Your Laundry & Infection Control Partner

Calderdale and Huddersfield NHS
NHS Foundation Trust

Microfibre Efficacy Following Ozone Disinfection Laundering – A Clinical Study

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1. Introduction

The role of the healthcare environment in the spread of infections is far from universally agreed, however there is a large body of clinical evidence which does identify links between poor environmental hygiene and the transmission of micro-organisms causing hospital acquired infections. Hospital floors and surfaces become contaminated by the settlement of airborne bacteria, by contact with hands and items such as shoes, trolley wheels and the presence of body fluids Microfibre products are increasingly becoming the norm for the cleaning of these surfaces with several UK hospitals now adopting this cleaning technology. Whilst there have been various studies conducted on the efficacy of microfibre cloths in comparison to conventional methods, the effect of the laundering/decontamination process and the sustained performance of the microfibre during its life, has been afforded very little attention.

This study's objective is to provide data on the efficacy of the microfibre cloth following decontamination using a non-routine laundering process with ozone within a clinical environment.

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 nearly 40 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.

OTEX, a commercially available ozone disinfection laundry system developed by JLA Ltd provides an alternative chemical disinfection to traditional thermal disinfection. Ozone is a powerful biocide and fungicide, second only to Fluorine (F). 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. During the OTEX laundry process Ozone gas is injected directly into the water via a patented interfusor system. This provides a continual flow of water containing ozone throughout the laundry process. The advantage of this system is that the wash load is continually treated with ozone providing constant disinfection at ambient water temperatures.

2. Objectives

The overall aim of this study was to provide data on the efficacy of microfibre cloths after a series of ozonated laundry process within a clinical environment.

3. Methodology

The trial was conducted in a cohort ward at Calderdale & Huddersfield Foundation Trust. The 14-bedded ward was at 65 % occupancy at the time of the sampling.

The study was conducted over 2 days with collected samples focusing on potential clinical areas (patient areas). Clostridum difficile was selected as the indicator organism. Contact plates and surface swabs were used to evaluate the bacteriological status of the surfaces. Sampling took place prior to the scheduled morning clean on both test days.

Two commercially available microfibre cloths were used; Jonmaster Pro (Johnson Diversey Ltd), manufactured by ACTEX, Sweden and Vermop. Both types of cloth are manufactured from composite 80% polyamide/20% polyester fibre. The cloths were laundered for 150 and 350 processes in a 10kilo commercial washing machine with ozone throughout the cycles. No detergent was added to the laundry process and none of the cloths were dried between wash cycles. All surface wiping tests were conducted with dry cloths adopting the 16-side method, this involves folding the cloth 3 times giving the potential for 16 sides to be used when unfolding and refolding during cleaning. The following surfaces were cleaned:

Toilet Seat
Hand Basin
Shower Panel
Wall surface
Bed Frame
Bedside Cabinet
Patient Table

Swabs and contact plates were used on each surface prior to cleaning with the microfibre cloth. Each surface was then given a single wipe with a new, 150 and 350 washed microfibre cloth after which further swabs and contact plates were used to provide an assessment of the bacterial status of the surface following cleaning.

Hyson TC contact slides for the determination of microorganisms from surfaces were purchased from Biotest UK (Solihull, UK). The contact surface area is 25cm^2. Swabs, NRS Transwab for measuring residual contamination or its absence on surfaces were purchased from Medical Wire & Equipment Co. These swabs are well established within the food industry and are detailed in the ISO 18593:2004 Microbiology of food & animal feeding stuffs – Horizontal method for sampling techniques from surfaces using contact plates and swabs.

All bacteriological samples were submitted to the Pathology department at Huddersfield Royal Infirmary and work carried out in accordance with standard laboratory procedures. Contact plates were incubated at 37^{o}C for 48 hours. Clostridium difficile swabs were inoculated into an enrichment broth for 48 hours and subcultured onto Braziers agar (E & O Labs Ltd) and incubated anearobically for 48 hours.

