Your inhouse Laundry Partner

Microbiological Analysis of Microfibre Cloths Employed Within A Hospital Environment.

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1. Introduction

At any time approximately one in 10 patients in acute hospitals have a hospital-acquired infection (HAI). At the same time an unquantified number of patients discharged into the community from hospital have an infection related to their hospital admission. HAI imposes both a financial and non-financial burden to society.

A clean hospital environment is vital to provide a background to acceptable hygiene standards as well as maintaining the confidence and morale of patients, healthcare staff and visitors. Hospital floors and surfaces become contaminated by settlement of airborne bacteria, by contact with items such as shoes, trolley wheels and other solid objects, and occasionally by the spilling of urine, pus, sputum and other fluids. Some of the bacteria lie loosely in dust while others are ingrained into the surface and between cracks. Pathogens commonly present include Staphylococcus aureus dispersed by patients and staff and in much smaller numbers Gram-negative rods, such as Pseudomonas aerogenous. Clostridium difficile is transmitted between patients, health care workers and the environment. Environmental contamination with C.difficile spores, often widely dispersed has been demonstrated in 34-58% of sites in hospital wards. Commodes, bed frames, sluice rooms and toilet floors were the most frequently contaminated sites and the floor areas showed heaviest contamination. Although it can be difficult to distinguish cause and effect in most studies correlation can be shown between environmental contamination and infection rates.

A number of initiatives have been introduced to improve cleaning standards within hospitals and nursing homes. These have included the introduction of colour coding and microfibre mops and cloths.

Studies with microfibre have been carried out both in the UK and in Europe; these have indicated that infection rates can be reduced with additional financial benefits. Laundering of microfibre products is crucial to both the life and efficacy of these materials. *Without good laundering capabilities the use of microfibre or even conventional mops and cloths should not be considered.*

Current UK healthcare laundering guidelines (HSG (95) 18) recommend that wash cycles should be maintained at 65^{o}C for at least 10 minutes or 71^{o}C for at least 3 minutes with additional time for mixing. These guidelines were first introduced over 30 years ago, following research carried out in the late 1960's. The Central Public Health Laboratory at the British Laundries Research Association laboratory supervised this work. Four test organisms were selected to represent the various degrees of resistance to heat and chemicals. Whilst the guidelines are considered adequate for disinfection of most bacteria in the vegetative form and also for many viruses there has been very little importance placed on reviewing these guidelines, particularly in light of current public health concerns.

It was not until the 1970's that the toxigenic C.difficile was identified as the cause of Pseudomembranous colitis (PMC) in man. The genus Clostridium comprises a group of gram-positive, anaerobic or aero-tolerant bacilli, widely distributed in soil and in the intestinal tracts of animals. Its vegetative cells are capable of forming spores, which have resistance to heat, drying and chemical agents. Permitting the organism to survive in relatively harsh environments. The organism is now thought to be responsible for a spectrum of largely but not exclusively hospital-acquired disease, ranging from asymptometric colonisation to life threatening colitis. This spectrum has become known as C.Difficile

Associated Disease (CDAD). CDAD also imposes a significant financial burden in health care services.

A hospital outbreak in Manchester in 1992 affected 175 patients and was estimated to have cost £47K. In 1996 the total cost of CDAD was estimated at over £4K per case. Other sources of environmental contamination include doctors and nurse's uniforms and blood pressure cuffs. In a microbiological study conducted in 2001, C. difficile was detected on nurse's uniforms before and after span of duty. A similar study carried out by the Public Health Laboratory, East Birmingham Hospital reported that the cuffs and pockets of doctors white coats were the most highly contaminated areas. Staphylococcus aureus was isolated from a quarter of the coats examined.

It is in the interest of everyone to investigate and promote new technologies, which may prevent or reduce the risk of HAI. The National Clostridium difficile Standards Group recommends that Healthcare providers (both hospital and community based) should be encouraged to promote practices known to reduce the incidence of CDAD. This includes cleanliness and hygiene – including environmental cleaning.

Ozone is a powerful biocide and fungicide, second only to fluoride (F_2). It is a highly reactive gas comprising triatomic oxygen O_3 formed by the recombination of oxygen. It exists as a natural component of the atmosphere. Commercially it is produced by a range of mechanisms for a wide range of applications from swimming pool disinfection, water purification, laundries and food sanitation. OTEX a system developed by JLA, the UK's largest supplier of laundry equipment has gained success within the hotel and care industry. It has gained approval from the Director of Nursing, Director of Infection Prevention Control, East and North Hertfordshire NHS. CSCI has officially confirmed that OTEX is fully compliant with the National Minimum Standards. Ozone gas is injected directly into the water employed in the wash process via JLA's patented interfusor system. This provides a continual replenishment flow of ozonated water throughout the wash and rinse cycles. The advantage of this system is that the bio burden is continually treated with ozone providing constant disinfection.

Microfibres are a blend of polyester and polyamide fibres, which have undergone a process splitting the yarn into thousands of tiny fibres each less than a 100^{th} the size of a human hair. This creates the potential of a huge surface area with unique absorbency properties enabling them to be used effectively in both wet and dry conditions. When used dry static electricity attracts soil to the fibres, whilst in damp applications soil is drawn into the fibres by capillary action. Their effectiveness at cleaning surfaces and removing bacteria, yeast and moulds is well documented.

