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## American Journal of Infection Control

journal homepage: [www.ajicjournal.org](http://www.ajicjournal.org)

## Brief report

## Bacterial contamination of computer touch screens


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## Key Words:

 Computer touch screen  
 Methicillin-resistant *Staphylococcus aureus*  
 Vancomycin-resistant enterococcus  
 Coliforms  
*Clostridium difficile*

The goal of this study was to determine the occurrence of opportunistic bacterial pathogens on the surfaces of computer touch screens used in hospitals and grocery stores. Opportunistic pathogenic bacteria were isolated on touch screens in hospitals; *Clostridium difficile* and vancomycin-resistant *Enterococcus* and in grocery stores; methicillin-resistant *Staphylococcus aureus*. Enteric bacteria were more common on grocery store touch screens than on hospital computer touch screens.

Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc.

Computer keyboards and computer mice have been documented in a number of studies to harbor opportunistic bacterial pathogens and respiratory viruses.<sup>1–5</sup> The contamination of computer keyboards in the hospital setting has been postulated to play a significant role as a vector of cross-contamination in hospital-acquired infections.<sup>6</sup> Computers that are shared by different individuals can serve as vehicles for transfer of microorganisms between individuals in public and health care settings. To reduce this risk, recommendations have been made for the regular cleaning and disinfection of keyboards and computer mice. In more recent years, computer touch screens have become more common both in public and hospitals; however, no information appears to be available on the occurrence of bacteria on these surfaces. The goal of this study was to determine the occurrence of opportunistic bacteria on the surfaces of computer touch screens in hospitals and grocery stores.

Computer touch screen samples were taken at the University of Arizona Medical Center and at various grocery stores in Tucson, Arizona. The surface of the touch screen was sampled using a sterile Sponge-Stick (3M, St. Paul, MN) and placed in a letheen neutralizer broth provided by the manufacturer. Samples were collected from available computer touch screens at the sites throughout the day. Approximately, 3 mL of fluid was extracted from the Sponge-Stick. Total heterotrophic plate count bacteria were determined by

placing 0.1 mL directly onto Difco R2A Agar (BD, Sparks Glencoe, MD) by the spread plate method and by dilution in Tris-buffered saline (Sigma-Aldrich, St. Louis, MO). R2A is a media used for enhanced recovery of environmentally stressed bacteria. The agar plates were incubated at room temperature (23°C–25°C) for 5 days. For isolation of methicillin-resistant *Staphylococcus aureus* (MRSA) and *Streptococcus*, 0.1 mL volumes were placed on Difco Tryptic Soy Agar (TSA; BD) amended with 5% sheep blood (Hardy Diagnostics, Chandler, AZ) and naladixic acid (Sigma-Aldrich) and colistin (Sigma-Aldrich) to select for gram-positive bacteria. After incubation of the agar plates at 37°C for 48 hours, a gram stain was done on β-hemolytic and nonpigmented colonies to determine bacterial morphology (rods or cocci). The colony was then passed on to TSA, and a catalase test was conducted using 3% hydrogen peroxide, which differentiates between *Streptococcus* and *Staphylococcus*.<sup>7</sup> Identification was confirmed by the use of API 20 Staph and API 20 Strep identification strips (bioMérieux, Durham, NC). Identification of vancomycin-resistant *Enterococcus* was done by assay of 0.1 mL volumes on Columbia agar (Hardy Diagnostics), amended with 5% sheep blood (Hardy Diagnostics) containing naladixic acid, colistin, and vancomycin (Sigma-Aldrich).

The presence of coliform bacteria and *Escherichia coli* was determined by placement of 1 mL of the fluid extracted from the Sponge-Stick in a test tube containing Colilert (IDEXX, Westbrook, ME) and incubation for 24 hours at 35°C. Tubes positive for coliforms and *E coli* were plated on MacConkey Agar (BD) to confirm the presence of coliform bacteria. Selected lactose-fermenting colonies were then passed on TSA and identified using API 20E (bioMérieux) identification strips.

*Clostridium difficile* was detected by placement of a 1 mL sample in a tube containing 10 mL of cooked meat broth (Hardy

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Funding/support: Supported in part by The Clorox Company.

Conflicts of interest: None to report.

**Table 1**  
Bacteria on hospital touch screens

| Touch screen     | HPC (CFU)/<br>touch screen | Coliforms                 | Gram-positive bacteria  |
|------------------|----------------------------|---------------------------|---|
| 1                | 30                         | -                         | <i>Staphylococcus epidermidis</i>   |
| 2                | 30                         | -                         | Vancomycin-resistant <i>Enterococcus</i>  |
| 3                | 120                        | -                         | Vancomycin-resistant <i>Enterococcus</i> , <i>Sta epidermidis</i>                   |
| 4                | 90                         | -                         | -   |
| 5                | 180                        | -                         | <i>Kocuria varians</i> , <i>Micrococcus luteus</i>                                  |
| 6                | 120                        | -                         | -   |
| 7                | 6,000                      | <i>Klebsiella oxytoca</i> | <i>Clostridium difficile</i> , <i>Streptococcus oralis</i> , <i>Sta epidermidis</i> |
| 8                | 6,900                      | <i>Kle oxytoca</i>        | <i>C difficile</i> , <i>M luteus</i>  |
| 9                | 60                         | -                         | -   |
| 10               | 90                         | -                         | -   |
| 11               | 24,000                     | -                         | -   |
| 12               | 270                        | -                         | <i>Sta epidermis</i>  |
| 13               | 270                        | -                         | <i>Kytococcus sedentarius</i> , <i>Sta caprae</i> , <i>Sta epidermidis</i>          |
| 14               | 90                         | -                         | <i>Kyt sedentarius</i> , <i>M luteus</i>  |
| 15               | 60                         | -                         | <i>Sta epidermidis</i>  |
| 16               | 30                         | -                         | -   |
| 17               | 30                         | -                         | <i>Micrococcus spp</i>  |
| Average          | 2,257                      |                           |   |
| % positive (n/N) | 100                        | 12 (2/17)                 | 65 (11/17)  |

Abbreviations: CFU, colony forming units; HPC, heterotrophic plate count bacteria; -, no bacteria detected.

