Laboratory and in-use assessment of methicillin-resistant *Staphylococcus aureus* contamination of ergonomic computer keyboards for ward use

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Background: An ideal computer keyboard for clinical use would be easily cleanable and cleaned by staff, meet acceptable levels of usability, and not attract hospital bacteria.
Methods: In vitro studies were performed to demonstrate bacterial transfer between keyboard surfaces and gloves. This was followed by a usability study and a controlled trial of keyboard contamination in an intensive care unit both with and without an alarm to indicate the need for cleaning. Eight cleanable keyboards were placed at random beds and compared with standard keyboards.
Results: Bacteria were most easily removed from a flat silicone-coated surface. The total viable count on flat keyboards with an alarm was lower than that on standard or other cleanable keyboards (median, 19 colony-forming units [cfu] (interquartile range, 7 to 40 cfu), n = 34; 65 cfu (33 to 140 cfu), n = 50; and 40 cfu (21 to 57 cfu), n = 80). Compliance with hand hygiene before touching the standard keyboard was 27%, but the alarmed keyboard was cleaned on 87% of occasions on which the alarm was triggered. The usability study found the flat profile of the cleanable keyboard did not interfere with routine use, except for touch-typing.
Conclusion: The flat keyboard with an alarm is easy to clean, and it use is associated with better cleaning compliance. (Am J Infect Control 2008;36:e19-e25.)

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With the advent of electronic patient records, the numbers of computer keyboards and mice in use in clinical areas are on the increase. Caregivers frequently touch keyboards immediately after patient-related procedures without first performing hand hygiene.[1] They then touch other keyboards without disinfecting their hands, possibly passing bacteria, including methicillin-resistant *Staphylococcus aureus* (MRSA), to other patients. Domestic workers do not clean electronic equipment, and compliance with cleaning by nurses is poor (9.3%).[1] Up to 25% of computer keyboards in wards are contaminated with MRSA and other pathogens, regardless of their design.[1-3] The hands of staff are believed to be the main vector for transfer of pathogens.[3] The aim of this study was to develop a user-friendly computer keyboard to which bacteria are not readily transferred (and can be easily removed) and that can be easily cleaned.

METHODS

Specifications for a functional keyboard surface that is smooth, impervious, and cleanable with a single wiping action yet can allow reasonably fast typing were sent to 3 keyboard manufacturers (herein designated A, B, and C) (Fig 1).

Preselection study

Experiment 1: Cleaning efficacy. Five existing keyboards were seeded with the 2 most common clinical

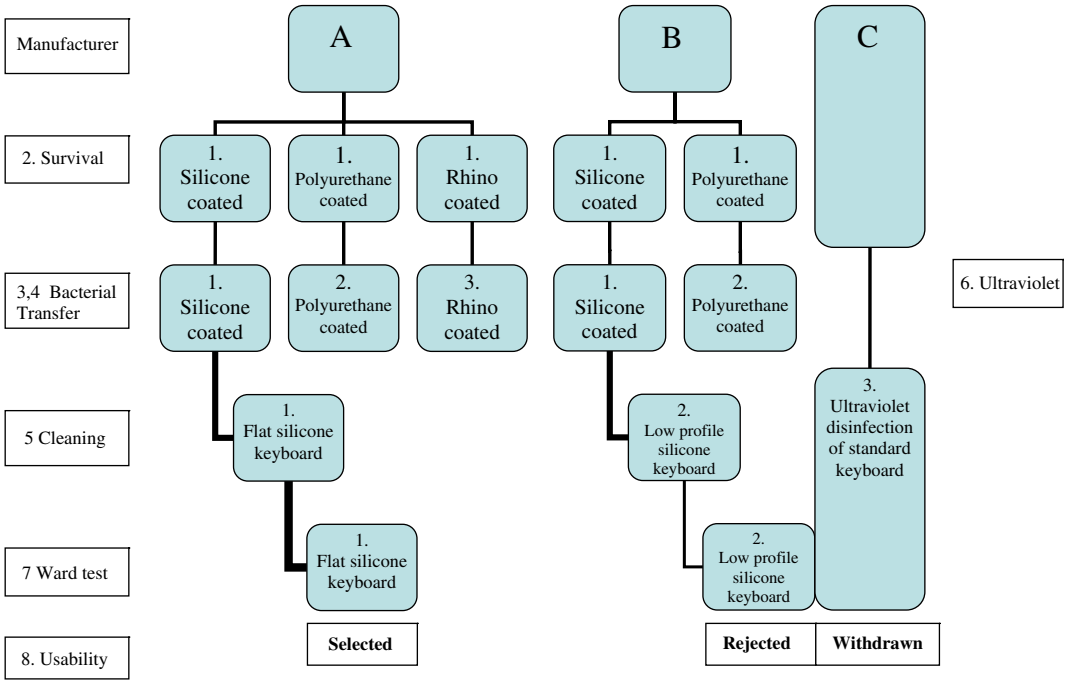

Fig 1. Flow diagram of the study work stream in keyboard design and selection. Number indicates rank at that stage of selection.

isolates of MRSA[4] (Table 1). The efficacy of wiping with isopropyl alcohol cloth or sterile water cloth was confirmed using contact plates.

Selection of coating

Experiment 2: Survival of MRSA on different elastomer surfaces. MRSA was inoculated onto 24 1 × 1 cm squares of elastomer coated with silicone or polyurethane (manufacturers A and B) or Rhino coat (manufacturer A) in artificial light at a temperature of 20°C and humidity level of 70% (Table 1). Three squares were removed at 8 time points over a 1-week period and pressed onto agar contact plates.

Experiment 3a: Transfer of MRSA from a glove to a surface. A glove tambour was inoculated and pressed against the same elastomer samples used in Experiment 2 (Table 1). In addition, their components were tested (painted [Ax1 and Bx2], laser-etched [Ax2], and raw elastomer). Contact plates were applied to all surfaces (replicates A3 and B6).

Experiment 3b: Transfer of MRSA from a surface to a glove. To demonstrate the transfer of countable numbers of MRSA to the glove tambour from a sample surface, an undiluted overnight broth culture was inoculated on the sample surface (as in Experiment 3a, omitting components of the B replicates). Contact plates were again used (5 replicates).

Experiment 4: Bacterial transfer to keyboard in the presence of lanolin. Lanolin was applied to the glove tambour to simulate an unwashed hand. Transfer from the glove tambour to the keyboard material was assessed as in Experiment 3a (3 replicates).

Keyboard testing

Manufacturers A and B provided silicone-coated prototypes. Keyboard A had a completely flat surface incorporating 2 cleaning sensors and a light alarm. Two resistive sensors detected the presence of 70% isopropyl alcohol (Table 1), and a third hidden sensor detected pressure, switching off the light alarm if detection occurred within 20 seconds. The alarm was activated at a fixed time point after cleaning. Manufacturer B supplied a keyboard with 1-mm-high keys but no alarm. Manufacturer C provided a standard keyboard and an ultraviolet light source (254 nm) as an automatic sterilizing system, but this system was later withdrawn due to production difficulties.

Experiment 5: Ease of cleaning. Fluorescent cream (Glo Germ, Moab, UT) was applied to both keyboards, and its removal by an alcohol-based wipe was assessed by UV photography.

Experiment 6: Ultraviolet light. A standard keyboard was inoculated evenly with a 1:50 dilution of a broth culture of EMRSA-16. One-sixth of the keyboard area, selected at random, was then exposed for 0, 10, 20, 30, 60, or 120 seconds (4 replicates).

Experiment 7: Ward testing of keyboards A and B. Manufacturer A supplied 8 keyboards and written