

Paper Money and Coins as Potential Vectors in Transmissible Diseases- A Review

Varusha Sharon C¹, Dr. Gowri Sethu²

*BDS First year¹, Head of department of Physiology²
Saveetha Dental College and Hospitals, Chennai, India.*

INTRODUCTION:

Money is one of the most valuable and has become one of the most important part of life in every aspects. The same money has many negative aspects too. Money is found to play a very vital role in transmitting diseases.

Paper money and coins can be one of the factors which is highly related to public health risk as it is exchanged from hand to hand. Recent researches show that money can transmit nosocomial infections. Money obtained from hospitals showed a high range of *Staphylococcus aureus*, *Escherichia coli* and a wide range of *Salmonella* species. It was also found that *S.aureus* was able to survive on coins[1].

When a individual living in a unhygienic atmosphere, having unhygienic habits handles money and from there everything starts. Those notes and coins will act as a fomite and contaminates the next user. As we all know nothing in this world is stable, the same theory works even in money. Money is not stable, it transfers from hand to hand across places transferring pathogens too.

All would have noted that many people during counting money use their saliva. It have germs which is also transmitted. Paper money from hospitals eventually shows high contamination of pathogens as hospital is a place where one can encounter more and more infections. People who come to get treated will mostly have infections and the money given by them in the hospitals for bill payment and other needs also is infected.

This review summarizes the recent researches on this topic and how paper money and coins serve as a potential vectors in transmitting diseases among population.

DISCUSSION :

Persistence of Pathogens on Surfaces of Paper Money and Coins

The main factors which promoted the growth of pathogens on the surface of paper money and coins were the presence of organic matter, solar radiation, temperature and humidity [2]. A recent review reported that many Gram-positive bacteria, such as *Enterococcus* sp., *S. aureus* and *Streptococcus pyogenes*, and Gram-negative bacteria, such as *Acinetobacter* sp., *Escherichia coli*, *Klebsiella* sp., *Pseudomonas aeruginosa*, *Serratia marcescens* and *Shigella* sp., can survive for months on surfaces. In addition, mycobacteria and *Clostridium difficile* can survive for months, while other pathogens, such as *Bordetella pertussis*, *Haemophilus influenzae*, *Proteus vulgaris* or *Vibrio cholera*, persist only for days[3]. *Candida albicans* can survive for up to 4 months on surfaces, whereas respiratory tract viruses, such

as Corona virus, Coxsackie virus, Influenza virus, severe acute respiratory syndrome-associated virus or Rhinovirus, can persist on surfaces for a few days[3].

Currency Notes

Paper currency very frequently passed among individuals which contains microbes which is also carried along. Paper currency is made of a rugged mix of 75% cotton and 25% linen, and offers surface area for bacteria and microorganisms to reside on both sides[4]. Polymer-based banknotes presented lower bacterial counts than cotton-based banknotes[5]. It is possible that the fibrous surfaces of cotton-based banknotes provide a good surface for bacterial attachment [5]. As a result, fewer bacteria were isolated in Australia and New Zealand, where polymer-based banknotes are used[5]. Moreover, in banknotes from Mexico, where both polymer and cotton-based notes are used, it was found that polymer-based banknotes were much less contaminated than cotton-based notes [5]. The longer the paper bill remains in circulation, the more opportunity there is for it to become contaminated, and lower-denomination notes receive the most handling because they are exchanged more often[4],[5].

1) *Bacteria*

The amount of bacterial contamination on currency varies widely between countries. As a result, 88% of the paper notes tested in Jeddah, Saudi Arabia were contaminated with a variety of microorganisms [6], and 94% of US\$1 bills had bacterial contamination[7]. The number of bacteria per square cm on banknotes was also different between countries. As a result, polymer-based banknotes from Australia and New Zealand presented less than 10/cm² bacteria, whereas cotton-based notes from China presented more than 100/cm² bacteria [5]. Cotton-based notes from the USA contained about 10/cm² bacteria [5]. The number of bacteria on currency also varies within a single country, as the number of bacteria isolated from US currency varied from 20 to 2.5 × 10⁴ CFU[5]. In India, approximately 18–69 CFU of *S. aureus* were isolated per banknote[8]. In a recent study on banknotes from different countries, it was found that *E. coli* was most commonly isolated on banknotes from the USA and China, and a *Salmonella* sp. was isolated only from samples in the USA, China and Ireland, while the presence of *S. aureus* varied[5]. In summary, many species of bacteria have been identified from different countries.

