



Clean and green: saving water in the operating theatre

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ABSTRACT

INTRODUCTION There is a growing trend to use alcohol-based hand disinfectants in clinical practice. In addition to their anti-bacterial efficacy, these disinfectants offer an alternative to traditional surgical hand disinfection agents that can save water in the operating theatre.

MATERIALS AND METHODS The amounts of water and soap used during traditional surgical hand disinfection with antiseptic soap preparations were measured and water usage over a 1-year period was estimated. Costs of traditional disinfection agents were compared with alcohol-based agents.

RESULTS One surgical hand disinfection episode with traditional agents used 18.5 l of water. During 15,500 procedures performed at our institution over a 1-year period, 931,938 l of water were used which could have been saved had alcohol-based agents been used. Cost per episode of hand disinfection depends on the amounts used and is not higher compared to traditional agents.

CONCLUSIONS The benefits of using an alcohol-based surgical hand disinfectant may include significant water savings, in addition to previously published advantages of improved efficacy. When deciding on the method of surgical hand disinfection, careful thought should be given to the use of water as a resource. Surgeons should be aware of the environmental impact of their profession.

KEYWORDS

Surgical hand disinfection – Water use – Alcohol hand rub

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Twenty years before Louis Pasteur developed the germ theory, Ignaz Semmelweis in Vienna established the practice of washing hands in a chloride solution to prevent puerperal fever.¹ Joseph Lister, who is widely credited for introducing asepsis into surgery, subsequently started sterilising bandages and surgical instruments with steam and used carbolic acid to clean wounds with great success. Today, surgical hand disinfection remains an important part of modern surgical practice.

Traditionally, surgical hand disinfection (scrubbing) comprises washing with antimicrobial soap containing water, detergent and an antiseptic agent such as chlorhexidine, iodine, alcohol or a quaternary ammonium compound. The minimum recommended time to ensure disinfection varies between 2–6 min depending on the product used. Alternative alcohol-based hand rub disinfectants can provide superior disinfection² when compared to traditional techniques, thus saving a significant amount of water at a time when this resource is in high demand.

The objectives of this study were to: (i) quantify water usage of operating theatre staff during surgical hand disinfection and thereby estimate potential water savings in using alternative means of hand disinfection; and (ii) investigate the

cost involved in adopting a new hand disinfection technique in our hospital.

Materials and Methods

The number of operations and operating lists over a 1-year period, including the number of scrubbed staff members involved in every procedure, was determined from a prospectively collected theatre database. In order to determine the amount of water and disinfectants used during a scrubbing episode, we undertook a small observational study of 30 scrub episodes in our operating department, collecting data on the time period that taps were running and the number of squirts of soap or alcohol rub used by theatre staff. The volumes of the two traditional antimicrobial soaps used, chlorhexidine gluconate solution 20% (Hibiscrub™, Regent Medical Ltd, Irlam, UK) and Povidone-iodine 7.5% in aqueous solution (Videne®, Adams Healthcare, Leeds, UK), was measured by then dispensing the soaps into a 50-ml syringe from their standard dispensers. The amount of alcohol rub (Sterillium®, Bode Chemie, Hamburg, Germany) used to disinfect hands was measured from standard dispensers, again by using a 50-ml syringe. In addition, the

Table 1 Comparison of cost per hand disinfection episode

Scrubs/bottle	–	20	33.3	83.3
Disinfectant	Cost/500-ml bottle	Cost/25-ml	Cost/15-ml	Cost/6-ml
Alcohol rub	£4.50	22.5p	13.5p	5.4p
Iodine	£1.60	8p	4.8p	1.9p
Chlorhexidine	£2.35	11.8p	7.1p	2.8p

authors verified the above measurements by independently measuring the volume of alcohol rub used to keep hands and forearms continuously wet with disinfectant, for the minimum 3-min period recommended by the manufacturer. Similarly, the authors also independently measured the minimum volume of antimicrobial soap used to perform a traditional scrub with water. Water usage was calculated by measuring, into a calibrated bucket, the volume of water dispensed from taps in different operating theatres over a 3-min period. These data were collated to calculate the total amount of water delivered from taps in our operating theatres. Costs were calculated based on purchase prices recorded at our institution at the time of writing.

