A Study on the Application of Pasteurization of Medical Equipment

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Objectives : *To study the need of pasteurization of medical equipment and the possibility of production of pasteurizer in Thailand.*
Material and Method : *The need of pasteurization of medical equipment was studied by a set of questionnaires to heads of the central sterile supply department (CSSD) and head ward nurses in 29 hospitals across Thailand. Efficacy of pasteurization was demonstrated by disinfection with an imported pasteurizer. A pasteurizer was later produced by the researchers and had it tested for efficacy in disinfection.*
Results : *There were 26 items of medical equipment that could be disinfected by pasteurization. The number of the equipment was 6.2 pieces per bed per week. Disinfection of the equipment was done in C.S.S.D. as well as in patient's wards. The imported pasteurizer was efficacious in disinfection. The pasteurizer made by researchers was convenient for use, not expensive to manufacture and the operating cost for disinfection was 2 to 6 folds less than that done by ethylene oxide gas.*
Conclusion : *Pasteurization is effective in disinfection and is applicable to certain heat labile medical equipments. A pasteurizer is not difficult to produce, cheap and the operating cost is low. Pasteurization should be more widely applied in Thailand.*

Keywords : *Pasteurization, Medical equipment*

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Disinfection of medical equipment can be achieved by pasteurization. The process involves heating of water up to 60-75 degrees celcius for 30 minutes. All forms of micro-organisms are eliminated by pasteurization except bacterial spores. Certain heat labile medical equipments for respiratory, gastro-enterology systems and for pelvic examination can be disinfected by pasteurization[1-4]. It is reliable, cheap and easy to operate. Unfortunately, pasteurization is used less than it should due to several reasons. The machine is bulky and is connected to a water delivery system. Drying of the equipment is required after pasteurization. More convenient methods, usually more expensive are often applied. It is common to observe that respiratory care tubes are sterilized by ethylene oxide or even by low temperature plasma sterilization. They are overused due to ignorance or the influence of advertisement.

Data to convince medical personnel that pasteurization is effective is essential before the process can be recognized and accepted. Production of a pasteurizer requiring less labor for operation is another mean to promote its use. The authors conducted a study on the effectiveness of pasteurization, its need and produced a new model of pasteurizer to promote its use in Thailand.

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Material and Method

Medical equipment requiring pasteurization for reuse were identified by the researchers. The amount of the equipment used in hospitals was acquired by a set of questionnaires distributed to 29 hospitals across the country enrolled by stratified random sampling. Data from head nurses and chiefs of central sterile supply department (CSSD) were collected and compared.

To convince the effectiveness of pasteurization, a pasteurizer was imported as there was no such machine in Thailand at the time of study. Respiratory care equipment was pasteurized and then cultured. A modified model of pasteurizer was produced by the researchers and tested for its efficacy. Cost comparison between pasteurization and ethylene oxide, low temperature steam and formaldehyde sterilization was done.

Results

Twenty-nine hospitals were randomly enrolled by stratified random sampling (Table 1). Sets of questionnaires were sent to 85 head nurses of patients' wards in different departments and to the chiefs of CSSD of each hospital. With the assistance of co-ordinating infection control nurses, all questionnaires were responded. The items suitable for disinfection by pasteurization were identified by the researchers, chiefs of CSSD and head nurses in Siriraj Hospital, one of the participating university hospitals. This equipment was mostly for respiratory care (Table 2). The amount of use of this equipment was acquired from head nurses and chiefs of CSSD. Almost all items were disinfected in both CSSD and in wards depending on the scope of service of CSSD in each hospital. In one week, there were 76,363 pieces of equipment which needed to be disinfected, accountable for 6.3 equipments per one hospital bed per week. Various methods were used in disinfection ie. : boiling, use of disinfectants, gaseous sterilization and autoclaving. Problems identified were : damage to the heat labile equipment which had under-

Table 1. Persons responded to questionnaires

Hospitals	No	Head Nurses	Chiefs of CSSD	Total
University	2	20	1	42
Regional	5	10	1	55
Provincial	10	6	1	70
District	10	2-3	1	31
Private	2	6	1	14
Total	29	183	29	212

