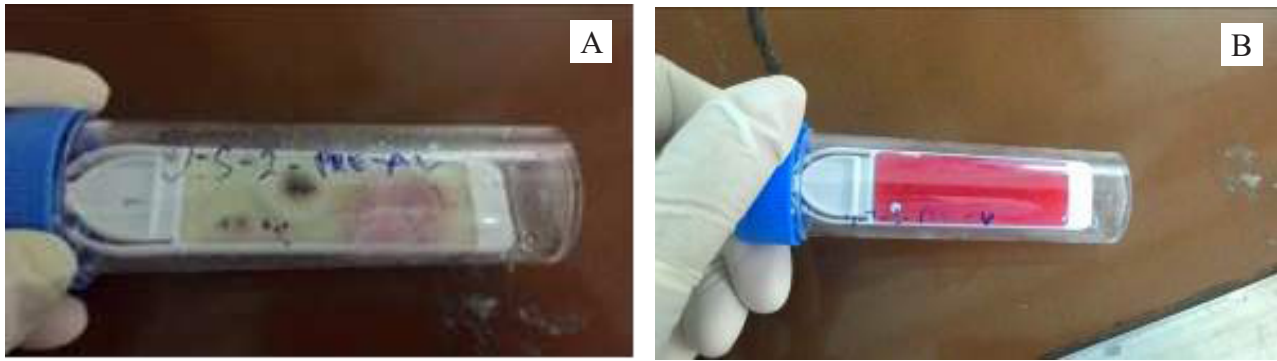


Figure 3. Colonies on Contact Agar after 72 Hours Incubation
A. Colonies of Fungi; B. Colonies of Bacteria

Bacterial and Fungal Colony Counts

The bacterial and fungal colony counts before and after disinfection of the samples with an

incubation period of 72 hours with contact agar are presented on Table 1.

Table 1. Mean Colony Counts Before and After Disinfection Using Caviwipe® and Alcohol 70% Wipe

Disinfectant	Mean Colony Count (CFU)		Reduction of Colony Count (CFU)
	Before disinfection	After disinfection	
Caviwipe®	17,58	0,222	17,36
70% Alcohol	11,75	0,138	11,61

Statistical analysis showed no significant difference between the means of the colony counts that were taken before and after disinfection for both disinfectants ($p > 0.05$). Separately, each disinfectant showed a significant difference of colony counts between before and after disinfection ($p < 0.05$). The mean reduction in the colony counts after disinfection between both disinfectants indicates that there is no significant difference ($p > 0.05$).

Discussions

The objects tested in this study were the patients' furniture, patients' beds (including infant incubators at NICU), and syringe pumps. These surfaces are classified as noncritical environmental surfaces, which can be cleaned by using disinfectant-containing disposable towels or disposable wipes to achieve a low level of disinfection.⁵ These cleaning methods were more practical and safer than the mop dipped in a bucket of mop fluid, which can cause the cleaned objects (by mop fluid) to be a source of transmission of nosocomial infections, unless these objects are not properly disinfected.⁶

Caviwipe® is composed of 17.2% isopropanol and 0.28% benzethonium chloride (quaternary

ammonium compound), without high-level disinfectants (aldehyde and phenol). Benzethonium chloride is a low-level disinfectant. The 20% alcohol added to the benzethonium chloride will increase the disinfectant level to the intermediate level, so it can eliminate *Mycobacterium tuberculosis*.

Caviwipe® does not contain fragrances and it does not have a sting odor. It is safe for breathing as it already meets the standard criteria of the US Environmental Protection Agency. However, 70% alcohol wipes produce a sting odor because of the high concentration of alcohol.

The disinfected surfaces are left moist because of the heavy saturation of Caviwipe®, thereby making the drying process difficult. However, the use of alcohol alone or a high concentration of alcohol solution dries easily because the alcohol evaporates quickly. Alcohol is also known to cause allergies or skin irritation in some people, whereas Caviwipe® causes only mild irritation if it is continuously exposed to the skin for a long term. Both of these disinfectants are easy to use since they are available in tissue forms and do not require a mop for disinfection. The use of mop can spread microorganisms that cause nosocomial infections.⁶

A research work in 2018 compared the use of alcohol combined with chlorine for the disinfection of surface environment in an ICU ward. They compared the efficacy of disinfection by using a washcloth by outsourced cleaning services and disposable wipes that contain quaternary ammonium compound disinfectant by in-house auxiliary nurses at the time of infection outbreak of the carbapenem-resistant *Acinetobacter baumannii*. The study reported that the results of disinfection with tissue containing quaternary ammonium compound by nurses were more effective in reducing microbial contamination.¹⁵ However, the results contradict the findings observed in the current study; no difference in the effectiveness between quaternary ammonium compound and alcohol was observed.

To the best of our knowledge, no study has compared the efficacy of disinfection by alcohol with other disinfectants. However, one study compared the disinfectant-containing quaternary ammonium compound with chlorine, but it specifically compared the disinfectants only against certain bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) and vancomycin-resistant *Enterococcus faecium* (VRE) in an environmental surface of a hospital. The results of our study suggest that quaternary ammonium compound-based disinfectant may be an effective choice for the reduction of low-levels bacterial pathogens from contaminated environmental surfaces.¹⁶

Both 70% alcohol wipe and Caviwipe® are effective low-level disinfectants for disinfection surfaces in the hospital environment and noncritical items, which may come in contact with intact skin.¹⁷ Both of them have the potential to prevent the transmission of bacteria and fungi and reduce healthcare-associated infections.

Conclusions

We conclude that there is no significant difference in the efficacy between the Caviwipe® and 70% alcohol tissue in reducing the amount of bacteria and fungi present on the surfaces and equipment that are close in proximity with the patient in the hospital environment.

Acknowledgements

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