Results

We calculated that approximately 3.25 staff members scrub for each case, including a primary surgeon, scrub nurse/operating department practitioner and surgical assistant. Case mix and variation between surgical specialties were taken into account and numbers were calculated from a sample of 995 cases during a standard calendar month. Approximately one in four cases required a fourth scrubbed staff member. These cases included, but was not limited to, a second surgeon or second surgical assistant, additional scrubbed operating department practitioner, scrubbed medical or nursing students and personnel changes during a procedure (requiring a further scrub episode).

Water usage during a standard 3-min period amounted to 18.5 l. The total water used for 3.25 surgical hand disinfections per operation amounted to 60.2 l. When multiplied by 15,500 procedures performed during one year at our hospital, the figure rises to 931,958 l of water used only for hand disinfection in theatre. We were not able to determine what percentage of the total hospital water usage the operating department uses.

Traditional scrubbing with antimicrobial soap consumed an average of 25 ml over a 3-min period (range, 20–35 ml). The average volume of alcohol rub used over a comparable 3-min period was 15 ml (range, 10–20 ml). Costs per bottle of disinfectant and relative costs according to volume used per scrub episode are outlined in Table 1.

Discussion

According to the Environment Agency, eight water companies had restrictions on non-essential water usage in place during 2006, covering most of Southeast of England.⁵ The persistent dry weather compounded the water shortages, and stimulated public awareness of water as a precious resource. At our institution this awareness, coupled with a drive to reduce expenditure, has promoted the use of alcohol-based hand disinfection agents in an effort to decrease water usage in the operating theatre.

Our study showed that there are on average over three hand disinfection episodes for every procedure performed. This figure will vary between different institutions, according to case mix and surgical discipline. Our figures reflect our own experience and figures are extrapolated from a sample taken during the study period. We found, for example, that routine ophthalmological procedures required less scrub episodes than general surgical or orthopaedic procedures where more assistants were required. Furthermore, measuring water usage was in itself difficult as compliance with recommended disinfectant procedures varied between staff. Other factors such as the time spent waiting for water to heat up, the slight differences in the degree to which taps were opened and not turning the taps off can also influence water usage. In the absence of data to quantify our water use accurately, we measured the amount of water over a standard 3-min period as advised for traditional scrubbing in the literature.^{4,5} In the absence of published data on water use in hospital operating departments, we cannot compare our findings to other institutions but hope to highlight the environmental cost of water use in the operating department. To our knowledge, our study is the first to do so.

There is a growing trend to use alcohol-based products for hand disinfection in clinical practice. Not only has alcohol in preparations containing 60–90% alcohol been shown to provide the most effective decontamination for a wide variety of organisms,^{6,7} but the use of rub-in gel or liquid preparations has increased compliance with hand-hygiene procedures across hospital staff.⁸ The use of alcohol-based products for surgical hand disinfection is less wide-spread although current evidence

supports its use.⁹ Internationally, the Centers for Disease Control acknowledges the superior efficacy of alcohols in their *Guidelines for Hand Hygiene in Health-Care Settings* when compared to more traditional agents such as chlorhexidine gluconate or Povidone-iodine.² These guidelines recommend the use of alcoholic hand disinfectants for surgical hand antisepsis after washing hands and forearms with non-antimicrobial soap. The current draft of the NICE guidelines on preventing surgical site infections¹⁰ similarly recommends a scrub technique at the start of an operating list with alcoholic rubs used between cases, providing hands are not visibly soiled.

Factors that determine the method of surgical hand disinfection include not only efficacy, spectrum of antimicrobial activity and duration of action of the agent, but also cost and factors that influence compliance such as potential for skin irritation. The benefits of alcohol-based preparations have been shown to include significantly less skin dryness, irritation and allergies when compared to traditional antiseptic preparations.^{11–13} Despite these findings, certain users still prefer traditional scrubbing with antimicrobial soaps. Disadvantages of alcohol rubs further include a pungent odour and the time needed to air-dry hands before donning surgical gloves, although the latter is in our opinion not significant when compared with the time taken to towel dry hands rinsed with water.

