Security swipe cards and scanners are a potential reservoir for hospital-acquired infection

MJ SULTAN, A ALM, A HINDMARSH, RA GREATOREX

Department of General Surgery, The Queen Elizabeth Hospital, King's Lynn, Norfolk, UK

ABSTRACT

INTRODUCTION Hospital-acquired infections complicate 10% of hospital admissions resulting in increased morbidity, mortality and cost to hospitals. Most hospitals issue doctors with plastic swipe cards that function as electronic keys to access clinical areas. The card is handled many times a day, often before direct patient contact. The aim of this study was to determine if swipe cards harbour potentially harmful bacteria.

SUBJECTS AND METHODS On a single day, doctors working in the surgical directorate completed a questionnaire to determine their pattern of swipe card use. Cards were inoculated onto agar plates and incubated for 48 h under standard laboratory conditions, following which the number of colony forming units (CFUs) cultured from each card was determined. Representative colonies were sampled and sub-cultured for staphylococcal, enterococcal, coliform and pseudomonad species. Isolated bacterial pathogens were tested for antimicrobial sensitivity. Swipe-card scanners were swabbed for microbiological culture on the same day.

RESULTS All cards were colonised with environmental bacteria (mean, 73 CFU). Of cards, 21% were contaminated with pathogenic bacteria including *Staphylococcus aureus* (5.1%), *Pseudomonas putida* (2.6%), and coliform species (12.8%). The pattern of card use did not significantly affect the amount of bacterial contamination, but infrequent use of the card and keeping the card in a pocket or wallet was associated with higher levels of contamination. Environmental bacteria were cultured from 88% of card scanners, the highest counts coming from scanners in main theatres and the day-surgery unit.

CONCLUSIONS Doctors' swipe cards are contaminated with, and may therefore be a reservoir for, pathogenic bacteria implicated in hospital-acquired infection.

KEYWORDS

Hospital-acquired infection – Security swipe cards – Security scanners

CORRESPONDENCE TO

RA Greatorex, Consultant Surgeon, The Queen Elizabeth Hospital, Gayton Road, King's Lynn, Norfolk PE30 4ET, UK

T: +44 (0)1553 613613; F: +44 (0)1553 613700; E: robert.greatorex@qehkl.nhs.uk

Hospital-acquired infections complicate up to 10% of all hospital admissions.¹ In surgical in-patients, hospital-acquired infections result in a significant increase in morbidity and mortality; it has been estimated that in-patients who acquire a hospital-acquired infection have double the probability of mortality during their hospital stay.² In addition, the cost of treating patients whose hospital stay is complicated by hospital-acquired infection is significantly greater than matched patients who do not acquire infection.^{2–4}

To reduce the incidence of hospital-acquired infection, it is necessary to identify and control the source of infection. It has been established that the hands of healthcare workers can act as vectors for transmission of infection and that hand washing before patient contact reduces the incidence of hospital-acquired infection.⁵ More recently, other potential vectors for transmission of infection have been identified, including stethoscopes,⁶ and nurses' scissors.⁷ Regular cleaning of these objects has been advocated to reduce the incidence of hospital-acquired infection.

A number of objects that do not usually come into direct contact with patients have also been shown to harbour potentially harmful bacteria. Many of these objects are regularly handled prior to patient contact (including case notes,⁸ pens⁹ and hospital pagers¹⁰) and can act as an intermediate vector for pathogens.

Due to the increased need for security in hospitals, many institutions issue healthcare workers with plastic swipe cards. These act as a security badge and electronic key to secure clinical areas, such as operating theatres, intensive care units, obstetric and paediatric wards. These cards required manual application to a wall-mounted contact plate or 'swipe through' scanner to permit access. Repeated use of cards and scanners by differing healthcare workers could, therefore, create an opportunity for dissemination of infection into clinical areas caring for vulnerable patients.

The aim of this study was to determine if plastic swipe cards and wall-mounted scanners harbour bacteria and act as

reservoirs for dissemination of infection. In addition, methods of cleaning swipe cards and scanners were examined.

Subjects and Methods

On a single afternoon, and without prior knowledge, all 45 doctors working in the departments of general, orthopaedic and urological surgery at the Queen Elizabeth Hospital, King's Lynn, were invited to take part in the study. Thirty-nine consented. Participants were asked to complete a questionnaire (Appendix 1) to determine where they kept their swipe card whilst at work, how frequently they used it and which clinical areas they had accessed using their card in the previous 24 h. In addition, information regarding frequency and method of cleaning cards was recorded.

The front and back of each participant's swipe card was then inoculated onto a Tryptone Soya Agar contact plate under sterile conditions. The plates were incubated aerobically at 36°C for 24 h and thereafter at 30°C for a further 48 h.

