Effectiveness of Disinfectant Wipes for Decontamination of Bacteria on Patients' Environmental and Medical Equipment Surfaces at Siriraj Hospital

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Objective: *To determine the effectiveness of Virusolve^R+ disinfectant wipes and PAL^R disinfectant wipes for decontamination of inoculated bacteria on patients' environmental and medical equipment surfaces at Siriraj Hospital.*
Material and Method: *Tryptic soy broths containing MRSA and XDR A. baumannii were painted onto the surfaces of patient's stainless steel bed rail, patient's fiber footboard, control panel of infusion pump machine and control panel of respirator. The contaminated surfaces were cleaned by either tap water, tap water containing detergent, Virusolve^R+ disinfectant wipes or PAL^R disinfectant wipes. The surfaces without any cleaning procedures served as the control surface. The contaminated surfaces cleaned with the aforementioned procedures and control surfaces were swabbed with cotton swabs. The swabs were streaked on agar plates to determine the presence of MRSA and XDR A. baumannii.*
Results: *MRSA and XDR A. baumannii were recovered from all control surfaces. All surfaces cleaned with tap water or tap water containing detergent revealed presence of both MRSA and XDR A. baumannii. However, the amounts of bacteria on the surfaces cleaned with tap water containing detergent were less than those cleaned with tap water alone. All surfaces cleaned with PAL^R disinfectant wipes also revealed presence of both MRSA and XDR A. baumannii. However, the amounts of bacteria on the surfaces cleaned with PAL^R disinfectant wipes were less than those cleaned with tap water containing detergent. No bacteria were recovered from all surfaces cleaned with Virusolve^R+ disinfectant wipes.*
Conclusion: *Virusolve^R+ disinfectant wipes were more effective than tap water, tap water containing detergent and PAL^R disinfectant wipes for decontamination of bacteria inoculated on patients' environmental and medical equipment surfaces at Siriraj Hospital.*

Keywords: *Disinfectant wipes, Hospital-acquired infection, Acinetobacter baumannii, Methicillin-resistant Staphylococcus aureus, MRSA*

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Healthcare-associated infection (HAI) is a serious and growing problem at every level of the healthcare system. HAI is associated with an increased attributable mortality, length of hospital stay and healthcare costs incurred by patients, insurers and healthcare facilities[1]. Overall prevalence of HAI in Thailand was 4.9% to 7.6%[2]. Prevalence rate of HAI was highest among university hospitals. The common sites of HAI were lower respiratory tract and urinary tract. Multidurg-resistant bacteria including *Acinetobacter baumannii* and methicillin-resistant *Staphylococcus aureus* (MRSA) were commonly observed in HAIs[2]. Extreme drug resistant (XDR) *A. baumannii* was the most common cause of hospital-acquired pneumonia and ventilator-associated pneumonia in Thailand[3,4].

The hospital environmental surfaces and surfaces of medical equipment and furniture are usually contaminated with hospital-acquired pathogens from hospitalized patients[5-11]. The frequently touched environmental surfaces include bed rail, bed headboard, bed footboard, bed linens, bed curtain, bedside table,

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control panels of medical equipments and medical devices. The contaminated pathogens on the aforementioned surfaces could be transmitted to other patients by many means, but especially through hospital personnel's hands[5-11]. The risk of acquiring infection from the pathogens on hospital's frequently touched environmental surfaces is significant. Therefore, periodic decontamination of hospital's frequently touched environmental surfaces has been recommended since it could reduce HAI[10-14]. Decontamination of hospital's frequently touched environmental surfaces can be done either by non-disposable wipes or disposable wipes. If non-disposable wipes are inappropriately used, the contaminated pathogens of the wipes could be transmitted to other surfaces[12,15]. Pre-prepared wipes are increasingly being used in clinical situations for the cleaning or disinfection of low risk equipment and the near-patient environment. Pre-prepared disposable disinfectant wipes are more convenient but they are usually more expensive than non-disposable wipes.

Siriraj Hospital is considering using pre-prepared disposable disinfectant wipes for decontamination of hospital's frequently touched environmental surfaces in high risk areas of hospital wards or during epidemic of infections due to XDR bacteria. Two pre-prepared disposable disinfectant wipes were proposed to be used in Siriraj Hospital. They were Virusolve^{R}+ disinfectant wipes [2-Aminoethanol $\leq$ 1%, Didecyldimethyl ammonium Chloride $\leq$ 1%, C, Bis (3-aminopropyl) dodecylamine 0.5-1%] and PAL^{R} disinfectant wipes [alkyl dimethyl benzyl ammonium chloride 0.48%, polymeric biguanide hydrochloride 0.2%, denatured ethanol 9.58%]. Since there are currently no accepted standards to support the selection and purchase of disinfectant wipes in health care settings, the objective of the present study was to determine the effectiveness of Virusolve^{R}+ disinfectant wipes and PAL^{R} disinfectant wipes for decontamination of inoculated bacteria on patients' environmental and medical equipment surfaces at Siriraj Hospital.

