Efficacy of a stand-alone aerosol fogging system for total room decontamination

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Improvement Issue and Context

Once a patient colonised with a multi-antibiotic resistant organism or spore forming bacteria has vacated their side room a key issue for Infection Prevention and Control (IP&C) is how to disinfect the room quickly and easily in time for a new admission.

The Alder Hey IP&C team already used a hydrogen peroxide misting system for some terminal cleans. This system required in excess of 2.5 hours to complete a cycle (system set-up, release of chemical, dwell time, product removal) and not all staff are trained to use the system. The time required to complete a cycle impacts adversely on patient flow and delays admission to the room. In addition the hydrogen peroxide misting system could not be used in areas without power sockets such as bathrooms.

Aims and Objectives

The Alder Hey IP&C team required a rapid, cost-effective, easy to use misting/ fogging product capable of complete room disinfection in under an hour. This had to include system set up, activation, dwell time and product removal.

Methods and Measurement

IP&C identified the TECcare® CONTROL aerosol as a potential alternative which could overcome their issues around ease of use, time required for complete room fogging and use in areas without power supplies (i.e. bathrooms etc.).

The TECcare® CONTROL Single Use Misting System aerosol (see Figure 1) is a new innovation so a formal product evaluation was set up in a vacant side room (measuring 4mx4m) in order to answer the following questions;

1. Does the plume emitted by the system reach all areas of the side room?
2. Are biocides dispersed in sufficient concentrations to affect a microbial kill?

The following protocol was used to determine efficacy of the TECcare® aerosol fogging system when used in a clinical setting;

1) Prior to product activation discs of absorbent 1 micron test paper were placed on horizontal surfaces at five pre-determined locations around the side-room (see Table 1 for test locations). Distance from aerosol and height off the ground varied according to test location.

2) The product was activated and the room sealed.

3) Upon completion of room fogging, and observing a 20 minute dwell time, the test paper was collected using sterile tweezers and placed in sterile bags before being sent to the microbiology laboratory for processing.

4) A modified Kirby-Bauer disk diffusion susceptibility test was used to determine the sensitivity of a range of bacteria to the TECcare® CONTROL aerosol. This required the 1 micron samples of test paper to be divided into three equal sized pieces and placed onto a range of nutrient agar plates inoculated with clinically relevant bacteria including *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Escherichia coli*.

5) Plates were incubated at 37°C for 120 hours.

6) The 'zone of inhibition' (ZOI) around each piece of test paper was measured to determine the antimicrobial capacity of the biocides absorbed into the paper as a result of room fogging.

The presence or absence of growth around the sections of absorbent paper is a measure of the ability of the biocides absorbed into the paper during fogging to inhibit microbial growth. See Table 1 for a summary of test results and Figure 2 for examples of the ZOI test outcome.

Figure 1. TECcare® CONTROL Single Use Misting System

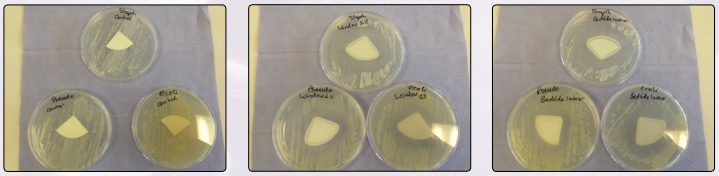
Evidence of Improvement

Table 1. Zone of inhibition test results detailing the ZOI (in mm) achieved after exposure of the absorbent paper to the TECcare® CONTROL aerosol fogging system

SAMPLE LOCATION	INCUBATION TIME	TEST ORGANISM ZONE OF INHIBITION IN MM FROM TEST PAPER		
		E. Coli	*P. aeruginosa*	*S. aureus*
Top of waste bin	24 hours	10	10	12
	120 hours	10	10	12
Bedside locker	24 hours	8	10	15
	120 hours	8	10	15
Station shelf	24 hours	10	10	15
	120 hours	10	10	15
Under bed frame	24 hours	10	10	15
	120 hours	10	10	15
Window sill	24 hours	6	8	15
	120 hours	6	8	15
Control (no exposure)	**24 hours**	**0**	**0**	**0**
	120 hours	**0**	**0**	**0**