Table 2. Numbers of medical equipments recycled in one week in 29 hospitals

Equipmnets	No.
1. Feeding syringe	8,491
2. Rubber bulb	2,119
3. Tracheal suction tube	42,522
4. Oxygen cannula	6,674
5. Oxygen mask	1,385
6. Ambu bag	562
7. Ambu bag connector	406
8. Corrugated tube	930
9. Extension tube	2,779
10. Humidifier of respirator	2,925
11. Plastic connector	3,431
12. Metal connector	615
13. Other respiratory equipment	183
14. Humidifier	477
15. Nebulizer	1,686
16. Endotracheal tube-plastic	897
17. Endotracheal tube-rubber	209
18. Tracheostomy tube-plastic	72
19. Tracheostomy inner tube-plastic	75
20. Tracheostomy tube-metal	63
21. Tracheostomy inner tube-metal	49
22. Mouth gag	819
23. Nasogastric tube	141
24. Proctoscope	78
25. Sigmoidoscope	25
26. Vagina speculum	3,299
Total	76,363

Table 3. Problems of disinfection of the 26 medical equipments

Categories	Common Problems
Administration	Inadequate supply
	Lost equipment
Service	Difficult to manage
	Time consuming
	Long waiting time
Quality	Broken equipment
	Moisture on equipment
	Staining of equipment
	Unclean equipment
	Damaged equipment
	Mold contamination

gone boiling or autoclaving, stains of disinfectants on equipment etc. (Table 3).

The imported pasteurizer functioned well. Table 4 shows the results of bacterial culture of the pasteurized products. All equipment was free from vegetative bacteria and fungi. Almost all samples yielded Bacillus spp. These bacteria have spore and thus survive pasteurization. A modified model of pasteurizer was produced by the researchers with the advice of nurses and CSSD personnel (Figure 1). The special feature of the presented model was that cleaning, pasteurizing and drying of tubes were all done in the same chamber, reducing the risk of contamination.

The efficacy of the pasteurizer produced by the researchers was tested; the results of bacterial culture of the equipment after pasteurization are illustrated in Table 5. All cultures were negative for vegetative bacteria and fungi.

Fig. 1 Pasteurizer developed by the researchers

Table 4. Results of bacterial culture after pasteurization with the imported pasteurizer

Equipment	No	Culture
Tracheal suction tube	22	Bacillus spp. (22)
Corrugated tube	27	Bacillus spp. (27)
Nebulizer	21	Bacillus ssp. (21)
Oxygen canula	21	Bacillus spp. (12)

Table 5. Results of bacterial culture after pasteurization with pasteurizer developed by the researchers

Equipment	No	Culture
Tracheal suction tube	22	Bacillus spp. (22)
Corrugated tube	17	Bacillus spp. (14)
Nebulizer	22	Bacillus ssp. (22)
Oxygen canula	25	Bacillus spp. (25)

Table 6. Cost comparison for disinfection by different methods (baht)

Equipment	Pasteurization		Low temp.	Ethylene
	Imported	Local	Formaldehyde	Oxide
Nebulizer (Hudzon)	3.01	2.65	1.70	5.40
Oxygen cannula	3.01	2.65	1.70	5.40
Corrugated tube	4.82	4.24	7.45	23.64
Trachealsuction tube	2.89	2.54	2.90	4.73

The operating costs for disinfecting various medical instrument are compared in Table 6. It was cheaper to disinfect the equipment by pasteurization than by ethylene oxide. The costs for disinfection were comparable between pasteurization and low temperature steam and formaldehyde. The latter involves a large and expensive machine. The costs were calculated as full load which is difficult to apply to low temperature steam and formaldehyde.

Discussion

The present study demonstrated the problems in disinfecting commonly used medical equipment in all hospitals. Due to economic reasons, much equipment is reused in Thailand (Table 1 and 2). Disinfection of the equipment is done either in wards or in CSSD or in both places and by different methods. In addition to problems in quality control for disinfection, many others followed (Table 2). Disinfection with chemicals was done in many hospitals. This was associated with damage to the material, staining of equipment and finally contamination with pathogens. Sterilization of certain equipments (Table 2) is not necessary and is a real economic loss because sterilization is more expensive than disinfection. Expensive procedures, for examples, ethylene oxide gaseous sterilization, low temperature gas plasma sterilization, are wrongly applied in many institutions. Pasteurization needs to be promoted in developing countries. The process is reliable and cheap. A pasteurizer is not difficult to produce, even for one single machine, the presented pasteurizer cost one-fourth of the imported machine; but they are both com-

