Effect of Domestic Laundering on Removal of Bacterial Contamination from Nurses' White Coats

Priyanka Gupta, Nilanjana Bairagi and Deepti Gupta

Abstract *Objective* Effect of laundering in bacterial decontamination of nurses' white coats. *Methodology* Patches of sterilized polyester and polyester cotton blend fabric were stitched on a washed white coat, worn by nurses for two shifts. At the end of the second shift, one patch was removed and plated. The other patch was removed and plated after domestic laundering of the coat. Total microbial contamination on the patches was assessed in brain heart infusion (BHI) broth before and after laundering. *Findings* All white coats sampled in the study across different wards of the hospital were found to be contaminated even after laundering. After two shifts, the contamination on blend was 54% higher than polyester fabric. After the domestic laundering, the bacterial reduction was 76% on polyester and 81% on the blend. *Conclusion* Nearly 20% of the contaminants were retained on the coat after laundering, indicating that the nurses, in fact, are carrying potentially harmful infections both into the hospital and their homes. The current home-laundering practices followed in India are not sufficient for sterilization of the nurses' uniform; thus, laundering guidelines are required to completely decontaminate the coats.

Keywords Laundering · Decontamination · Uniforms · Hospital textiles · Infection control

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1 Introduction

There are a number of bacterial reservoirs in a hospital setting, and hospital textiles are one of them. The growth of micro-organisms on textiles inflicts a range of unwanted effects not only on the textiles itself but also on the wearer. These effects include the generation of unpleasant odour, stains and discoloration in the fabric, a reduction in fabric mechanical strength and an increased likelihood of contamination.

Surfaces in hospital environment get contaminated with pathogenic micro-organisms which usually come from patients, healthcare workers, visitors, or from external sources. Therefore, the hospital environment is considered as a reservoir of pathogenic micro-organisms and some of which can survive for a longer period of time. These pathogens can spread to patients through direct or indirect contact leading to the development of healthcare-associated infections (HAIs) [6].

The rising incidence of hospital infections is a matter of great concern in India. This growth is often attributed to the absence of effective infection control strategies in healthcare facilities. The studies are mostly focused on ineffective laundering practices followed by hospitals and nurses. Research finding of healthcare worker's uniform laundering is very limited, and the methods and study designs vary significantly, making positive correlations and definitive justifications difficult to confirm [7]. In one of the study, the occurrence of bacterial contamination of the linens in the hospital due to improper laundering was observed [5]. The linens in the hospital environment have more patient contact than healthcare workers' uniforms; hence, improper decontamination of the linens can have severe consequences for patients. The studies show the contradictions in the effectiveness of home laundering and industrial laundering of the scrubs.

The nature and frequency of laundering practices may have implications in the spread of infections. The laundering methods used for nurses' uniform are diverse in India. The two laundering methods which are used for washing the contaminated uniforms are industrial laundering and domestic laundering. The temperature, detergent, time of washing and drying conditions are different in both the laundering mechanisms. The lack of specific guidelines or policies for laundering in the literature suggests that the contamination arrives at the hospital due to improper handling of the uniforms during laundering. It has been reported that hospitals and other health organizations are unable to monitor the home-laundering practices of the healthcare workers' uniform and hence cannot prevent the problem [4]. Therefore, it is important to investigate the home-laundered scrubs as a possible source of contamination.

There are limited studies on the efficacy of domestic laundering methods practised in India in decontaminating soiled nurses' white coats. This paper investigates the effectiveness of domestic laundering method in eliminating bacterial contamination from nurses' white coats. Microbial contamination on polyester and blend fabric patches, worn for two shifts (12 h of exposure), was studied for home-laundered nurses' white coats, which is a normal practice in government hospitals in India.

2 Methodology

The study was undertaken in a 100-bedded government hospital in Delhi, India, during the month of April–May 2016. Two nurses from five different wards, namely paediatric, medicine, gynaecology, casualty and intensive care unit, participated in the study.