The obvious advantage of traditional antimicrobial preparations is lower cost. Our study did show alcohol rub to be more expensive per volume when compared to traditional agents. However, when used in practice, we found far greater volumes of antimicrobial soaps used compared to lesser volumes of alcohol rub. Taking this into account when comparing cost per episode of hand disinfection, alcohol rub still proved more expensive than chlorhexidine and iodine (13.5 p versus 11.8 p and 8 p, respectively). These figures do not include the cost of water saved, nor do they include the cost of towels (disposable or re-usable) used to dry hands after traditional scrubbing. When alcohol rub is used in the lesser 6-ml amount, as promoted by the manufacturers, the costs per disinfectant episode would favour alcohol-based disinfectants. Despite recent published evidence that efficacy is adequate with a reduced 6-ml volume of disinfectant over a shorter 90-s time period,¹⁴ we have found that a higher volume is used in our practice.

In our district general hospital with 500 beds servicing a population of 280,000, the annual cost of water amounted to £283,000 during 2005, paid at UK mains supply rate of £0.42–1.00/m³. According to the UK NHS website,¹⁵ there are 74 acute hospital trusts in the South East of England (Cambridgeshire, Norfolk, Suffolk, Essex, Kent and Medway, Sussex, Hampshire, Surrey, Thames Valley, Bedfordshire, Hertfordshire and London). In the absence of advanced water saving infrastructure such as motion-activated taps, a waterless hand disinfection policy throughout this region could dramatically benefit the environment by reducing water use with no harm to patients or staff.

Conclusions

The benefits of using an alcohol-based surgical hand disinfectant may include significant water savings, in addition to previously published advantages of improved efficacy. When deciding on the method of surgical hand disinfection, thought should be given not only to product cost but also to the use of water, a precious resource often taken for granted.

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References

1. Semmelweis I. The etiology, concept, and prophylaxis of childbed fever. Carter KC. (ed) 1st edn. Madison, WI: The University of Wisconsin Press, 1983.
2. Boyce JM, Pittet D. Guideline for hand hygiene in health-care setting. Recommendations of the healthcare infection control practices advisory committee and the HICPAC/SHEA/APIC/IDSA hand hygiene task force. *MMWR* 2002; **51**: 1–45.
3. <http://www.environment-agency.gov.uk/subjects/waterres/1014767/1131486/?version=1&lang=_e>.
4. Hingst V, Juditzki I, Heeg P, Sonntag HG. Evaluation of the efficacy of surgical hand disinfection following a reduced application time of 3 instead of 5 minutes. *J Hosp Infect* 1992; **20**: 79–86.
5. O'Shaughnessy M, O'Malley VP, Corbett G, Given HF. Optimum duration of surgical scrub time [Short note]. *Br J Surg* 1991; **78**: 685–6.
6. Boyce JM. Using alcohol for hand antisepsis: dispelling old myths. *Infect Control Hosp Epidemiol* 2000; **21**: 438–41.
7. Pratt RJ, Pellowe C, Loveday HP, Robinson N, Smith GW, Barrett S *et al*. The EPIC project: developing a national evidence-based guidelines for preventing healthcare associated infections. *J Hosp Infect* 2001; **47** (Suppl A): S3–8.
8. Pittet D, Hugonnet S, Harbarth S, Mourouga P, Sauvan V, Touveneau S *et al*. Effectiveness of a hospital-wide programme to improve compliance with hand hygiene. *Lancet* 2000; **356**: 1307–12.
9. Rotter ML. Arguments for the alcoholic hand disinfection. *J Hosp Infect* 2001; **48**: S4–8.
10. NICE. *Surgical Site Infections*. NICE guidelines draft, section 1.2.11. London: NICE, 2006.
11. Parienti JJ, Thibon P, Heller R, Le Roux Y, von Theobald P, Bensadoun H *et al*. Hand-rubbing with an aqueous alcoholic solution vs traditional surgical hand-scrubbing and 30-day surgical site infection rates – a randomised equivalence study. *JAMA* 2002; **288**: 722–7.
12. Stone S, Teare L, Cookson B. The guiding hands of our teachers [Letter]. *Lancet* 2001; **357**: 479–80.
13. Kampf G, Muscatello M. Dermal tolerance of Sterillium, a propanol-based hand rub. *J Hosp Infect* 2003; **55**: 295–8.
14. Kampf G, Ostermeyer C, Heeg P. Surgical hand disinfection with a propanol-based hand rub: equivalence of shorter application times. *J Hosp Infect* 2005; **59**: 304–10.
15. <<http://www.nhs.uk/England/AuthoritiesTrusts/Acute/Default.aspx>>.