Material and Method

Patients' environment and medical equipments

They were patient's bed, infusion pump machine and respirator. The present study sites were patient's stainless steel bed rail, patient's fiber bed footboard, surface of control panel of infusion pump machine and surface of control panel of respirator. The surface area of each study sites were 5 cm x 10 cm.

Disinfectant wipes

They were Virusolve^{R}+ disinfectant wipes and PAL^{R} disinfectant wipes. Both products were generously donated by Amity International and Thanes Development Co., Ltd respectively.

Tested bacteria

They were one isolate of MRSA and one isolate of XDR *A. baumannii*. Both bacterial isolates were the pathogens causing hospital-acquired infections. The tested bacteria were prepared by inoculating fresh colonies of bacteria grown on blood agar plate into tryptic soy broths. The inoculated broths were mixed and adjusted to achieve 10^{8} CFU of bacteria per 1 ml of broth.

Study procedures

1. One millimeter of inoculated broth containing MRSA was painted onto the surface of each study site within the clean 5 cm x 10 cm paper frame for 5 sites and left at an ambient temperature for 15 minutes to dry.

2. Decontamination of the present study site was done with 5 methods by the same personnel.

No decontamination

This site served as a control.

Tap water

A clean cloth sized 10 cm x 10 cm was soaked with tap water and the squeezed tap water soaked cloth was used to rub the present study site for a few minutes.

Detergent in tap water

A solution containing 15 grams of detergent in 1,000 ml of tap water was prepared. A clean cloth sized 10 cm x 10 cm was soaked with such detergent solution and the squeezed detergent solution soaked cloth was used to rub the present study site for a few minutes.

Virusolve^{R}+ disinfectant wipes

A sheet of Virusolve^{R}+ disinfectant wipes sized 25 cm x 30 cm was used to rub the study site for a few minutes.

PAL^{R} disinfectant wipes

A sheet of PAL^{R} disinfectant wipes sized 13 cm x 18 cm was used to rub the present study site for a few minutes.

All study sites were left at an ambient

temperature for 15 minutes to dry after they were rubbed with decontamination procedures.

3. Each contaminated surface area within the sterile 5 cm x 10 cm paper frame that received decontamination method delineated in 2 was rubbed with cotton swabs. Then the cotton swabs were placed into a tube containing 1 ml of MHB and the tube was taken to the laboratory. Each swab was streaked on 4 quadrants of blood agar and MacConkey agar plate. The inoculated agar plates were incubated at 35°C for 18-24 hours. The incubated agar plates were examined for bacterial colonies.

4. The aforementioned procedures were also done using XDR *A. baumannii* instead of MRSA.

Results

The presence of tested bacteria after decontamination procedures are shown in Table 1 for MRSA and Table 2 for XDR *A. baumannii* MRSA and XDR *A. baumannii* were recovered from all control surfaces. All surfaces cleaned with tap water or tap water containing detergent revealed presence of both MRSA and XDR *A. baumannii*. However, the amounts of bacteria on the surfaces cleaned with tap water containing detergent were less than those cleaned with tap water alone. All surfaces cleaned with PAL^{R} disinfectant wipes also revealed presence of both MRSA and XDR *A. baumannii*. However, the amounts of bacteria on the surfaces cleaned with PAL^{R} disinfectant wipes were less than those cleaned with tap water containing detergent. No bacteria were recovered from all surfaces cleaned with Virusolve^{R}+ disinfectant wipes.

