Personal Accessories as a Carrier for Zoonotic Disease

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Ruba Ashraf[1], Razia Kausar[2], Ghulam Murtaza*[2], Bushra Zaidi[3], Qadoosiyah Naeem[4], Sahib Jan Nasar[5], Abdul Bari Nasar[5], Fasiullah[3], Hammadullah[7], Muhammad Rehan[4] and Awais Illyas[6]

ABSTRACT

Healthcare workers are vital for public health, but they can get sick and unintentionally spread infections among patients. Microorganisms can enter healthcare settings through items like laptops, lab coats, money, keys, drinks, phone accessories, and medical tools. Healthcare workers can unknowingly pass infections between patients by using various objects and accessories. For example, female healthcare workers are advised to clean their handbags daily and avoid fabric purses. White coats can also spread contamination, so there are suggestions to limit their use in non-clinical areas. Zoonotic diseases, which transfer from animals to humans, are a growing concern. Diseases like Anthrax, Rabies, Tuberculosis, Salmonellosis, Campylobacteriosis, and Leptospirosis pose health risks. Preventing zoonotic diseases involves vaccination programs, such as immunizing dogs against Rabies. Vaccinating animals is crucial to protect public health and prevent the spread of these diseases. To address the risks of zoonotic diseases, collaboration between public health veterinarians and other stakeholders is necessary for effective prevention and management.

Key words: Personal Accessories, zoonotic diseases, Vaccination, Public health Healthcare workers.

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[1]Faculty of Veterinary Sciences, University of Agriculture, Faisalabad, Pakistan.
[2]Department of Anatomy, University of Agriculture, Faisalabad, Pakistan.
[3]Department of CMS, University of Agriculture, Faisalabad, Pakistan.
[4]Department of Microbiology, University of Agriculture, Faisalabad, Pakistan.
[5]Department of Livestock and Dairy Development, Baluchistan, Pakistan.
[6]Department of Livestock and Dairy Development, Punjab, Pakistan.
[7]Veterinary Research Institute, KPK, Pakistan.
***Corresponding author:** murtazakhanarman516@gmail.com, rubaashraf63@gmail.com.

1. INTRODUCTION

Healthcare workers play a vital role in preserving public health, although they are not immune to falling ill themselves. In some cases, they inadvertently contribute to the transmission of illnesses between patients (Belay et al. 2017). Micro-organisms can be introduced into healthcare settings through the use of various inorganic objects by healthcare personnel, increasing their susceptibility to infection and facilitating the spread of infections among patients (Braam et al. 2021). Commonly used items such as laptops, lab coats, currency notes, keys, canned beverages, mobile phone accessories, and medical instruments from healthcare environments can be sources of infection (Spoorthy et al. 2020). Additionally, healthcare workers can inadvertently spread infections within hospitals from one patient to another through various accessories and objects (Danzmann et al. 2013). For instance, it is recommended that female healthcare workers wash their handbags daily and avoid using fabric purses (Tedder et al. 1995). Moreover, white coats have been identified as potential sources of cross-contamination, leading to suggestions for their prohibition in non-clinical areas such as study spaces and eating areas (Rahman et al. 2020).

Moreover, the emergence of diseases that are transmitted from animals to humans has become a growing concern (Atlas 2012). Notably, major zoonotic diseases, including Anthrax, Rabies, Tuberculosis, Salmonellosis, Campylobacteriosis, and Leptospirosis, have raised significant health risks (Keck et al. 2018). Among these, Anthrax has been observed to cause clinical epidemics in both humans and cattle, leading to multiple cases of infection and mortality (Chakraborty et al. 2012; Han et al. 2017). Furthermore, zoonotic diseases like Rotavirus pose global threats to mammals and birds (Samad 2011), impacting the health and production rates of farm animals (Nelson 1999). The effects of zoonoses include not only the direct consequences of illness but also financial losses, damage to the reputation of workers, and the implementation of control measures (Zhang et al. 2016; Ostfeld et al. 2004).