4. Test Results

Table 1 Jonmaster Microfibre Cloth

Ref No:	Description	Microfibre Cloth	Lab number	Total Viable Count (Cfu/25 cm^2)	*Clostridium difficile*
1A/B	Toilet Bowel Before	JD New	400651	>1000	Neg
1A/A	Toilet Bowel After	JD New	400650	0	Neg
1B/B	Toilet Bowel Before	JD 150 OTEX Cycle	400653	52	Neg
1B/A	Toilet Bowel After	JD 150 OTEX Cycle	400652	1	Neg
1C/B	Toilet Bowel Before	JD 350 OTEX Cycle	400655	58	Neg
1C/A	Toilet Bowel After	JD 350 OTEX Cycle	400654	0	Neg
2A/B	Shower Before	JD New	400657	350	Neg
2A/A	Shower After	JD New	400656	28	Neg
2B/B	Shower Before	JD 150 OTEX Cycle	400659	200	Neg
2B/A	Shower After	JD 150 OTEX Cycle	400658	31	Neg
2C/B	Shower Before	JD 350 OTEX Cycle	400661	83	Neg
2C/A	Shower After	JD 350 OTEX Cycle	400660	16	Neg
3A/B	Hand Basin Before	JD New	400663	32	Neg
3A/A	Hand Basin After	JD New	400662	4	Neg
3B/B	Hand Basin Before	JD 150 OTEX Cycle	400665	75	Neg
3B/A	Hand Basin After	JD 150 OTEX Cycle	400664	0	Neg
3C/B	Hand Basin Before	JD 350 OTEX Cycle	400667	22	Neg
3C/A	Hand Basin After	JD 350 OTEX Cycle	400666	7	Neg
4A/B	Bathroom Wall Area Before	JD New	400669	160	Neg
4A/A	Bathroom Wall Area After	JD New	400668	1	Neg
4B/B	Bathroom Wall Area Before	JD 150 OTEX Cycle	400671	0	Neg

Table 1 Jonmaster Microfibre Cloth continued

Ref No:	Description	Microfibre Cloth	Lab number	Total Viable Count (Cfu/25 cm^2)	*Clostridium difficile*
4B/A	Bathroom Wall Area After	JD 150 OTEX Cycle	400670	3	Neg
4C/B	Bathroom Wall Area Before	JD 350 OTEX Cycle	400673	2	Neg
4C/A	Bathroom Wall Area After	JD 350 OTEX Cycle	400672	10	Neg
5A/B	Bed Frame Before	JD New	400675	0	Neg
5A/A	Bed Frame After	JD New	400674	0	Neg
5B/B	Bed Frame Before	JD 150 OTEX Cycle	400677	40	Neg
5B/A	Bed Frame After	JD 150 OTEX Cycle	400676	0	Neg
5C/B	Bed Frame Before	JD 350 OTEX Cycle	400679	>1000	Neg
5C/A	Bed Frame After	JD 350 OTEX Cycle	400678	9	Neg
6A/B	Patient Chair Before	JD New	400681	>1000	Neg
6A/A	Patient Chair After	JD New	400680	10	Neg
6B/B	Patient Chair Before	JD 150 OTEX Cycle	400683	34	Neg
6B/A	Patient Chair After	JD 150 OTEX Cycle	400682	6	Neg
6C/B	Patient Chair Before	JD 350 OTEX Cycle	400685	17	Neg
6C/A	Patient Chair After	JD 350 OTEX Cycle	400684	44	Neg
7A/B	Patient Table Before	JD New	400686	0	Neg
7A/A	Patient Table After	JD New	400687	17	Neg
7B/B	Patient Table Before	JD 150 OTEX Cycle	400689	0	Neg
7B/A	Patient Table After	JD 150 OTEX Cycle	400688	0	Neg
7C/B	Patient Table Before	JD 350 OTEX Cycle	400691	0	Neg
7C/A	Patient Table After	JD 350 OTEX Cycle	400690	2	Neg