2.1 Sampling Method

Two kinds of fabric, namely polyester and polyester cotton blend fabric, were selected for the study in India based on the current uniform fabrics used for nurses' uniform. To investigate bacterial contamination in a hospital environment, bacterial growth was studied in brain heart infusion (BHI) broth for the total microbial load. Brain heart infusion broth is a highly nutritious general-purpose growth medium where all bacteria can grow. All chemicals and media used for bacterial sampling were procured from HiMedia Laboratories Pvt. Ltd., Mumbai.

The samples were taken from the abdominal region over the pockets of the nurses' white coat. The nurses were asked to get the laundered coat before the beginning of the shift. Fabric patch method was developed in the study to assess the bacterial load on nurses' white coats. A 20 cm × 10 cm fabric sample of 100% polyester was stitched to a 20 cm × 10 cm swatch of 70/30 polyester cotton-blended fabric to make a total patch of size 20 cm × 20 cm. This fabric patch was marked on the wrong side to differentiate between the exposed and non-exposed fabric sides. The prepared sterilized patch was stitched with gloved hands over the abdominal area (below belt) of the nurses' coat—one on the left and another on the right side using a sterile needle and thread at 8:00 am as shown in Fig. 1. The nurse would wear the coat and perform their normal duties. The patch was removed after the two shifts (twelve hours of exposure), and the patch on the right side was removed and taken immediately for plating. Then the coat with an exposed patch on the left side was folded and kept in a sterile polythene bag which was then home-laundered by the nurse. At home, it was soaked in water along with commercial detergent at room temperature for 30 min. This is followed by scrubbing, rinsing and finally drying in the open. After drying, the patch on the left side was removed from the laundered coat, bagged and taken to the microbiology laboratory for plating on BHI plates.

A total of 40 swatches were sampled in this study—10 nurses × 2 fabrics × 2 methods (before and after laundering).

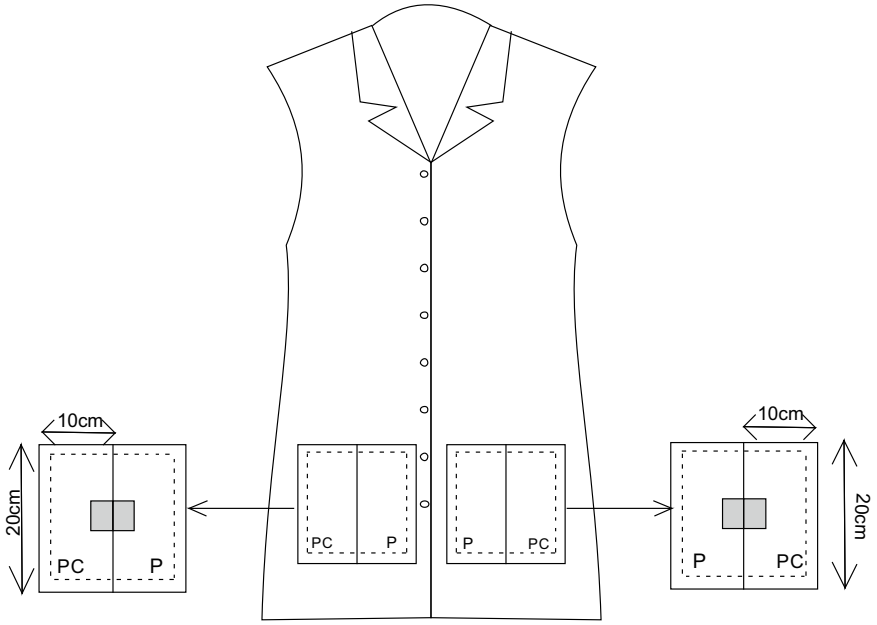

Fig. 1 White coat with test patch attached. P, polyester; PC, polyester cotton. Shaded portion indicates the location of the swatch cut for sampling

2.2 Determination of Bacterial Counts

In the microbiology laboratory, the collected patches of polyester and blend fabric were cut into swatches of 4 cm × 3 cm as marked, inside a biological safety cabinet. The cut samples were kept for five minutes in the non-nutritive medium phosphate-buffered saline (PBS, 1X) to moisten and maintain pH and osmolarity of the bacteria present on the sample, taken out and placed on the brain heart infusion (BHI) broth plates for 15 min with the exposed area facing the media. After 15 min of contact time, the swatches were removed and discarded. The inoculated plates were dried for 10 min and then incubated for 24 h at 37 °C. The colonies were counted manually the next day.