Efforts to prevent zoonotic diseases often involve vaccination programs, such as those for Rabies, which include regular immunization of dogs (Hasanov et al. 2018; Vial et al. 2006). Vaccination of animals serves as a crucial strategy in safeguarding public health and preventing the transmission of zoonosis and foodborne illnesses (Hafez 2020). Given the potential risks associated with zoonotic diseases, collaboration between public health veterinarians and other stakeholders is imperative for effective disease prevention and management (McGee 2003).

2. THE PURSES AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Purses have long been regarded as prized possessions in many households (Aruga et al. 2021). Beyond just carrying cash, people use handbags to store various valuable items, devices, debit cards, car accessories, and receipts (Mittal et al. 2022). Typically, handbags are not regularly cleaned and are often used for extended periods, potentially serving as agents for the spread of infections (Strong et al. 2017). Individuals' bags can become carriers of infections within communities. In healthcare settings, the handbags of medical workers have been found to harbor bacteria (Brownlie 2006). Studies have shown that approximately 96% of handbags in community settings are contaminated with microorganisms, a higher rate than the 69.2% contamination rate found in handbags in pharmaceutical settings. Previous research has indicated that the interiors of women's purses and wallets are also teeming with microorganisms. Several studies have reported bacterial colonization on currency notes during circulation (Lusher et al. 2017).

Various types of bacteria such as Staphylococcus, Enterococcus, E. coli, Pseudomonas, and Micrococcus have been isolated from these handbags, highlighting the presence of both cooperative and opportunistic pathogenic organisms (Owusu-Kwarteng et al. 2020). The attachment and persistence of microorganisms may be facilitated by the surface environment. Uneven and textured materials increase the surface area and create concealed spots that can aid microbial attachment, in contrast to smooth surfaces. Additionally, pathogens tend to adhere more readily to textured materials compared to smooth ones (Nash et al. 2015).

3. THE WHITE COAT AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Traditionally, the white coat is regarded as a symbol of honor and dignity within the medical profession, serving as personal protective equipment (PPE) for healthcare workers to safeguard against skin irregularities and patient contact (Willemsen et al. 2019). Studies have suggested that infectious microorganisms, including drug-resistant bacteria such as Erysipelothrix rhusiopathiae, can persist on white coats, potentially leading to skin infections (Zachary and McGavin 2017). It has been found that bacteria can survive on the fabric of white coats, including materials like linen, polyester, or cotton, for approximately 20 to 80 days (Todd et al. 2010). Another study identified the sleeves and pockets of white coats as the areas most heavily contaminated. Therefore, medical professionals should purchase new white coats annually and have at least two in rotation (Willemsen et al. 2019).

It is crucial to encourage healthcare workers to wash their white coats daily. Inadequate hand hygiene practices significantly contribute to the contamination of white coats, especially as these garments frequently come into contact with patients during medical duties (Burgess 2021). Thus, it is imperative to emphasize the importance of thorough handwashing before and after patient interaction. Furthermore, the promotion of alternatives to white coats, such as the widespread use of protective gowns, should be encouraged (Kraus et al. 2018).

4. MOBILE PHONES AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Mobile phones play an integral role in communication among doctors and other healthcare workers (HCWs) in hospitals, where hospital-associated infections (HAI) are common (Stempliuk et al. 2014). The hands of healthcare workers are a significant factor in the transmission of hospital-associated infections, and cell phones, which are often not regularly cleaned and frequently come into contact with patients during or after examinations, can serve as a medium for the spread of healthcare-associated infections (HAIs) (Ulger et al. 2015). Approximately one-fourth of cell phones belonging to healthcare workers are contaminated with hidden pathogens. Microorganisms commonly found on our skin thrive and multiply in warm environments, making cell phones an ideal breeding ground for these microorganisms, particularly as they are often kept close and easily transported in bags and pockets (Chiappelli et al. 2015). Simple precautions, such as proper hand hygiene practices and regular disinfection of cell phones using ethanol, can help reduce the risk of healthcare-associated infections caused by these devices (Gunning 2014).

5. FACE MASKS AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Many zoonotic diseases can spread through the inhalation of droplets, and healthcare workers are instructed to use personal protective equipment (PPE) when treating patients affected by these diseases (Stawicki et al. 2020). PPE includes gloves, face shields, and masks. However, prolonged use of masks can lead to physical and mental strain, potentially reducing performance efficiency (Khan 2022). Work effectiveness tends to decrease over time with the use of face masks compared to when they are not used. Additionally, the duration of work is often shortened when utilizing face masks and PPE (Kähler and Hain 2020).