The data in Table 1 shows clear zones of inhibition around each piece of absorbent paper placed in the side room during fogging. This result demonstrates that the TECcare® CONTROL aerosol is dispersed effectively throughout the room at a concentration that is sufficient to affect a microbial kill. The ZOI can be seen clearly in Figure 2. The 'Control' paper which was not exposed to the fogging process has had no impact on microbial growth.

Figure 2. Photos which demonstrate a clearly visible ZOI for the absorbent paper placed in the room during fogging vs. no ZOI for the Control paper (this was not exposed to the TECcare® aerosol fogging system)



Control paper | Window sill | Bedside locker

Future Steps

Prior room occupancy by a patient colonised with VRE, [1] Gram-negative bacilli (such as *Pseudomonas aeruginosa*), [2] MRSA [3] or with a CDI, [4] is a significant risk factor for acquisition by subsequent room occupants. To reduce the risk of infection there is an obvious need for thorough cleaning and disinfection of clinical areas previously occupied by colonised or infected patients. With routine hospital cleaning resulting in inadequately cleaned surfaces or missing 50% of surfaces altogether [5, 6] and with increasing pressure on available bed spaces, the problem for IP&C teams is how to disinfect an entire clinical area quickly, easily and cost effectively in time for a new admission.

This formal product evaluation clearly demonstrates that the biocide containing plume emitted from the TECcare® aerosol is dispersed throughout the room during fogging. In addition, upon completion of the fogging process the deposition of biocides onto environmental surfaces within the clinical environment is of sufficient concentration to affect a microbial kill on a range of clinically relevant microbes.

The TECcare® CONTROL aerosol system was very easy to set up and use (requiring a single button to activate the system) and enabled a side room to be turned around in under 1 hour. With a unit cost working out at approximately £1 / cubic metre the system is also highly cost effective.

This product meets all of the requirements identified by IP&C in terms of product performance, ease of use and cost effectiveness and it has now been adopted into clinical use across the Trust for the disinfection and decontamination of appropriate clinical areas where there is a need for a rapid room turnaround.

References

1. Drees M, Snydman DR, Schmid CH, Barefoot L, Hansjosten K, Vue PM, et al. Prior Environmental Contamination Increases the Risk of Acquisition of Vancomycin-Resistant Enterococci. Clin Infect Dis. 2008 Mar 1;46:678-85.
2. Nseir S, Blazejewski C, Lubret R, Wallet F, Courcol R, Durocher A. Risk of acquiring multidrug-resistant Gram-negative bacilli from prior room occupants in the intensive care unit. Clin Microbiol Infect. 2011 Aug;17(8):1201-8.
3. Huang SS, Datta R, Platt R. Risk of acquiring antibiotic-resistant bacteria from prior room occupants. Arch Intern Med. 2006 Oct 9;166(18):1945-51.
4. Shaughnessy MK, Micielli RL, DePestel DD, Arndt J, Strachan CL, Welch KB, et al. Evaluation of hospital room assignment and acquisition of Clostridium difficile infection. Infect Control Hosp Epidemiol. 2011 Mar;32(3):201-6.
5. Carling PC, Parry MF, Von Beheren SM. Identifying opportunities to enhance environmental cleaning in 23 acute care hospitals. Infect Control Hosp Epidemiol. 2008 Jan;29(1):1-7.
6. Goodman ER, Platt R, Bass R, Onderdonk AB, Yokoe DS, Huang SS. Impact of an environmental cleaning intervention on the presence of methicillin-resistant Staphylococcus aureus and vancomycin-resistant enterococci on surfaces in intensive care unit rooms. Infect Control Hosp Epidemiol. 2008 Jul;29(7):593-9.

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