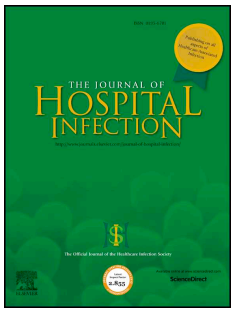

Article:
Muirhead, E, Dancer, SJ, King, M-F orcid.org/0000-0001-7010-476X et al. (1 more author) (2017) Novel Technology for Door Handle Design. Journal of Hospital Infection, 97 (4). pp. 433-434. ISSN 0195-6701

https://doi.org/10.1016/j.jhin.2017.09.013

Accepted Manuscript



Novel Technology for Door Handle Design

E. Muirhead, S.J. Dancer, M.-F. King, I. Graham

PII: S0195-6701(17)30519-4

DOI: 10.1016/j.jhin.2017.09.013

Reference: YJHIN 5227

To appear in: *Journal of Hospital Infection*

Received Date: 12 September 2017

Accepted Date: 13 September 2017

Please cite this article as: Muirhead E, Dancer S, King M-F, Graham I, Novel Technology for Door Handle Design, *Journal of Hospital Infection* (2017), doi: 10.1016/j.jhin.2017.09.013.

Muirhead E [1], Dancer SJ[1, 2]*, King M-F [3], Graham I[4].

[1] Dept. of Microbiology, Hairmyres Hospital, NHS Lanarkshire

[2] School of Applied Sciences, Edinburgh Napier University, Edinburgh

[3] Institute for Public Health & Environmental Engineering, School of Civil Engineering, University of Leeds

[4] Glana Ltd., 59 Patrickbank Crescent, Elderslie, Renfrewshire, PA5 9UG

*Corresponding author: Professor S. J. Dancer, Dept. of Microbiology, Hairmyres hospital, East Kilbride, Lanarkshire G75 8RG; stephanie.dancer@lanarkshire.scot.nhs.uk

Tel: +44-1355 585000; Fax: +44-1355 584350

Running title: Novel technology for door handle design

Key words: Hospital-acquired infection; hospital environment; hand hygiene; bacterial transmission; hand-touch sites; environmental contamination.

Letter to the Editor

Novel Technology for Door Handle Design

Dear Sir,

We note the recent paper, 'The potential of alcohol release doorplates to reduce surface contamination during hand contact', in the *Journal of Hospital Infection*.[1] We agree that reducing microbial contamination of frequently touched door surfaces and bacterial transfer via hands, could feasibly reduce the risk of healthcare-associated infections (HAI).[1-3] We recently examined a novel prototype door handle with precisely the same intention. This door handle is steel framed and vertically aligned with the hand grip portion encased by a specially prepared surface material (Figure 1a). The design of the handle is patent protected and includes a method of transmitting an antibacterial fluid to continuously wet the grip of the handle. The product is self-sanitizing with no moving parts, power or pressurised containers.

Two trial handles (control: Test Unit 1 & test: Test Unit 2) were secured on the urine bench in a clinical microbiology laboratory and four separate sections of the surface material covering the handle were cleaned with alcohol wipes. The reservoir in Test Unit 1 was filled with sterile distilled water and that in Test Unit 2 with household antiseptic (Dettol™, Reckitt Benkiser Ltd, Slough, UK). The liquids were allowed to condition the full area of the surface material. The surface sections were sampled at Time=0 (9am) using double-sided dipslides (Hygiena International, Watford, UK). Dipslides were coated with nutrient and Baird-Parker agars so that two of the four sections per handle were sampled with each type of agar. Each slide was pressed against the section for 3-5 seconds before incubation at 35^0 C for 48 hrs. Sampling was repeated at one, two, four, eight, 12, 24, and 48 hours after T=0.

Microbiology staff were asked to grasp each handle with unwashed hands for 3 seconds every time they passed the handles during the working day; one handle with the right hand and the other with the left. The whole 48 hr cycle was repeated three times during a six week period, with units repositioned to take account of any bias from the dominant hand. Total bioburden was assessed for number of aerobic colony forming units (cfu) from all four

sections, with colonies on Baird Parker agar investigated for possible *Staphylococcus aureus.* Coagulase-positive colonies were confirmed as *S.aureus* according to standard laboratory protocol.[3]

The total average bioburden for each handle section was calculated and compared between control and test units (Figure 1b). Each experiment produced similar data, in that the control handle rapidly acquired mixed bioburden, including eight *S.aureus*, whereas the test unit remained relatively uncontaminated without any isolations of *S.aureus*. Bioburden diminished from 24-48 hours for the control unit without obvious cause, although there may have been staff handling fatigue or complacency. Both test and control units remained fully functioning and continued to provide surface wetting at the completion of each 48 hour test.

The test unit clearly inhibited contamination from hands during routine duties in a microbiology laboratory. It is assumed that the antiseptic protected handle surfaces from accumulating bioburden, with the potential for reducing the risk of onward transmission to hands touching the unit. Light moisture was briefly detected on hands after touching the handles, which could be regarded as a supplementary hand hygiene agent. Use of this door handle technology in the healthcare environment thus offers an additional strategy regarding hand hygiene compliance, since this remains an issue in most hospitals.[4] Antimicrobial door handles would also reduce microbial contamination from patient and visitor hands, depending upon areas employed.