parably effective (Tables 4 and 5). The imported machine consisted of a separate pasteurizer and dryer. Contamination can easily occur during transferring equipment from the pasteurizer to the dryer. The presented pasteurizer combines cleaning, pasteurizing and drying in the same chamber and thus reduces the risk of contamination. The process takes 30 minutes to wash and clean, 30 minutes to pasteurize and 90 minutes to dry. The whole cycle lasts about 3 hours. One cycle can handle 28 plastic tubes and many other small pieces of equipment. It is possible to run up to 3 cycles a day. The operating cost for pasteurization was lower when compared with ethylene oxide gaseous sterilization. The latter was widely applied for the 26 studied pieces of medical equipment. Low temperature steam and formaldehyde is an economic sterilization process. It is applied in only a few institutions due to high cost and big size of the machine. Pasteurization with locally produced pasteurizers is effective and cost-saving.[5,6] It is an appropriate disinfection method, especially in developing countries.

Conclusion

The need for disinfection by pasteurization was high in Thailand. A pasteurizer was produced locally and was proved effective and cost-saving.

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การศึกษาเพื่อประยุกต์ใช้พาสเตอร์ไรเซชั่นสำหรับเครื่องมือแพทย์

สมหวัง ด่านชัยวิจิตร, ไพโรจน์ สุวรรณสุทธิ, ชาญวิทย์ ตรีพุทธรัตน์, เชิดศักดิ์ ธีระบุตร, วราภรณ์ พุ่มสุวรรณ, สุมาลี ภควรวุฒิ

วัตถุประสงค์ : *ศึกษาความต้องการการทำลายเชื้อด้วยวิธีพาสเตอร์ไรเซชั่นสำหรับอุปกรณ์ทางการแพทย์และความเป็นไปได้ของการผลิตเครื่องพาสเตอร์ไรเซอร์ไว้ใช้ในประเทศไทย*

วัสดุและวิธีการ : *ความต้องการการทำลายเชื้อด้วยวิธี พาสเตอร์ไรเซชั่น ศึกษาโดยใช้แบบสอบถามหัวหน้าหน่วยจ่ายกลางและพยาบาลหัวหน้าหอผู้ป่วยในโรงพยาบาลต่าง ๆ 29 แห่งทั่วประเทศไทย ศึกษาประสิทธิภาพของการทำลายเชื้อด้วยวิธีพาสเตอร์ไรเซชั่นโดยใช้เครื่องที่นำเข้าจากต่างประเทศ คณะผู้วิจัยสร้างเครื่อง pasteurizer ที่มีคุณสมบัติที่เหมาะสมและทดสอบประสิทธิภาพ*

ผลการศึกษา : *เครื่องมือทางการแพทย์ที่เหมาะสมสำหรับการทำลายเชื้อด้วยวิธีพาสเตอร์ไรเซชั่นมี 26 รายการ จำนวนเครื่องมือดังกล่าวเท่ากับ 6.2 ชิ้นต่อเตียงต่อสัปดาห์ การทำลายเชื้อเครื่องมือข้างต้นทำทั้งในหน่วยจ่ายกลางและในหอผู้ป่วย เครื่องพาสเตอร์ไรเซอร์ที่นำเข้าจากต่างประเทศมีประสิทธิภาพดี เช่นเดียวกับเครื่องที่นักวิจัยสร้างขึ้นมา เครื่องที่สร้างขึ้นเองสะดวกในการใช้ ต้นทุนไม่แพงและค่าใช้จ่ายในการทำลายเชื้อต่ำกว่าวิธีการอบแก๊สเอธิลีน ออกไซด์ 2-6 เท่า*

สรุป : *พาสเตอร์ไรเซชั่นมีประสิทธิภาพดีในการทำลายเชื้อและสามารถนำมาประยุกต์ใช้กับเครื่องมือแพทย์หลายชนิดที่ทนความร้อนไม่ได้ เครื่องพาสเตอร์ไรเซอร์สร้างได้ไม่ยาก ราคาถูกและเสียค่าใช้จ่ายในการดำเนินการต่ำ ประเทศไทยน่าจะนำวิธีพาสเตอร์ไรเซชั่นมาใช้มากขึ้น*