Control: Sterilized 100% polyester and 70/30 polyester cotton blend fabric patches were plated and incubated on BHI media, and the colonies were counted on the next day.

Table 1 Bacterial count (CFUs) on polyester and blend fabric

Ward	Polyester		Polyester cotton	
	BL	AL	BL	AL
Paediatrics	280	41	398	53
	287	38	374	42
Gynaecology	192	58	363	71
	184	50	347	66
Medicine	155	62	297	77
	164	40	278	53
Casualty	150	43	183	57
	134	52	187	69
Intensive care unit	255	57	387	63
	270	49	376	54
Total (CFUs)	**2071**	**490**	**3190**	**605**

(Before laundering: BL; after laundering: AL)

3 Results

There was no growth observed on the two control samples, indicating no contamination prior to sample collection and testing.

3.1 BHI Broth

Test patches were sampled for total bacterial contamination before and after laundering of coats that had been worn for two consecutive shifts. Total colony counts obtained on test samples in BHI broth, before and after laundering, are compiled in Table 1. The total colony count on polyester was around 2071 CFUs, and on polyester cotton was around 3190 CFUs. After the home-laundering process, bacterial colonies were reduced by nearly 76% (60–87%) on polyester and 81% (63–89%) on the blend. Mean colony counts on blend after laundering were 60.5 CFUs (42–77 CFUs) which was 23.4% higher than polyester with 49 CFUs (38–62 CFUs) as shown in Fig. 2.

4 Discussion

All white coats sampled in the study across different wards of the hospital were found to be contaminated even after laundering. The difference in a number of colonies from various coats could be because each nurse used a different method of laundering. The temperature of laundering, type of detergent or vigorousness of scrubbing with

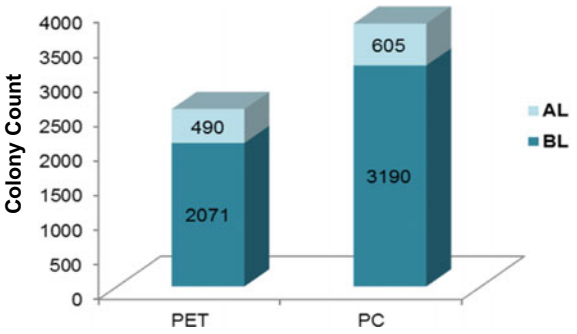

Fig. 2 Total bacterial count (CFUs) on polyester (PET) and blend fabric (PC) in BHI media (BL, before laundering; AL, after laundering)

hand or brush can have an effect on the degree of decontamination. However, it is worthwhile to note that variations in the method notwithstanding, about 11–13% microbes were always remaining after laundering. In some cases, the values were as high as 40%. This may also be attributed to the low washing temperature of less than 70 °C as per the recommendation of US CDC and also due to lack of chlorine bleach treatment on the laundered coats [1].

In another study when the bacterial contamination was compared on new, disposable, laundered and unlaundered hospital scrubs, it was documented that significantly higher bacteria counts were isolated from home-laundered scrubs and unwashed scrubs than from new, hospital-laundered and disposable scrubs [3]. Similar results were observed in this study.

Laundering of contaminated scrubs at home also increases the chances of contamination of the home environment. Inappropriate laundering temperature and lack of decontamination instructions may lead to contamination of an entire load of clothing [2, 4].

5 Conclusion

This research provides the latest insights on the degree of contamination of nurses' uniform in Indian hospital across different wards. It was found that nearly 20% of bacteria were retained on the nurses' coat after home laundering, indicating that the nurses, in fact, were carrying potentially harmful infections both into the hospital and their homes. The nurses should use a new set of laundered and sterilized uniform in each shift to avoid nosocomial infection and build-up of microbial contamination on the uniform from one shift to the next. To ensure complete decontamination policy needs to be included in determining the type of detergent, the temperature of wash and the method of drying and ironing. Methods for safe handling and transporting of soiled textiles based on hygienic storage should also be defined.

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