Gloves Reprocessing: Does It Really Save Money?

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Received: 19 December 2014 / Accepted: 11 May 2015 / Published online: 21 May 2015
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Abstract Gloves are reprocessed and reused in health-care facilities in resource-limited settings to reduce the cost of availability of gloves. The study was done with the aim to compute the cost of reprocessing of gloves so that an economically rationale decision can be taken. A retrospective record-based cross-sectional study was undertaken in a central sterile supply department where different steps during reprocessing of gloves were identified and the cost involved in reprocessing per pair of gloves was calculated. The cost of material and manpower was calculated to arrive at the cost of reprocessing per pair of gloves. The cost of a reprocessed pair of surgical gloves was calculated to be Indian Rupee (INR) 14.33 which was greater than the cost of a new pair of disposable surgical gloves (INR 9.90) as the cost of sterilization of one pair of gloves itself came out to be INR 10.97. The current study showed that the purchase of sterile disposable single-use gloves is cheaper than the process of recycling. Reprocessing of gloves is not economical on tangible terms even in resource-limited settings, and from the perspective of better infection control as well as health-care worker safety, it further justifies the use of disposable gloves.

Keywords Gloves · Reprocessing · Cost · Health-care worker safety

Introduction

Gloves are used throughout the health-care setting by all categories of health-care workers, i.e. doctors, nurses, technicians and housekeeping staff. The types of gloves used should vary depending upon the intended use; however, surgical gloves being donned for inappropriate use can be seen commonly.

The use of gloves in health-care settings is not new and is the mainstay of barrier and universal precautions [1]. The emergence of HIV and other blood-borne pathogens like HBV and HCV has increased the awareness regarding their importance in prevention of transmission of these diseases during patient care. The role of gloves in health-care worker safety is an established fact. It is expected that appropriate gloves will be present at the site of their intended use at all the times. However, the actual situation is far removed from the expectation. Some of the basic requirements of hand hygiene are not met in resource-limited settings forcing the users to adopt less than desirable alternatives. The reprocessing and use of surgical gloves is one such measure to overcome the shortage of gloves [2]. The study was undertaken to estimate the cost of reprocessing surgical gloves so as to understand the economics of reprocessing since it is assumed that the reprocessing of gloves is done to offset the cost of procuring new gloves.

Materials and Methods

Setting

This retrospective record-based cross-sectional study was conducted in a large public sector tertiary care teaching hospital of North India with more than 1700 beds, and data was

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Fig. 1 Steps involved in reprocessing of gloves

collected for a period of 1 year from 1 April 2012 to 31 March 2013.

Resource Consumption and Cost Estimation

The gloves were procured (in the study setting) through open tender process and were sent for sterilization after receipt in the CSSD through central stores. Various steps involved in the process were catalogued (Fig. 1), and the cost involved in each step and consumables used was determined to arrive at the cumulative cost. Costing heads considered were men, material and machine. The cost of material, i.e. gloves, cleaning agent, powder and packing envelope, was taken from central stores to know the spending on the procurement of raw material since all the raw materials were received there. The cost of manpower was calculated on the basis of salary being paid to the particular worker directly engaged in the process and was deduced to per day and per hour basis for computation. The expenditure incurred on electricity was calculated from the wattage/hour of the equipment and the amount of time the equipment was operational. Similarly, water consumed was also calculated as per consumption. The rates as charged by local authorities for electricity and water during the study period were taken for arriving at the final charges for the same. The overall cost was deduced by integrating the costs obtained in individual processes and then divided with the number of

total pair of gloves reprocessed in a year to arrive at the cost of reprocessing per pair of gloves.

Results

Outcome

A total of 18,850 pairs of gloves procured were subjected to reprocessing during the time period 1 year from 1 April 2012 to 31 March 2013. At the end of study period, it was found that some of the gloves could only last one cycle of reprocessing and were discarded, while others lasted for more. Therefore, practically, the total number of gloves which were reprocessed from 18,850 pairs of gloves was 52,775 after having undergone through couple of cycles of reprocessing before these 18,850 pairs could no longer be reprocessed. Costs involved in the various processes towards reprocessing a pair of glove were calculated (Tables 1, 2 and 3). The study brings out that the total cost of a reprocessed pair of gloves was Indian Rupee (INR) 14.33. The total cost included the cost attributable to machine, manpower and material in various processes involved. Around 66.57 % of the cost was attributable to manpower, while the cost of material constituted 26.42 % of the total costs.