Discussion

XDR *A. baumannii* and MRSA were used to inoculate the study sites of frequently touched environmental surfaces because they were common causes of hospital-acquired infections in Thailand and were very resistant to many antibiotics[2-4]. The authors

Table 1. MRSA recovered from the study areas after various decontamination procedures

Study site	Decontamination procedure	Culture result on blood agar	Culture result on macconkey agar
Stainless steel bed rail			
	None	MRSA 3+	No growth
	Tap water	MRSA 2+	No growth
	Detergent in tap water	MRSA 2+	No growth
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	MRSA 6 colonies	No growth
Fiber bed footboard			
	None	MRSA 4+	No growth
	Tap water	MRSA 1+	No growth
	Detergent in tap water	MRSA 1+	No growth
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	MRSA 2+	No growth
Control panel of Infusion Pump			
	None	MRSA 4+	No growth
	Tap water	MRSA 2+	No growth
	Detergent in tap water	MRSA 2+	No growth
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	MRSA 2+	No growth
Control panel of Respirator			
	None	MRSA 3+	No growth
	Tap water	MRSA 1+	No growth
	Detergent in tap water	MRSA 1+	No growth
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	MRSA 1+	No growth

4+ = growth of bacteria seen on 4 quadrants of agar plate, 3+ = growth of bacteria seen on 3 quadrants of agar plate, 2+ = growth of bacteria seen on 2 quadrants of agar plate, 1+ = growth of bacteria seen on 1 quadrant of agar plate

Table 2. XDR *A.baumannii* (AB) recovered from the study areas after various decontamination procedures

Study site	Decontamination procedure	Culture result on blood agar	Culture result on macconkey agar
Stainless steel bed rail			
	None	AB 3+	AB 3+
	Tap water	AB 3+	AB 2+
	Detergent in tap water	AB 2+	AB 1+
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	AB 1+	AB 1+
Fiber bed footboard			
	None	AB 3+	AB 3+
	Tap water	AB 2+	AB 1+
	Detergent in tap water	AB 2+	AB 2+
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	AB 1+	AB 1+
Control panel of infusion pump			
	None	AB 4+	AB 3+
	Tap water	AB 1+	AB 1+
	Detergent in tap water	AB 1+	AB 1+
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	AB 3 colonies	No growth
Control panel of respirator			
	None	AB 3+	AB 2+
	Tap water	AB 10 colonies	AB 6 colonies
	Detergent in tap water	AB 1+	AB 1+
	Virusolve^{R}+ wipe	No growth	No growth
	PAL^{R} wipe	AB 6 colonies	AB 5 colonies

4+ = growth of bacteria seen on 4 quadrants of agar plate, 3+ = growth of bacteria seen on 3 quadrants of agar plate, 2+ = growth of bacteria seen on 2 quadrants of agar plate, 1+ = growth of bacteria seen on 1 quadrant of agar plate

inoculated these bacteria on the surfaces of hospital environments and medical equipments at amounts much higher than naturally occurring bacteria acquired since the authors wanted to be certain that disinfectant wipes were still effective even on the surfaces with heavy contamination of antibiotic resistant bacteria. The authors used tap water containing detergent as a comparison procedure because this procedure has been commonly used in many hospitals. Determination of leftover bacteria on the inoculated surfaces after decontamination procedures used in the present study had at least two limitations, 1) semi-quantitative method was used instead of quantitative method and 2) neutralization or inactivation of leftover antiseptic at the swabs taken from the present study surfaces decontaminated with antiseptics was not done. This study did not follow the aforementioned ideal procedures because the costs of both wipes products were comparable and we just wanted to screen if antiseptic activity of both products were significantly different. Therefore, neutralization procedures and quantitative culture that were complicated procedures were not used in the present study.

The present study found two main important observations. Tap water and tap water containing detergent might not be adequate procedures for decontamination of surfaces heavily contaminated with antibiotic resistant bacteria. Virusolve^{R}+ disinfectant wipes were more effective than PAL^{R} disinfectant wipes for decontamination of inoculated bacteria on patients' environmental and medical equipment surfaces. A difference in effectiveness of both disinfectant wipes could be due to the characteristics of antiseptics impregnated in the wipes. However, the sizes of disinfectant wipe sheets between Virusolve^{R}+ and PAL^{R} disinfectant wipes are different. A sheet of Virusolve^{R}+ disinfectant wipe is nearly twice as large as that of PAL^{R} disinfectant wipe. Therefore, a difference in sheet size of disinfectant wipes may have contributed to the more effectiveness of Virusolve^{R}+ than PAL^{R} disinfectant wipes that was observed. It should be kept in mind that our study was conducted on

decontamination of a large amount of XDR *A.baumannii* and MRSA on the frequently touched environmental surfaces. Whether Virusolve^{R}+ disinfectant wipes are more effective than PAL^{R} disinfectant wipes for decontamination of other pathogens, such as *Clostridium difficile*, fungi or viruses, is unknown. Although our study revealed that PAL^{R} disinfectant wipes were less effective than Virusolve^{R}+ disinfectant wipes, they were still more effective than tap water containing detergent. The evidence on effectiveness of decontamination of the frequently touched environmental surfaces inoculated with XDR *A. baumannii* and MRSA by using more than one sheet of PAL^{R} disinfectant wipes is not available.