Table 2 Vermop Microfibre Cloth

Ref No:	Description	Microfibre Cloth	Lab number	Total Viable Count (Cfu/25 cm^2)	*Clostridium difficile*
21A/B	Toilet Bowel Before	Vermop New	400693	3	Neg
21A/A	Toilet Bowel After	Vermop New	400692	1	Neg
21B/B	Toilet Bowel Before	Vermop 150 OTEX Cycle	400695	3	Neg
21B/A	Toilet Bowel After	Vermop 150 OTEX Cycle	400694	0	Neg
21C/B	Toilet Bowel Before	Vermop 350 OTEX Cycle	400697	29	Neg
21C/A	Toilet Bowel After	Vermop 350 OTEX Cycle	400696	0	Neg
22A/B	Shower Before	Vermop New	400699	3	Neg
22A/A	Shower After	Vermop New	400698	29	Neg
22B/B	Shower Before	Vermop 150 OTEX Cycle	400701	18	Neg
22B/A	Shower After	Vermop 150 OTEX Cycle	400700	2	Neg
22C/B	Shower Before	Vermop 350 OTEX Cycle	400703	6	Neg
22C/A	Shower After	Vermop 350 OTEX Cycle	400702	2	Neg
23A/B	Hand Basin Before	Vermop New	400705	29	Neg
23A/A	Hand Basin After	Vermop New	400704	0	Neg
23B/B	Hand Basin Before	Vermop 150 OTEX Cycle	400707	0	Neg
23B/A	Hand Basin After	Vermop 150 OTEX Cycle	400706	0	Neg
23C/B	Hand Basin Before	Vermop 350 OTEX Cycle	400709	81	Neg
23C/A	Hand Basin After	Vermop 350 OTEX Cycle	400708	0	Neg
24A/B	Bathroom Wall Area Before	Vermop New	400711	13	Neg
24A/A	Bathroom Wall Area After	Vermop New	400710	0	Neg
24B/B	Bathroom Wall Area Before	Vermop 150 OTEX Cycle	400713	36	Neg
24B/A	Bathroom Wall Area After	Vermop 150 OTEX Cycle	400712	0	Neg
24C/B	Bathroom Wall Area Before	Vermop 350 OTEX Cycle	400715	21	Neg
24C/A	Bathroom Wall Area After	Vermop 350 OTEX Cycle	400714	1	Neg

Table 2 Vermop Microfibre Cloth Continued

Ref No:	Description	Microfibre Cloth	Lab number	Total Viable Count (Cfu/25 cm^2)	*Clostridium difficile*
25A/B	Bed Frame Before	Vermop New	400717	70	Neg
25A/A	Bed Frame After	Vermop New	400716	0	Neg
25B/B	Bed Frame Before	Vermop 150 OTEX Cycle	400719	40	Neg
25B/A	Bed Frame After	Vermop 150 OTEX Cycle	400718	2	Neg
25C/B	Bed Frame Before	Vermop 350 OTEX Cycle	400721	11	Neg
25C/A	Bed Frame After	Vermop 350 OTEX Cycle	400720	1	Neg
26A/B	Patient Chair Before	Vermop New	400723	2	Neg
26A/A	Patient Chair After	Vermop New	400722	0	Neg
26B/B	Patient Chair Before	Vermop 150 OTEX Cycle	400725	6	Neg
26B/A	Patient Chair After	Vermop 150 OTEX Cycle	400724	2	Neg
26C/B	Patient Chair Before	Vermop 350 OTEX Cycle	400727	3	Neg
26C/A	Patient Chair After	Vermop 350 OTEX Cycle	400726	1	Neg
27A/B	Bed Frame Before	Vermop New	400729	1	Neg
27A/A	Bed Frame After	Vermop New	400728	0	Neg
27B/B	Bed Frame Before	Vermop 150 OTEX Cycle	400731	1	Neg
27B/A	Bed Frame After	Vermop 150 OTEX Cycle	400730	0	Neg
27C/B	Bed Frame Before	Vermop 350 OTEX Cycle	400733	1	Neg
27C/A	Bed Frame After	Vermop 350 OTEX Cycle	400732	0	Neg

Key = CFU Colony Forming Units Neg Negative > greater than

5. Statistical Interpretation of Results

Separate analyses were conducted for the two microfibre cloths, both with and without outliers included in the data. In all cases the same qualitative result was found i.e.

Sites cleaned and number of laundry washes of microfibre cloths were non-significant.

Treatment i.e. wiping before/after was significant with, across the trial, far fewer micro-organisms being found after wiping at all sites and for all ages of cloth.

Full statistical analysis given in Appendices 1.

6. Conclusion

No Clostridum difficile was isolated from any of the samples.

Swabbing before and after wiping was found to be statistically significant with, across the trial, far fewer micro-organisms being found after wiping.

There was no evidence that the number of ozone decontamination/laundry processes applied had any influence on the efficacy of microfibre cloths.

APPENDIX 1

TECHNICAL *matters…*

Statistical Analysis of Data from a Surface Cleaning Trial Conducted at Calderdale Royal Hospital

INTRODUCTION

In the trial two cleaning cloths, processed for 1, 150 & 350 OTEX wash processes (three age levels), were used to clean seven hard surface sites. The surfaces were swabbed for microorganisms before and after wiping with the clothes (i.e. two treatment levels). The data collected was forwarded to Technical matters… for analysis.