We used a household antiseptic for this pilot study but the nature of the simple design for fluid dispersion and surface sanitisation means that there are other choices of fluids suitable for the test handle, e.g. chlorhexidine or desalinated neutral electrolysed water. Given the nature of the leading pathogens in hospitals nowadays, an antiseptic active against norovirus and *Clostridium difficile* would be of much interest, and preferable to alcohol.[1] As with existing hospital infrastructure, the handle would require regular cleaning, inspection and fluid refill, which would entail some minor ongoing costs; the unit itself can be manufactured at low cost and would be cheaper than alternative products currently on the market (http://www.purehold.co.uk/).[5] Additionally, due to the simple design, matching

existing standard handle sizes and with no requirement for power, the handles can be easily fitted to doors to replace standard handles.

As this pilot used an initial prototype, the next stage is to assess full production designs before completing a practical trial in a busy hospital department. Simple clean handle technology such as this could have an impact on HAI because of the frequency of use and user exposure - everyone touches door handles.[6] Dirty hands may not be quite so dangerous to patients or staff if there are quiescent additives to hand decontamination incorporated into routine practice on the wards and elsewhere.[5,7]

Acknowledgments

We would like to thank all the microbiology staff at Hairmyres hospital for cheerfully taking part in this proof of concept experiment. Dipslides were kindly donated by Professor Jeremy Ramsden courtesy of Collegium Basilea (Institute of Advanced Study).

Funding

This project was funded by NHS Lanarkshire and Aqualution Systems Ltd.

Disclaimers

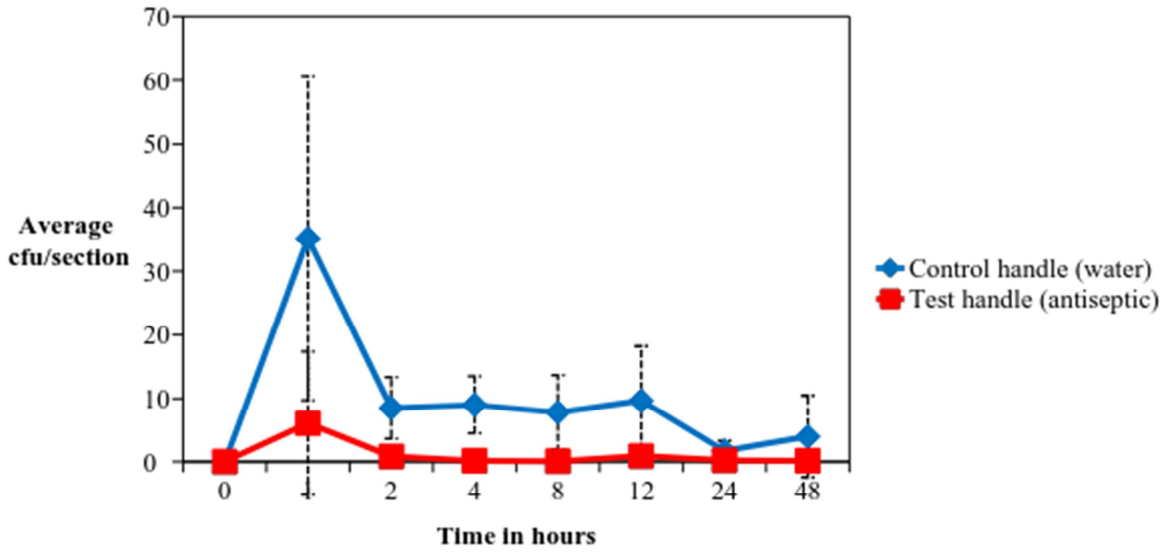
Mr Ian Graham of Glana Ltd, is credited with inventing the antimicrobial door handle and has patent protection in place for same. None of the other authors or funders stands to gain from any commercial enterprise regarding this product.

References

1. Best EL, Parnell P, Wilcox MH. The potential of alcohol release doorplates to reduce surface contamination during hand contact. *J Hosp Infect* 2017; in press.
2. Dancer SJ. The role of hospital cleaning in the control of hospital-acquired infection. *J Hosp Infect* 2009; **73**: 378-85.
3. Adams CE, Smith J, Robertson C, Watson V, Dancer SJ. Examining the relationship between surface bioburden and frequently touched sites in Intensive Care. *J Hosp Infect* 2017; **95**: 76-80.
4. Jones S, Reay S, Bull D, Gray J. Hand hygiene compliance monitoring: we need to stop kidding ourselves. *J Hosp Infect* 2017; **97**: 33-34.
5. Babiarz LS, Savoie B, McGuire M, McConnell L, Nagy P. Hand sanitizer-dispensing door handles increase hand hygiene compliance: a pilot study. *Am J Infect Control* 2014; **42**: 443-5.
6. Smith SJ, Young V, Robertson C, Dancer SJ. Cross-transmission audit of environmental surfaces, clinical equipment and patient: who touches what? *J Hosp Infect* 2011; **80**: 206-11.
7. Dancer SJ. Control of transmission of infection in hospitals requires more than clean hands. *Infect Control Hosp Epidemiol* 2010; **31**: 958-60.

Figure 1a: Steel framed prototype antimicrobial door handles

Figure 1b: Average bioburden on test and control door handles over 48 hours.



Error bars show one standard deviation from the mean

Over time, the test device increases efficacy to maximum of 99.04% difference with respect to control which begins to stabilize at 90% after 2 hours before further reduction at 12 hours. Each 48 hour cycle was repeated three times.