Survival of Influenza viruses on banknotes

Y. Thomas, G. Vogel, W. Wunderli, C. Tapparel, L. Kaiser
1 Central Laboratory of Virology, University Hospitals of Geneva, Geneva, Switzerland
2 Swiss National Centre for Influenza, Central Laboratory of Virology, University Hospitals of Geneva, Geneva, Switzerland
3 Kantonales Laboratorium Basel-Stadt, Kontrollstelle für Chemie- und Biosochemie, Basel, Switzerland

Background
To control influenza successfully, the different ways that could promote influenza virus transmission in humans need to be known. Droplets and aerosols are considered as the main route of transmission. Nevertheless, human influenza A viruses can survive for a prolonged period of time in the environment as fomites. In addition, even influenza viruses are excreted at high concentrations in stools, thus increasing the dissemination potential of this virus. 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/Shanghai/68/2000 (H3N2), Influenza A/New Canton/23/1999 (H1N1) and Influenza B/Hong Kong/335/2001 were used at different concentrations.

Detection of virus survival
Six of a viral suspension were deposited on a small piece of banknote that was then preserved at room temperature (Figure 1a, 1b). During the experiment, temperature remained at 22°C and relative humidity was maintained between 30% and 50%. At predefined period of time, standardized pieces of banknotes were eluted in culture medium (Figure 1c, 1d) for 10 min. 0.4 ml of the eluate was then used for cell inoculation. Cells were incubated at 35°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 infectivity for influenza A (H1N1) and influenza B was limited to 1h to 2h respectively (Figure 4). Survival of influenza A (H3N2) viruses, like influenza A/Moscow/68/2000 and A/New Canton/1999, tested at higher concentration, was significantly longer with a duration of up to 24h and 72h respectively (Figure 4).

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 those in vitro experiments could be reproduced under "natural conditions", we used nasopharyngeal secretion from infected individuals. Nasopharyngeal secretions of fourteen influenza-positive cases (detected by real-time RT-PCR and cell culture) 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 5).

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.