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LETTER TO THE EDITOR

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# Microbiological analysis of 1000-Yen banknotes in a hospital environment

*Dear Editor,*

Money is one of the items most frequently passed from hand to hand; when contaminated, it may play a role in the transmission of microorganisms between people.[1] Although paper money has been reported as a possible transmitter of multidrug-resistant pathogens,[1] to the best of our knowledge, no information regarding drug-resistant bacteria on the Japanese Yen is available; therefore, we investigated the contamination of 1000 Yen notes.

Forty 1000 Yen notes were collected from a convenience store in Hirosaki University Hospital and from healthcare workers of the hospital. The banknotes were placed on a sterilized sheet and were rubbed using a swab (Raspercheck, Becton, Dickinson, and Company, BD) 10

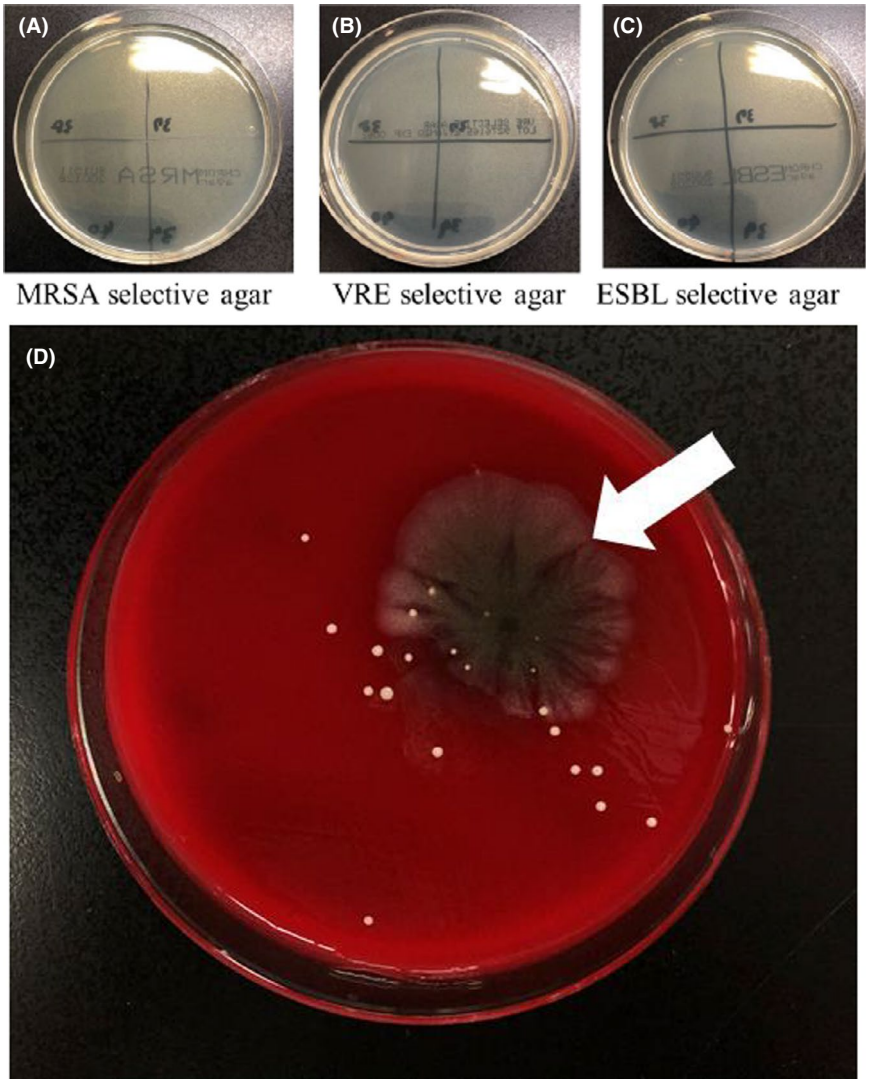


**FIGURE 1** (A-C) Representative plates showing bacterial growth on each selective agar. There was no growth of multidrug-resistant bacteria. (D) Example of bacterial growth on sheep blood agar. Out of the 40 analyzed bills, 18 showed bacterial growth on sheep blood agar. Colonies of Bacillus (white arrow) and other bacteria (small white colonies) could be seen