2) *Other Agents*

More recently, fungi were isolated from both old and new currency notes in Riyadh, Saudi Arabia [9]. The

most commonly isolated fungal species was *Aspergillus niger*, followed by *Aspergillus flavus*, *Candida* sp., *Penicillium* sp. and *Rhizopus* sp. [9]. In another study in India, currency notes from different occupational groups were evaluated for the presence of microbial contaminants, and fungi such as *Aspergillus niger* and *Fusarium* sp. were isolated from these currency notes, in addition to common pathogenic bacteria [10].

Coins

Few studies have examined the contamination of coinage, and copper (Cu) seems to be a limiting factor for bacterial survival on coins [11]. As a result, coins have been found to carry opportunistic bacterial pathogens, but they exhibit a lower bacterial load than paper currency [11].

1) Bacteria

Coins have been shown to carry opportunistic pathogens, such as a variety of species of the genera *Staphylococcus*, *Bacillus*, and *Corynebacterium* [11,12]. Abrams and Waterman found that 13% of the coins collected from laboratory personnel were contaminated by potential pathogens, such as *S. aureus*, *Klebsiella* sp., *Proteus aeruginosa* and *P. mirabilis* [13]. Most commonly, Gram-positive staphylococci and micrococci were isolated from EU€50 coins collected in Germany and Portugal [11]. The absence of streptococci isolates from coins probably suggests a high sensitivity of these bacteria to metallic Cu [11]. In a recent study on the bacterial flora collected from coins from 17 countries, all of the isolates from coins were Gram-positive strains, with the majority belonging to the genera *Bacillus* (40%) and *Staphylococcus* (28%) [12]. Multiple genes that are potentially involved in Cu resistance were identified in these bacteria [14].

2) Other Agents

More recently, *Penicillium* sp., *Aspergillus niger*, *Fusarium*, *Rhizopus*, *Altenaria* sp., *Candida* sp. and *Cryptococcus* were isolated from Kenyan coins [15].

Fomites & Money in the spread of a Nosocomial Infections

It is believed that the main route of transmission of most pathogens is via the transiently contaminated hands of the healthcare worker [17]. A single contact of a hand with a contaminated surface can result in a variable degree of pathogen transfer [3]. In hospitals, surfaces, such as beds and keyboards, that come into contact with hands serve as reservoirs of nosocomial pathogens and vectors for cross-transmission [18,19]. Banknotes and coins can also serve as pathogen reservoirs [8]. Moreover, hospital personnel may transmit *Clostridium difficile* to susceptible patients by transient carriage on their hands. The same strain of *C. difficile* was isolated from the hands of children and teachers in a diarrheal outbreak in a day-care setting [20]. In summary, evidence from healthcare studies and outbreaks has revealed that fomites, including money and coins, can serve as reservoirs of nosocomial pathogens.

Prevention

We can see that money is serving an indirect route for transmitting diseases. Hand washing should be made compulsory for people who are involved in clinical field and food manufacturers. As we can see that many pathogenic or antibiotic-resistant bacteria have been isolated from various coins and paper money collected from medical staff and food handlers [1]. As a result, microbial testing of banknotes and replacement of contaminated notes, and the regular withdrawal of damaged notes by federal authorities is recommended [16]. Antimicrobial polymer materials can also be used in the manufacture of banknotes and banknote paper can be treated with antimicrobial-active compounds, which prevent the growth of microorganisms on banknotes and consequently limit risks of contamination during handling [16]. In addition, the banknote paper can be treated with metallic ions, which are known to have a wide range of antibacterial properties.

CONCLUSION :

In this review, it is seen that contaminated paper money and coins are a public health risk when associated with the simultaneous handling of food, and currency may spread nosocomial infections. In this review it has been highlighted the potential for banknotes and coins to carry bacteria and fungi, as well as their potential capacity to spread infectious agents. As a result, reinforcing the need for good hand hygiene after handling money, especially when simultaneously handling food and money.

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