Analysis of variance was chosen as the most appropriate technique for analysing this type of data. (Cloths were excluded because there was no interest in distinguishing between them. Sites could not be combined as replicates by inspection – too much obvious difference). Preliminary statistical tests showed there was no difference in results between a balanced design analysis and the general linear model ANOVA. The latter was preferred because it flagged up outliers and had the facility to analyse the unbalanced designs resulting from the exclusion of outliers.

The factors in the design Site, Treatment and Age were respectively identified as fixed, fixed and random. (Sites chosen – all those of interest, treatments – only before and after, age – selected as representative of a continuous variable). Total Viable Counts (TVC) were designated CountJD and CountVp for the two cloths

1. ANOVA General Linear Model

1.1 ANALYSIS FOR JD CLOTH

The three factors shown below were assigned the values shown for the purposes of analysis.

Factor	Type	Levels	Values
Site	Fixed	7	1 2 3 4 5 6 7
Treatment	Fixed	2	-1 1
Age	random	3	-1 0 1

Analysis of Variance for CountJD, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Site	6	243765	243765	40627	0.65	0.687
Treatment	1	368859	368859	368859	**5.93**	**0.21**
Age	2	169653	169653	84826	1.36	0.270
Error	32	1990476	1990476	62202		
Total	41	2772753				

Unusual Observations for CountJD

Obs	CountJD	Fit	StDev Fit	Residual	St Resid
1	1000.00	362.02	121.70	637.98	2.93R
29	1000.00	256.55	121.70	743.45	3.42R
31	1000.00	362.02	121.70	637.98	2.93R

R denotes an observation with a large standardized residual. Observations with standardized residuals >2 are flagged up as possible outliers. However it is best to have a practical reason for excluding such results rather than to rely on a statistical indication

1.2 ANALYSIS FOR Vermop CLOTH

Factor	Type	Levels	Values
Site	fixed	7	1234567
Treatment	fixed	2	-1 1
Age	random	3	-1 0 1

Analysis of Variance for CountVp, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Site	6	2109.6	2109.6	351.6	1.25	0.309
Treatment	1	2688.0	2688.0	2688.0	**9.54**	**0.004**
Age	2	93.5	93.5	46.7	0.17	0.848
Error	32	9018.9	9018.9	281.8		
Total	41	13909.9				

Unusual Observations for CountVp

Obs	CountVp	Fit	StDev Fit	Residual	St Resid
17	81.0000	27.5952	8.1917	53.4048	3.64R
25	70.0000	29.5000	8.1917	40.5000	2.76R

R denotes an observation with a large standardized residual.
(See note about outliers in 1.1 above)

2. ANOVA General Linear Model (unbalanced, i.e. outliers removed)

2.2 ANALYSIS FOR JD CLOTH

Factor	Type	Levels	Values
Site	fixed	7	1 2 3 4 5 6 7
Treatment	fixed	2	-1 1
Age	random	3	-1 0 1

Analysis of Variance for CountJD, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Site	6	53170	51049	8508	2.87	0.026
Treatment	1	24434	26774	26774	**9.02**	**0.005**
Age	2	6793	6793	3397	1.14	0.332
Error	29	86093	86093	2969		
Total	38	171590				

Unusual Observations for CountJD

Obs	CountJD	Fit	StDev Fit	Residual	St Resid
6	350.000	162.862	27.399	187.138	3.97R

R denotes an observation with a large standardized residual.
Having removed outliers once, for statistical reasons no more should be removed.

2.2 ANALYSIS FOR Vermop CLOTH

Factor	Type	Levels	Values
Site	fixed	7	1 2 3 4 5 6 7
Treatment	fixed	2	-1 1
Age	random	3	-1 0 1

Analysis of Variance for Vpcount, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Site	6	659.5	698.3	116.4	1.12	0.375
Treatment	1	1026.34	1014.3	1014.3	**9.74**	**0.004**
Age	2	18.3	18.3	9.1	0.09	0.916
Error	30	3122.7	3122.7	104.1		
Total	39	4826.8				

Unusual Observations for Vpcount

Obs	CountJD	Fit	StDev Fit	Residual	St Resid
5	29.0000	10.2552	5.0478	18.7448	2.11R
8	29.0000	4.9055	5.0170	24.0945	2.71R
13	29.0000	11.6875	5.4107	17.3125	2.00R
20	36.0000	17.7381	4.9783	18.2619	2.05R
25	40.0000	17.7121	5.3459	22.2879	2.56R

R denotes an observation with a large standardized residual.
Having removed outliers once, for statistical reasons no more should be removed.

M J Palin 24th August 2009
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