2. Methodology

To investigate the effectiveness of the ozone wash process analysis of microfibre cloths from two UK hospitals was carried out before and after washing. Individual microfibre cloths were randomly selected cut in half. One portion was retained as the pre sample. The other remaining half was processed with OTEX. Its allocated batch number plus laboratory ref number identified each sample. In order to maintain confidentiality the identity of these sites has been withheld. Photographic evidence of the dividing of the cloths is given below:

Three separate laboratories were employed to provide independent data and carry out the analysis. Details of these laboratories are given below:

Test Facility	Details
Microsearch Laboratories Ltd	Microsearch Laboratories Ltd Unit 3-7 Scotts Trading Complex Mytholmroyd Halifax HX7 5LH Contact: R.D.O'Connor B.Sc.Ci. Biol M.I.F.S.T
Huddersfield University	University of Huddersfield Microbiology School of Applied Sciences Queensgate Huddersfield HD1 3DH Contact: Dr Paul Humphreys
NHS Grampian Microbiological Department	Public Health Laboratory Department of Microbiology Aberdeen Royal Infirmary Aberdeen AB25 2ZN Contact: Dr T Reid Consultant Microbiologist.

3. Programme Details and Test Conditions

The standard OTEX microfibre program was employed at each site, this is a cold program with minimal detergent dosed within the main wash.

Details of the wash program installed are given below together with a typical thermal disinfection program details for comparison.

Program	OTEX	Thermal Disinfection
	Temp	
Pre Wash	Cold	Warm 40°C
Main Wash	Cold	Hot 75°C
Rinse 1	Cold	Cold
Rinse 2	Cold	Cold
Rinse 3	Cold	Cold
Cycle Time	47 mins	1 hour

Based on a 16 kilo machine, cycle times dependent upon machine.

4. TEST RESULTS

Test Laboratory	Microfibre Batch No:	Site	Lab Ref Code	Sample	Date	TVC Before (Cfu/g)	TVC After (Cfu/g)	C.difficile Before (Cfu/g)	C.difficile After (Cfu/g)
Grampian NHS Microbiological Department	010.603	Scottish Hospital	W07040259	Red Microfibre Cloth	13/04/2006	1.90E+07	8.50E+03	Problems occurred with the analysis at the Grampian Hospital Microbiological Department. No C. difficile spores were detected.	
	010.603		W07040260	Red Microfibre Cloth	13/04/2006	3.20E+07	2.26E+04		
	010.680		W07040261	Blue Microfibre Cloth	13/04/2006	3.50E+07	1.00E+04		
	010.680		W07040262	Blue Microfibre Cloth	13/04/2006	8.32E+06	2.17E+03		
	010.603		W07040263	Red Microfibre Cloth	13/04/2006	4.12E+06	3.50E+02		

Test Laboratory	Microfibre Batch No:	Site	Lab Ref Code	Sample	Date	TVC Before (Cfu/g)	TVC After (Cfu/g)	C.difficile Before (Cfu/g)	C.difficile After (Cfu/g)
Microsearch Laboratories Ltd	010.603	Scottish Hospital	1/5	Red Microfibre Cloth	13/04/2006	2.90E+06	190	57	< 1
	010.603		2/6	Red Microfibre Cloth	13/04/2006	4.00E+07	300	60	< 1
	010.717		3/7	Blue Microfibre Cloth	13/04/2006	9.10E+06	180	13	< 1
	010.680		4/8	Blue Microfibre Cloth	13/04/2006	8.30E+06	59	9	< 1

Test Laboratory	Microfibre Batch No:	Site	Lab Ref Code	Sample	Date	TVC Before (Cfu/g)	TVC After (Cfu/g)	C.difficile Before (Cfu/g)	C. Difficile After (Cfu/g)
Huddersfield University	015.109	North West Hospital	3/15	Blue Microfibre Cloth	2/05/07	2.9E+09	1.1E+02	1.7E+02	No Growth
	010.675		4/16	Red Microfibre Cloth	2/05/07	8.8E+08	<10	6.5E+03	No Growth
	015.109		7/14	Blue Microfibre Cloth	2/05/07	<10	<10	No Growth	No Growth
	010.675		8/13	Red Microfibre Cloth	2/05/07	<10	<10	No Growth	No Growth

Test Laboratory	Microfibre Batch No:	Site	Lab Ref Code	Sample	Date	TVC Before (Cfu/g)	TVC After (Cfu/g)	C.difficile Before (Cfu/g)	C.difficile After (Cfu/g)
Microsearch Laboratories Ltd	015.109	North West Hospital	1/9	Blue Microfibre Cloth	2/05/07	1.3E+08	80	18	<1
	010.675		2/12	Red Microfibre Cloth	2/05/07	2.10E+07	420	94	<1
	015.109		5/10	Blue Microfibre Cloth	2/05/07	1.90E+07	<1	<1	<1
	010.675		6/11	Red Microfibre Cloth	2/05/07	2.10E+08	<1	27	<1

5. Conclusion

Due to limited time constraints placed upon this task two hospital sites were chosen to collect microfibre cloths for analysis. The Scottish hospital microfibres were processed within the hospital laundry in Scotland using an OTEX system previously installed. The microfibre cloths sourced from the North West Hospital were processed under laboratory conditions at JLA's own R & D facilities using a standard microfibre program.

Three independent laboratories were chosen, however the lack of experience at Grampian on the analysis of non-fluid specimens proved to be problematic particularly with the identification of C. difficile growth.

The results clearly show that consistent log reduction is being achieved with the OTEX system and the results from both Microsearch and Huddersfield University Microbiological department confirm the effectiveness of ozone to eradicate C.Difficile spores. This fully supports the data collated over the last three years starting with the development of the OTEX system and including the 6-month trial at QEII hospital at Welwyn Garden City.