**TABLE 1** Types of bacteria and number of colonies grown on sheep blood agar

| Sample No. | Number of colonies | Bacteria |
|---|---|---|
| 1 | 1 | *Bacillus subtilis* |
| 2 | 3 | *Bacillus subtilis* |
| 3 | No growth | |
| 4 | 1 | *Staphylococcus capitis* |
| 5 | No growth | |
| 6 | No growth | |
| 7 | No growth | |
| 8 | 1 | *Staphylococcus epidermidis* |
| 9 | No growth | |
| 10 | No growth | |
| 11 | No growth | |
| 12 | No growth | |
| 13 | 1 | *Bacillus subtilis* |
| 14 | No growth | |
| 15 | No growth | |
| 16 | No growth | |
| 17 | 1 | *Bacillus sphaericus* |
| 18 | No growth | |
| 19 | No growth | |
| 20 | No growth | |
| 21 | No growth | |
| 22 | 1 | *Micrococcus luteus* |
| 23 | No growth | |
| 24 | No growth | |
| 25 | No growth | |
| 26 | 7 (1, 5, 1) | *Micrococcus kristinae*, *Leuconostoc mesentoroides*, *Micrococcus luteus* |
| 27 | 1 | *Bacillus subtilis* |
| 28 | 1 | *Bacillus firmus* |
| 29 | No growth | |
| 30 | No growth | |
| 31 | No growth | |
| 32 | 22 (1, 21) | *Bacillus subtilis*, *Rothia amarae* |
| 33 | 23 | *Bacillus subtilis* |
| 34 | 11 | *Koucuria kristinae*, *Enterobactor sakazaki* |
| 35 | 2 | *Micrococcus luteus* |
| 36 | No growth | |
| 37 | 1 | *Corynebacterium genitalium* |
| 38 | 31 | *Stomatococcus mucilaginosus* |
| 39 | 1 | *Bacillus subtilis* |
| 40 | 2 | *Acinetobacter lwoffii* |

times vertically and horizontally and 5 times diagonally left and right following the manufacturer's instructions. After the swab was dissolved in the rinse solution and stirred, 100 μL from each tube was spread onto methicillin-resistant *Staphylococcus aureus* (MRSA) selective agar (CHROMagar Microbiology), vancomycin-resistant Enterococcus (VRE) selective agar (CHROMagar), extended-spectrum β-lactamase (ESBL) selective agar (CHROMagar), and trypticase soy agar (BD) with 5% sheep blood. Then, these plates were incubated at 35°C for 24 hours. The microorganisms that grew on these plates were identified by time-of-flight mass spectrometry (TOF-MS, Microflex LT/SH System 269 944.01267, Siemens). Microorganisms that could not be identified by TOF-MS were further analyzed using a BBLCrystal GP identification systems (BD) in combination with gram staining.

We did not detect MRSA-, VRE-, or ESBL-producing bacterial growth (Figure 1A-C). Out of the 40 banknotes, 18 showed bacterial presence as evidenced by bacterial growth on sheep blood agar (Figure 1D). The bacteria were identified (Table 1). *Bacillus* species (*Bacillus subtilis/firmus/sphaericus*) were 22.5%, *Micrococcus* species (*Micrococcus luteus/kristinae*) were 10%, gram-positive cocci (*Staphylococcus capitis/epidermidis*, *Leuconostoc mesenteroides*, *Rothia amarae*, *Koucuria kristinae*, *Stomatococcus mucilaginosus*) were 15%, and gram-negative bacilli (*Enterobactor sakazaki*, *Acinetobacter lwoffii*) were 5%.

Paper currency may pose a public health risk when associated with the simultaneous handling of food and may lead to the spread of nosocomial infections.[2] Studies have shown that the rate of contamination increases from higher-value to lower-value notes, suggesting that lower-value notes circulate more and thus have a greater chance of contamination.[3]

The 1000 Yen note is the banknote with the lowest value currently issued by the Bank of Japan. While the kind of isolated bacteria identified in different studies might vary owing to the methods used, season, environmental conditions, type of money (coin or banknote), or local community flora, in general, gram-positive bacteria were generally the most predominant.[1,4] There were more *Bacillus* and *Micrococcus* than *Staphylococcus*, which often caused the skin infectious disease. It was similar to the result of air normal bacteria detected in general environment of Japan.[5]

*Bacillus subtilis/ sphaericus*, *Micrococcus luteus*, and *Acinetobacter lwoffii* cause opportunistic infections. The present study suggested the risk of bacterial transmissions, although reliability is limited by its small sample size. We emphasize the importance of hand hygiene, especially handwashing, in order to protect you and people from infection.

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## DECLARATION

Approval of the research protocol: Yes

Informed Consent: Yes

Registry and the Registration No. of the study/trial: Committee of Medical Ethics of Hirosaki University Graduate School of Medicine(No. 2016-1061)

Animal Studies: None

## CONFLICT OF INTERESTS

The authors declare no conflicts of interest.

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