

# **Microbial Cultures on Banknotes as a health threat**

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## Key facts:

- Cash money is one of the overlooked critical points of disease transmission.
- We exchange banknotes with strangers every day without much thought.
- SARS-CoV2 coronavirus survives on banknotes for up to 4 days, maybe more under real conditions.
- Influenza virus survives on banknotes for up to 17 days under real life conditions.
- A UV-C banknote irradiator is an optimal solution to effectively inactivate viruses and bacteria.

## The problem

Right from the start of the corona pandemic outbreak there was a push toward interruption of person to person transmission chain. We started disinfecting our hands, wearing gloves, disinfecting surfaces in public areas, we started doing everything in our power to not touch something someone else has touched before us. And then there was cash. We are paying with and receiving banknotes that have been touched by many people in a short period of time. A US banknote can travel over 1000 km / day.<sup>1</sup> And a banknote will be used 2,328 times in its lifetime.<sup>2</sup> Researchers from the UK, Australia, China and New Zealand have found that bacteria transmitted from a person's hands survives on paper banknotes for 15 days without any significant reduction in virality.<sup>3</sup> Cash is the most widely used payment method in the world<sup>4</sup> but still remains one of the dirtiest things we mindlessly exchange with strangers every day.

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### “ SARS-CoV2 virus survives for up to 4 days on a banknote.

While ECB and WHO stated at the beginning of the corona crisis that the possibility of transmission of SARS-CoV2 through handling banknotes is low, they urged people to wash and disinfect their hands after handling cash.<sup>5</sup> Early studies concerning survival rates of the virus on various surfaces were conducted on paper, plastics, steel. While the virus survived on tissue paper for 3 hours it survived for up to 4 days on banknotes.<sup>6</sup> A more comprehensive study was done on survival of Influenza (flu) virus by Swiss scientists. It focused on tests under real world conditions, and it showed that viruses can live on banknotes even longer. The conclusion was that flu virus can survive on a banknote for up to 17 days.<sup>7</sup> And we all know from experience of handling cash, that notes are oftentimes less than ideal, they are wrinkled, full of crannies and debris.

## UV-C Banknote irradiator

A device that uses a special type of highly invasive UV light named germicidal UV-C to irradiate banknotes has been designed. Germicidal UV-C light is part of the UV spectrum that is not present on Earth's surface. It is extremely harmful to all life forms because it penetrates and breaks the DNA and RNA, rendering microorganisms inactive or dead. This technology is used in areas where utmost cleanliness is imperative, such as operating rooms, laboratories, water treatment facilities etc. The device called Cash Cleaner is designed in a way that reliably exposes the banknote surface to germicidal UV-C radiation while protecting the user. A measurement research has concluded that the device delivers at least a dose of 11.3 mJ/cm<sup>2</sup> in UV-C spectrum to the banknote<sup>8</sup>, providing enough disinfection power to eliminate more than 99% of microbes.

## Microbiological testing

The proposed effectiveness of the device was tested at Microbium Ltd. laboratory in real life conditions. The process used was a scientific process following the principles of ASTM E3135 - 18 standard. The testing proved that the banknote irradiator kills at least 99% of present microbes.<sup>9</sup> Based on those tests and UV-C irradiation measurements it is conclusive that the device inactivates various cultures including the novel coronavirus, E. coli, influenza, SARS, anthrax, salmonella etc., present on banknotes.

Below is a table that shows different microbial cultures harmful to human health and needed UV-C doses for log2 (99%) and log3 (99.9%) reduction in microbial activity. Based on irradiation measurement report and conclusions from the microbiological testing of the device we can estimate that it achieves a dose of at least **10.4 mJ/cm<sup>2</sup>**. We can compare that to the known doses that are needed for inactivation of microbes and see how effectively this irradiator does it to make banknotes safer to use. Doses that Cash Cleaner successfully achieves are colored in blue.

Microbial culture	99% reduction	99.9% reduction
E. Coli <sup>10</sup>	4 mJ/cm <sup>2</sup>	6 mJ/cm <sup>2</sup>
Influenza (flu) <sup>11</sup>	7.2 mJ/cm <sup>2</sup>	10.8 mJ/cm <sup>2</sup>
Anthrax <sup>10</sup>	9 mJ/cm <sup>2</sup>	13.5 mJ/cm <sup>2</sup>
Salmonella <sup>10</sup>	5.7 mJ/cm <sup>2</sup>	7.8 mJ/cm <sup>2</sup>
SARS-CoV2 <sup>12</sup> (novel coronavirus)	N/A	3.7 mJ/cm <sup>2</sup>
Poliovirus <sup>10</sup>	5.6 mJ/cm <sup>2</sup>	11 mJ/cm <sup>2</sup>
Hepatitis A <sup>10</sup>	10 mJ/cm <sup>2</sup>	15 mJ/cm <sup>2</sup>
Streptococcus faecalis <sup>10</sup>	8.6 mJ/cm <sup>2</sup>	9.8 mJ/cm <sup>2</sup>
Staphylococcus aureus <sup>10</sup>	3.2 mJ/cm <sup>2</sup>	4 mJ/cm <sup>2</sup>

## Conclusion

While the long term monetary future is surely digital, the transition period will be an ongoing process for at least a decade. Banknotes are known and proven to be a major possible health risk that we encounter on a daily basis and people's attitude towards using cash has shifted significantly during the latest pandemic. To ensure safety of employees and customers, and to mitigate the negative influence of fear of cash on business some measures must be taken. While hand disinfection and mask usage are a good prevention measure, the problem of pathogens on banknotes remains. A good solution is to disinfect banknotes, to ensure that people who touch them can do so without risking their health. It's been suggested and proven that banknote irradiation devices with germicidal UV-C radiation are a good solution to reliably, safely and cost effectively do that.

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