Table 1 Cost of material [all costs in Indian Rupee (INR)]

S. No.	Item	Number/unit	Cost/unit	Cost (INR)
1	Non-sterile gloves	18,850 pairs	9.40/pair	177,190.00
2	Glove powder	103 kg	39.49/kg	4067.50
3	Outer envelope	52,275	0.25/envelope	13,193.75
4	Cleaning agent (detergent)	72 kg	75/kg	5400.00
	Total (A)			199,851.25

Table 2 Cost of manpower (all costs in INR)

S. No.	Activity	Manpower	Salary/day (cost/day)	Cost in INR (per annum)
1	Packing	CSR assistant (1)	700/day	255,500.00
2	Packing	Hospital attendant (1)	500/day	182,500.00
3	Sterilization (1 h/day)	CSR assistant (1)	100/day	36,500.00
4	Sterilization (1 h/day)	Hospital attendant (1)	80/day	29,200.00
	Total (B)			503,700.00

Discussion

We undertook a retrospective cross-sectional study to determine the cost of reprocessing of surgical gloves in the central sterile supply department of a tertiary care teaching hospital in India so as to understand the economics of reprocessing.

During the study period, 18,850 pairs of gloves were procured and reprocessed. While reprocessing, gloves were checked by air insufflation for integrity and the gloves with leaks were rejected. It has been the experience of the authors that gloves do not last beyond three cycles and some even less. The cost of one pair of reprocessed gloves came out to be INR 14.33, and the cost of reprocessing came out to be INR 10.97. Interestingly, the institute was also procuring sterile disposable surgical gloves at INR 9.90 per pair. It is pertinent to mention that besides these pairs of gloves which were reprocessed, the hospital was also procuring disposable surgical gloves as per the sanctioned hospital budget for surgical stores at that point in time. The gloves procured by the patients from outside the hospital for various reasons also contributed to the pool of gloves. Gloves have been known to be one of the important components of PPE and, along with hand hygiene, play a significant role in the prevention of HAI. Intact surgical gloves are an important barrier for transmission of infection to and from the patients [3]. Esteban et al. demonstrated the possibility of transmission of hepatitis C from surgeon to the patients due to intraoperative perforation of the gloves [4]. Another study by Harpaz et al. also concluded that a surgeon may have transmitted hepatitis B to patients with perforated gloves as a probable cause [5]. Misteli et al. found that the risk of surgical site infection (SSI) increases

significantly in procedures in which gloves are perforated and microbial prophylaxis has not been administered [6]. It can be safely assumed that if reprocessed gloves with micro perforations are used, it may result in increasing the opportunity for transmission of infections from the patient to the treating team and vice versa.

Reprocessing is done in the health-care establishments to reduce the cost and to attempt its uninterrupted availability.

The costing exercise and the comparison of the cost of reprocessed gloves with disposable surgical gloves have shown that the reprocessing is not economical which is the only reason the process is undertaken. Additionally, numerous studies have proved that perforations occur in the surgical gloves during use. Laine and Aarnio [7] calculated the perforation rate to be 18.5 % during orthopaedic procedures. Solda et al. [8] used water leak method to check the integrity of used gloves and found that punctures were found in 16.3 % of gloves used in emergency surgical procedures with a larger percentage occurring in traumatic emergencies. Kojima and Ohashi [9] reported perforation rate to be 12 and 41 % in gloves used in thoracoscopic and open thoracotomy procedures, respectively. Hagos et al. [10] not only raised the issue of physical integrity in reprocessed gloves but also pointed out that such gloves failed sterility tests in 41 % of cases. Damage to the physical integrity of gloves being recycled was also noticed during the study, and such gloves were removed from the circulation. Air insufflation or air leak test was used to detect perforations. However, Gunasekera et al. [11] have averred that air leak test is not a very sensitive test to detect perforations and autoclaving would increase the friability of such gloves. Hence, the chances of glove perforations being

Table 3 Cost of water and electricity (all costs in INR)

S. No.	Item	Activity	Consumption	Cost per unit (in INR)	Cost in INR (per annum)
1	Water	Washing	75 l/day	12/kL	336.00
2	Water	Sterilization	25 l/h	12/kL	120.00
3	Electricity	Washing	2 units/day	5.5/unit	4015.00
4	Electricity	Sterilization	24 units/h	5.5/unit	48,180.00
	Total (C)				52,651.00

Total cost as calculated above ($A+B+C$) (in INR)=756,202.25; number of pairs of gloves reprocessed (D)=52,775; cost of one pair of reprocessed gloves= $A+B+C/D$

missed in the study setting were there and, if detected and removed, would increase the cost of reprocessing further.

Conclusion

In the absence of standardized process of glove reprocessing, different health-care organizations may be using different approaches for reprocessing, each with its own shortcomings. This leads to a scenario where gloves with doubtful physical integrity and sterility may be pushed into use on the pretext of cost saving. The present study showed that even purely on the tangible terms, the purchase of sterile disposable single-use gloves is cheaper than the process of recycling. The intangible benefits of not reusing gloves such as better infection control as well as health-care worker safety further justify the use of disposable gloves. Hence, as Gunasekera et al. [11] advocated, it is recommended that the gloves should not be reused even in a resource-limited settings.

Conflict of Interest None.

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