Table 1 Mean number of colony forming units (CFUs) and number of potentially pathogenic bacteria cultured from swipe cards of doctors according to their grade, speciality and pattern of use of the swipe card

	Mean number CFUs	Colonised with pathogenic bacteria: n (%)
Grade		
Consultant (n = 10)	59	3 (30)
Middle-grade (n = 13)	92	5 (38)
House officer (n = 16)	68	–
Specialty		
General surgery (n = 23)	73	5 (22)
Orthopaedics (n = 12)	84	2 (17)
Urology (n = 4)	46	1 (25)
Frequency of use		
Frequent (> 15 times/wk) n = 19	52	5 (26)
Moderate (5–15 times/wk) n = 14	86	3 (21)
Occasional (< 5 times/wk) n = 6	113	–
Where card kept		
Necklace (n = 11)	54	1 (9)
Belt (n = 13)	55	2 (15)
Pocket (n = 15)	108	5 (33)
Card cleaned		
Never (n = 32)	83	6 (19)
Ever (n = 7)	29	2 (29)

wk = week

To determine if swipe-card scanners harbour bacteria that can be transmitted to swipe cards during use, a sterile swipe card was used to 'swab' every scanner in the hospital on the same afternoon. Using sterile gloves, each scanner had a sterile card drawn through it three times following which the front and back of the card was inoculated onto a Tryptone Soya Agar plate as described above.

Three methods of cleaning swipe cards were assessed: (i) scrubbing with soap and water for 30 s; (ii) scrubbing with hibiscrub for 30 s; and (iii) cleaning with an alcohol-soaked swab for 15 s. Each card was inoculated onto a Tryptone Soya Agar plate as previously described.

Practicality determined that a single method be assessed for cleaning scanners. Scanners were cleaned using an alcohol-soaked swab drawn through the scanner repeatedly for 15 s. A sterile card was then drawn through the scanner three times and inoculated onto Tryptone Soya Agar as described above.

Following incubation, the number of colony forming units (CFUs) on each plate were counted. Representative colonies were sampled and subcultured for detection of staphylococcal species including *Staphylococcus aureus* and methicillin-resistant strains (MRSA), *Enterococcus* spp., coliforms and *Pseudomonas* spp. All isolated bacterial pathogens were tested for sensitivity using standard antimicrobial disc sets.

Results

Swipe cards

Of 45 doctors approached, 39 (86%) agreed to take part in the study. Fifteen (38.5%) doctors kept their cards in a pocket or wallet, 13 (33.3%) clipped cards to their belt and 11 (28.2%) wore their cards on a necklace. Only 7 (17.9%) cleaned their cards, of whom five cleaned them once a week and two once a year, all using soap and water.

All the swipe cards tested were colonised with bacteria. Thirty-one (79.5%) cards were contaminated with environmental bacteria alone. The mean number of CFUs cultured from cards was 73. There was no significant difference in number of CFUs cultured from different grades of staff (range, 52–92 CFUs) or between surgical specialties (range, 46–84 CFUs). There was an apparent, but non-significant, increase in the number of CFUs cultured from cards used occasionally, compared to those used frequently (113 CFUs versus 52 CFUs). There was also a marked, but non-significant, difference in number of CFUs cultured from cards kept in pockets or wallets (233 CFUs) compared to cards kept on a belt (55 CFUs) or necklace (54 CFUs). Swipe cards that had been cleaned once or more since issue had fewer CFUs (29 CFUs) than cards that had never been cleaned (83 CFUs).

Eight cards (20.5%) were contaminated with potentially pathogenic bacteria including *S. aureus*, *Pseudomonas putida*

Figure 1 The number of colony forming units (CFUs) cultured from a sterile swipe card after being drawn through card scanners around the hospital. All bacterial colonies were environmental bacteria.

and coliforms, one of the latter being resistant to ampicillin. All cards that were contaminated with potentially pathogenic bacteria belonged to consultant or middle-grade surgeons. There was no correlation between colonisation with pathogenic bacteria and any of the other recorded parameters, including how the card was carried, frequency of use, areas of use and cleaning practice (Table 1).

Scanners

Bacteria were cultured from 14 of 16 scanners (88%) examined. All the bacteria cultured were environmental pathogens. There was wide variation in the number of CFUs cultured from different scanners, the highest counts being obtained from scanners adjacent to main operating theatres, the day-surgery unit and the administration block (Fig. 1).

Card and scanner cleaning

No bacteria were cultured from swipe cards following a 30-s wash with hibiscrub or a 15-s clean with an alcohol-soaked swab. However, 31 CFUs were cultured from cards cleaned by washing in soap and water for 30 s.

No bacteria were cultured from scanners following cleaning with alcohol swabs.

Discussion

Bacterial contamination of swipe cards and scanners appears almost universal in this study. The majority of cards and scanners were contaminated by environmental bacteria

with low pathogenic potential. However, bacteria with significant pathogenic potential, and implicated as causes of hospital-acquired infection, were isolated from over 20% of swipe cards. Furthermore, large numbers of bacteria were transferred from card to scanner, and scanner to card during experimental use.

There is increasing evidence that objects regularly handled by healthcare workers have a significant degree of contamination. Reports include 93% of doctor's pens,⁹ 97% of case notes⁸ and 100% of pagers¹⁰ as contaminated with organisms such as *Streptococcus viridans* and *S. aureus*, including MRSA strains.

