

Dirty Money - How Contaminated Is It?

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The phrase “Dirty money” may have different meanings for different people...but as far as microbiology is concerned...have you ever thought about what else you are getting back along with your change when you’re doing your shopping? I’m sure most of us are more concerned about getting the correct change rather than what microbes come for free with our change. For the few who have thought about what else they may be getting, I suspect that even fewer would answer: “pathogenic and sometimes multidrug-resistant bacteria, fungi and human parasites.”

In reality, we shouldn’t be surprised that bank notes and coins are contaminated with various bacteria. After all, we hardly expect them to be sterile. Our own hands are colonized with millions of bacteria and [money is the most frequently passed item in the world](#).

All studies that I have come across investigating bacterial contamination on money (paper notes or coins) have found a significant proportion to be contaminated (53-100%). I suspect that the microbiological techniques used in the various studies impacted on the results and my personal view is that the majority if not all money commonly exchanged between people will be contaminated.

The level of contamination and type of organisms on the money vary depending on the country, season, environmental conditions, type of money (paper vs. coins), the type of material the money is made off,

local community flora, the general hygiene level of the population and who is likely to be handling the money. Also dirty/damaged money (indication of frequent exchange) has been shown to be significantly more contaminated than clean and mint condition currency notes, and low denomination notes were more likely to be contaminated than higher denomination notes (probably reflecting frequency of use and socio-economic factors).

The question to be asked, given the above, is: does it matter if money is contaminated with organisms? After all, this is not a new problem, as early as 1949, [Nisbet and Skeoch](#) have highlighted this issue. To answer this we need to look at a number of factors. These include: what type of organisms are on the money, how long are they able to survive and are they able to be transmitted to people and throughout the community from these contaminated currencies. So let's look at these factors in more detail:

The Type of Organisms Found on Money

It is expected that bacteria will be found on bank notes and coins regardless of which country the money is from. Studies from Mexico, USA, India, Saudi Arabia, Nigeria, Kenya, Burma, China and Turkey to name but a few have all found significant contamination on their money. The type of bacteria found on money includes [deep breath]: *E. coli*, *Vibrio* spp., *Klebsiella* spp. including *K. pneumoniae*, *Serratia* spp., *Enterobacter* sp., *Salmonella* spp., *Acinetobacter* spp., *Enterococcus* spp., *Staphylococcus* including *S. aureus*, *Bacillus* spp., *Staphylococcus epidermidis*, *Streptococcus pneumoniae*, *Proteus* spp., *Pseudomonas* spp. including *P. aeruginosa*, *Shigella* spp., *Corynebacterium*, *Lactobacillus* spp., *Burkholderia cepacia*, *Micrococcus* spp. and *Alcaligenes*.

Looking at this list, it is clear that some of these bacteria are common environmental bacteria considered non-pathogenic. However, many are either potentially pathogenic or common human pathogens. For example, *K. pneumoniae* is a virulent organism and may cause both community and hospital-acquired infections. Even those organisms not commonly associated with disease in healthy hosts can cause clinically significant infections in immuno-compromised and hospitalised patients. These include even the natural inhabitants of the human skin such as *Staphylococcus* spp.

The story doesn't end there since a number of studies have found multidrug-resistant and virulent strains on money. These have the potential to cause serious infections that are hard to treat, to disseminate in healthcare and community settings, and to spread antimicrobial resistant determinants to other bacteria.

Bacteria are not the only organisms found on money. A number of studies show that fungal contamination of money is also common. Some of these are potentially pathogenic to humans and other life forms including plants. This may have implications far beyond human health to economic consequences if non-native pathogenic species are introduced into different countries via money carried during travel.

How Long are Organisms Able to Survive on Money?

The survival of organisms on money depends on the type of the organism and their environmental resilience, the environmental conditions and the type of material the money is made of. Banknote paper is manufactured from cotton fibre, which gives the paper its strength and durability. Other additional elements maybe added to the cotton. Polymer (or plastic) bank notes were developed to improve durability and incorporate some security features. One study investigated survival of MRSA, VRE and ESBL-producing *E. coli* on various bank notes from around the world. They found that the 3 organisms survived on the Romanian Leu for 6 hours after drying and VRE was isolated from the same notes after one day of drying. Other currencies had variable survival rates. Another in-vitro study⁴ found that *S. aureus* was able to survive on Indian paper currency for 8 days at room temperature.

Are Organisms Able to be Transmitted from Money?

Transmission of organisms from money is highly significant if it occurs. For example, transmission from the community to the hospital setting is relevant because normally non-pathogenic, or opportunistic pathogens can have a serious clinical impact in such settings. On the other hand, transmission from the healthcare environment to the community is relevant when antimicrobial resistant strains (commonly found in hospitals) are involved. **In one study**, investigators artificially contaminated bank notes of a number of countries with *S. aureus* and *E. coli*, and investigated transmission after 3 subjects with disinfected hands came into contact with these notes. Transmission was not successful for the Euro notes but transmission from US Dollars and the Romanian Leu was observed.

So we probably should be concerned with contamination of money especially when virulent, pathogenic or multidrug-resistant strains are concerned. Transmission between the healthcare and community settings can also have important implications.

What's the solution? Disinfection of the currencies in banks with UV light, supersonic or chemical means, producing bank notes from materials which inhibit bacterial growth or material with antimicrobial activity as well as replacement of traditional methods of trading with electronic money transactions, have all been proposed. Personally I think for now, proper hand hygiene and overall hygiene remain the best ways to counter this problem.

About Saber Yezli



Saber Yezli is the Scientific Project Manager of the Healthcare Division of [Bioquell UK](#). Saber has a first class honours BSc degree in Genetics from Cardiff University (2003) and a PhD on the molecular basis of biocides and antibiotics resistance and susceptibility in bacteria in 2008. His special interest is in multidrug resistant nosocomial pathogens, epidemiology and hospital acquired infections and the role of the environment in the transmission of these infections. He is the author/co-author of numerous peer-reviewed publications, abstracts and invited oral presentations. He is also a member of the Infection Prevention Society (IPS) and European Society of Clinical Microbiology and Infectious Diseases (ESCMID). [View all posts by Saber Yezli on Bioquell's Micro Blog →](#)