Diagnostics) as an enrichment media for 24 hours at 37°C. Tubes with turbidity, indicating growth, were then assayed on Cycloserine Cefoxitin Fructose Agar with Horse Blood and Taurocholate agar (Anaerobe Systems, Morgan Hill, CA) and incubated in an anaerobic jar using GasPak Plus with palladium catalyst (BD) for 24-72 hours at 37°C. Isolates were identified as *C difficile* by a gram stain, characteristic yellowish color, flat morphology, specific horse odor, and green-yellow fluorescence under ultraviolet light.<sup>8</sup>

Opportunistic pathogenic bacteria were isolated on touch screens in the hospital and grocery stores (Tables 1 and 2). Enteric bacteria were common on grocery store touch screens used by the public for self-service check out. Coliform bacteria, including *E coli*, were isolated on 59% of the grocery store screens compared with only 12% of the screens in the hospital health care environment. MRSA was isolated once from the grocery touch screens, but not from the hospital touch screens. The average number of bacteria on the grocery store touch screens was 13,382 versus 2,257 colony forming units on the hospital touch screens (800-1,000 cm<sup>2</sup>). The touch screens in the hospital settings were also tested for gram-positive opportunistic pathogens. Vancomycin-resistant *Enterococcus* and *C difficile* were detected twice on different touch screens. Most 68% (13/19) of the gram-positive bacteria detected were commensal skin organisms.

Computer equipment has become common in the last decade, both in public places and health care settings. Previous studies have suggested that computer equipment has become a reservoir for pathogens because of usage by many different individuals and because of the isolation of various opportunistic pathogens from keyboards and mice of computers in health care settings.<sup>2,5,9</sup> Computer touch screens have become more common, and to our knowledge this is the first study on their potential as reservoirs of opportunistic pathogens.

The common occurrence of enteric bacteria and higher levels of bacteria on grocery touch screens used by the general public is probably not surprising. Raw meat and vegetable products contain coliform bacteria, and *C difficile* and proper handwashing is likely less common among the general public.<sup>8,10-12</sup> It was interesting that one opportunistic pathogen of concern to the health care industry, MRSA, was isolated from the grocery store touch screens. The numbers of heterotrophic plate count bacteria and enteric bacteria on the touch screens in the hospital were much less than the grocery store touch screens, probably reflecting better hand hygiene.<sup>12</sup>

**Table 2**  
Bacteria on grocery store touch screens

| Touch screen     | HPC (CFU)/<br>touch screen | Coliforms                   | Gram-positive<br>bacteria |
|------------------|----------------------------|-----------------------------|---------------------------|
| 1                | 1,290                      | -                           | -                         |
| 2                | 1,770                      | -                           | -                         |
| 3                | 27,000                     | <i>Klebsiella oxytoca</i>   | -                         |
| 4                | 36,000                     | <i>Enterobacter cloacae</i> | MRSA                      |
| 5                | 28,200                     | <i>Ent aerogenes</i>        | -                         |
| 6                | 15,000                     | <i>Escherichia coli</i>     | -                         |
| 7                | 16,800                     | <i>Ent aerogenes</i>        | -                         |
| 8                | 20,400                     | <i>K pneumoniae</i>         | -                         |
| 9                | 3,000                      | -                           | -                         |
| 10               | 570                        | -                           | -                         |
| 11               | 60,000                     | <i>Ent aerogenes</i>        | -                         |
| 12               | 1,590                      | <i>K oxytoca</i>            | -                         |
| 13               | 7,800                      | <i>Esc coli</i>             | -                         |
| 14               | 840                        | -                           | -                         |
| 15               | 6,900                      | <i>Ent aerogenes</i>        | -                         |
| 16               | 180                        | -                           | -                         |
| 17               | 150                        | -                           | -                         |
| Average          | 13,382                     |                             |                           |
| % positive (n/N) | 100                        | 59 (10/17)                  | 6 (1/17)                  |

Abbreviations: CFU, colony forming units; HPC, heterotrophic plate count bacteria; MRSA, methicillin-resistant *Staphylococcus aureus*; -, no bacteria detected.

Still, a large number of gram-positive opportunistic pathogens, including *C difficile* and antibiotic-resistant bacteria, were detected on hospital touch screens, which emphasizes the importance of frequent cleaning of high-touch surfaces.

Computer touch screens can be potential reservoirs of opportunistic pathogens in hospitals and grocery stores. These findings confirm the importance of hand hygiene in hospitals where health care workers need to practice the My 5 Moments for Hand Hygiene concept and grocery stores where consumers need to use alcohol-based hand sanitizers along with handwashing when available.<sup>12,13</sup> In addition, frequent cleaning of high-touch surfaces, such as computer touch screens, should be implemented in these settings to reduce the risk of transmission of pathogens.

#### Acknowledgment

We thank Sherri Carlino for assistance in conducting this project.

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