A number of studies have investigated the ability of different bacteria to persist on inanimate surfaces. A recent systematic review concluded that many bacteria implicated in hospital-acquired infection can persist for months on a dry surface.¹¹ The duration of persistence is prolonged by low temperature (4–6°C) and high humidity. There is also an on-going debate on prolonged persistence of bacterial contamination on plastic surfaces. The findings of our study concur with these reports. Of doctors' swipe cards tested, 20% were colonised with potentially pathogenic bacteria and two-thirds of these were from cards kept in pockets or wallets, a local environment that may promote bacterial persistence. The fact that all contaminated cards were carried by consultants and middle-grade surgeons suggests that duration of use of a card may be of relevance. The junior doctors involved in this study had carried their cards for no longer than 4 months whereas the senior doctors, whose cards were all contaminated, had possessed and used their cards for periods

ranging from 9 months to 3 years. Previous cleaning of swipe cards by owners resulted in a notable, but non-significant, reduction in the number of CFUs isolated, but only a small number of doctors had cleaned their cards, making valid conclusions difficult. However, cleaning cards and scanners with alcohol in a controlled fashion effectively removed all bacteria.

These findings have implications for infection control and prevention of hospital-acquired infection. Swipe cards are used to control access to secure clinical areas in most hospitals. While swipe cards do not come into direct contact with patients, they can act as a reservoir of infection and, thereby, as an intermediate vector. Cards are handled by staff during use and bacteria residing on hands, cards and scanners can be transferred. To reduce the potential for transfer of bacteria to patients, regular cleaning of cards and scanners with alcohol-soaked swabs would be a simple and cost-effective option. This does not, of course, remove the established need for regular hand-washing before and after patient contact.

Conclusions

Security swipe cards and scanners are contaminated with, and may therefore act as a reservoir for, pathogenic bacteria implicated in hospital-acquired infection. Wearing a card on a necklace or belt results in less contamination. Regular cleaning of cards and scanners with alcohol removes all bacteria and would be a simple method of removing this potential source of hospital-acquired infection.

Acknowledgements

The authors would like to thank Prof. Lynn Leibowitz, Professor of Microbiology and Consultant Microbiologist, and Graham

Rogerson, Chief Biomedical Scientist, in the Department of Microbiology at the Queen Elizabeth Hospital, King's Lynn, for their help and advice during this study.

References

1. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn VP *et al.* The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. *Am J Epidemiol* 1985; **212**: 182–205.
2. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. *Infect Control Hosp Epidemiol* 1999; **20**: 725–30.
3. Pittet D, Tarara D, Wenzel RP. Nosocomial bloodstream infection in critically ill patients; excess length of stay, extra costs, and attributable mortality. *JAMA* 1994; **271**: 1598–601.
4. Orsi GB, Stefano LD, Noah N. Hospital acquired, laboratory-confirmed bloodstream infection: increased hospital stay and direct costs. *Infect Control Hosp Epidemiol* 2002; **23**: 190–7.
5. Larson EL. APIC guidelines for handwashing and hand antisepsis in the healthcare setting. *Am J Infect Control* 1995; **23**: 251–69.
6. Milam MW, Hall M, Pringle T, Buchanan K. Bacterial contamination of the fabric of stethoscope covers: The velvet rabbit of health care? *Infect Control Hosp Epidemiol* 2001; **22**: 653–5.
7. Embil JM, Zhanell GG, Plourde PJ, Hoban D. Scissors: a potential source of nosocomial infection. *Infect Control Hosp Epidemiol* 2002; **23**: 147–51.
8. Bebbington A, Parkin I, James PA, Chichester LJ, Kubiak EM. Patients' case notes: look but don't touch. *J Hosp Infect* 2003; **55**: 299–301.
9. Datz C, Jungwirth A, Dusch H, Galvan G, Weiger T. What's on doctors' ball point pens? *Lancet* 1997; **350**: 1824.
10. Singh D, Kaur H, Gardner W, Treen L. Bacterial contamination of hospital pagers. *Infect Control Hosp Epidemiol* 2002; **23**: 274–6.
11. Kramer A, Schwebke I, Kampf G. How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis* 2006; **6**: 130.

Appendix 1: Questionnaire for swipe-card contamination study

Specialty _____	Children's ward	Where do you keep card?
Grade _____	Accident and Emergency Dept	Necklace
Areas of use in last 24 h	• Main entrance	Belt
Theatres	• Waiting room	Pocket
• Main entrance	Administration block	Do you ever clean card?
• Male changing room	• Entrance 1	Yes
• Female changing room	• Entrance 2	No
ITU	Other access	How do you clean card? _____
• Entrance 1	• Front access	_____
• Entrance 2	• Day-surgery entrance	How frequently do you clean card?
• Entrance 3	• Macmillan Centre entrance	_____
Day-case surgery	Use of swipe card	
• Back door	Frequently (> 15 times/week)	
• Front door	Moderate (5–15 times/week)	
	Occasional (1–5 times/week)	