Siriraj Hospital decided to have Virusolve^{R}+ disinfectant wipes to be used for decontamination of hospital's frequently touched environmental surfaces in high risk areas of hospital wards or during epidemic of infections due to XDR bacteria because Virusolve^{R}+ might contain more anti-bacterial activity and more convenient for use with comparable cost to the comparator.

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Potential conflicts of interest

None.

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ประสิทธิผลของผ้าชุบน้ำยาทำลายเชื้อในการทำลายเชื้อบนพื้นผิวของสิ่งแวดล้อมรอบผู้ป่วยและเครื่องมือแพทย์ในโรงพยาบาลศิริราช

จักรพงษ์ สีนามะ, พีร์นิธิ เตชะศิรินุกูล, ดวงพร จินตโนทัยถาวร, กาญจนา คชินทร, วิษณุ ธรรมลิขิตกุล

วัตถุประสงค์: *เพื่อทราบประสิทธิผลของผ้าชุบน้ำยาทำลายเชื้อ Virusolve^{R}+ และผ้าชุบน้ำยาทำลายเชื้อ PAL^{R} ในการทำลายเชื้อที่ป้ายบนพื้นผิวของสิ่งแวดล้อมและเครื่องมือแพทย์ในโรงพยาบาลศิริราช*

วัสดุและวิธีการ: *การทดสอบนี้ใช้เชื้อ MRSA และ XDR A.baumannii ป้ายที่ราวเตียงผู้ป่วยที่เป็นโลหะสเตนเลส ท้ายเตียงผู้ป่วยที่เป็นไฟเบอร์ หน้าปัดของเครื่องควบคุมการให้สารน้ำ และหน้าปัดของเครื่องช่วยหายใจ แล้วจึงทำความสะอาดด้วยน้ำประปา หรือน้ำประปาที่มีผงซักฟอก หรือผ้าชุบน้ำยาทำลายเชื้อ Virusolve^{R}+ หรือผ้าชุบน้ำยาทำลายเชื้อ PAL^{R} โดยมีบริเวณที่ป้ายเชื้อแต่ไม่ได้ทำความสะอาดใดๆ เป็นบริเวณควบคุมด้วย หลังจากนั้น จึงใช้ไม้ปลายพันสำลีป้ายพื้นผิวบริเวณที่ทำความสะอาดแล้วและพื้นผิวบริเวณควบคุมดังกล่าว แล้วนำไม้ปลายพันสำลีที่ป้ายพื้นผิวบริเวณดังกล่าวไปเพาะหาเชื้อ MRSA และ XDR A.baumannii ที่ใช้ป้าย*

ผลการศึกษา: *พื้นผิวบริเวณที่ไม่ได้ทำความสะอาดตรวจพบเชื้อที่ป้ายไว้ทุกบริเวณ พื้นผิวบริเวณที่ทำความสะอาดด้วยน้ำประปา และน้ำประปาที่มีผงซักฟอกก็ตรวจพบเชื้อที่ป้ายไว้ทุกบริเวณโดยพื้นผิวบริเวณที่ทำความสะอาดด้วยน้ำประปาที่มีผงซักฟอกพบเชื้อที่ป้ายไว้ปริมาณน้อยกว่าพื้นผิวบริเวณที่ทำความสะอาดด้วยน้ำประปา พื้นผิวบริเวณที่ทำความสะอาดด้วยผ้าชุบน้ำยาทำลายเชื้อ PAL^{R} ก็ตรวจพบเชื้อที่ป้ายไว้ทุกบริเวณ โดยมีปริมาณเชื้อที่ป้ายไว้เท่ากับหรือน้อยกว่าพื้นผิวบริเวณที่ทำความสะอาดด้วยน้ำประปาที่มีผงซักฟอก ส่วนพื้นผิวบริเวณที่ทำความสะอาดด้วยผ้าชุบน้ำยาทำลายเชื้อ Virusolve^{R}+ ตรวจไม่พบเชื้อที่ป้ายไว้ทุกบริเวณ*

สรุป: *ผ้าชุบน้ำยาทำลายเชื้อ Virusolve^{R}+ มีประสิทธิผลในการทำลายเชื้อบนพื้นผิวของสิ่งแวดล้อมและเครื่องมือแพทย์ในโรงพยาบาลศิริราช มากกว่าการทำความสะอาดด้วยน้ำประปา น้ำประปาที่มีผงซักฟอก และผ้าชุบน้ำยาทำลายเชื้อ PAL^{R}*