Survival of Influenza viruses on banknotes

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Background
To control influenza successfully, the different ways that novel or circulating influenza viruses are transmitted to humans need a better understanding. Infection and transmission are considered the main routes of transmission. Influenza viruses can survive for a prolonged period of time in the environment and are transmitted to others via infected individuals. In addition, some influenza viruses are inactivated at high concentrations in soils, and this may be the main route of transmission. The aim of our study was to assess the survival of human influenza viruses on banknotes knowing that billions of them are exchanged daily.

Methodology

Viral stocks
Influenza A/Moscow/10/99 (H3N2), Influenza A/Wisconsin/67/2000 (H3N2), Influenza A/New Caledonia/25/99 (H1N1), and influenza B/Hong Kong/339/2001 were used at different concentrations.

Detection of virus survival
The virus suspensions were deposited on a small piece of banknote that was then conserved at room temperature (Figure 1a, 1b). During the experiments, temperature remained at 22°C and relative humidity was maintained between 30% and 50%. At predefined period of time, standard-sized pieces of banknotes were eluted in culture medium (Figure 1c, 1d) for 10min. 0.4 ml of the eluate was then used for cell inoculation. Cells were incubated at 33°C for 10 days and harvested for staining by immunofluorescence. 50 Francs Swiss Banknotes were provided by the Swiss National Bank.

Results

1) Survival of influenza viruses on banknotes
With a low concentration, the duration of infectiousness for influenza A (H1N1) and influenza B was limited to 1h to 2h respectively (Figure 2). Survival of influenza A (H3N2) viruses, like influenza A/Wisconsin/67/2000 and A/Moscow/1999, tested at higher concentration, was significantly longer with a duration of up to 24h and 72h respectively (Figure 2).

2) Impact of the initial concentration and the presence of mucus on survival of influenza viruses

3) Survival of influenza viruses on banknotes
To assess whether these in vitro experiments could be reproduced under "natural conditions", we used nasopharyngeal secretions from infected individuals. Nasopharyngeal secretions of fourteen influenza-positive cases (detected by real-time RT-PCR) collected during the 2007 season were inoculated on banknotes. In 11/14 cases, influenza virus survived for at least 24h and in 6/14 cases influenza survival was 24h (Figure 4).

Conclusions
- Influenza A viruses in respiratory secretions can survive up to 17 days on banknotes.

- Time of survival of infectious virus is related to the inoculum size and the presence of mucus.

- Contamination of environmental surfaces such as banknotes need to be considered as a potential vector for influenza in case of a pandemic.