Long-term use of face masks can lead to various adverse physical effects such as headaches, breathing difficulties, skin irritation, and pressure ulcers, as well as impaired perception (Laurie 1983). It can also interfere with vision, neural impulses, and homeostasis (Glenn 1985). Headaches associated with long-term face mask usage are linked to factors like increased carbon dioxide levels (hypercapnia) and decreased oxygen levels (hypoxemia) (Böing et al. 2015). Tight straps and pressure on facial nerves can contribute to headaches (BIEKMAN 1950). Factors such as sleep deprivation, irregular meal times, and high-stress levels can also contribute to headaches in healthcare workers who wear face masks for extended periods (Rasmussen et al. 2020). Face masks with tight straps can impede proper breathing and result in increased carbon dioxide levels (CO2) known as hypercapnia (McDonell 2015). Additionally, the accumulation of CO2 between the mask and the face can lead to respiratory distress and breathing difficulties. Symptoms of hypoxemia, such as chest discomfort and hyperventilation, can also be observed in healthcare workers who wear masks for extended periods (Fried 1993).

6. MEDICAL INSTRUMENTS AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Clinical instruments commonly used by physicians, such as sphygmomanometers and stethoscopes, which are not regularly cleaned during routine clinical procedures, are potential sources of infection (Dancer 2014). Dental gloves, designed to protect the dental care team from being contaminated by the patient, are not always a foolproof method for preventing contamination (Illich 1975). The use of mobile phones by healthcare workers with covered hands in gloves is not uncommon, leading to an increased risk of spreading healthcare-associated infections (Wolfensohn 2008). However, the use of gloves does not eliminate the necessity for hand washing, as gloves themselves can become contaminated due to tears or other issues during use. Research suggests that prolonged glove usage, combined with the use of antiseptics, complex secretions, and ethanol, can compromise the integrity of the gloves. The American Dental Association recommends that hands be thoroughly cleaned with a bactericidal agent before and immediately after glove usage (Li et al. 2010).

7. BEVERAGES AND REFRESHMENT BOTTLES AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Indulging in chilled bottles of beverages and refreshments is a common practice among healthcare workers during their busy shifts, providing a sense of freshness and enjoyment (Rhys-Taylor 2010). However, many modern storage and retail food facilities often store these products alongside perishable items, potentially exposing them to unhygienic conditions before they reach the market (Higgins 2011). Rodents, commonly found in such storage areas, can serve as carriers of various diseases such as bubonic plague, epidemic louse-borne typhus, icterus (yellowing of the skin and whites of the eyes due to abnormal bile pigments in the blood), rat-bite fever, rabies, and microbial foodborne illnesses (Anstead 2020). Additionally, zoonotic diseases like hemorrhagic nephrosonephritis and epidemic hemorrhagic fever can be transmitted through the contaminated urine and excrement of rats (Forbes et al. 2012). Hemorrhagic nephrosonephritis, also known as Lancereaux-Mathieu-Weil Spirochetosis, has emerged as a significant epidemic disease characterized by spleen enlargement, kidney and liver deterioration, as well as severe bleeding or hemorrhage in the lungs (BARBERO et al. 1953). Raising awareness about these diseases through active informational campaigns is crucial to implementing preventive measures against them (Windahl et al. 2008).

8. AUTOMOBILE INTERIORS AS A SOURCE OF TRANSMITTING ZOONOTIC DISEASE

Automobiles are often a necessary means of transportation for many healthcare workers who frequently travel to and from hospitals or clinics to attend to calls and spend significant amounts of time in these settings (Dominelli 2021). *Staphylococcus epidermidis, S. aureus,* and *S. warnerii* are among the most commonly found microbes, as Staphylococci can easily adhere to commonly touched surfaces (Neela et al. 2019). It is plausible that the interiors of automobiles may serve as a reservoir for infectious staphylococci and play a significant role in the transmission of these bacteria to individuals. It is hypothesized that individuals constantly in contact with S. aureus may contract diseases, or those in contact with the S. aureus carrier may facilitate the storage of S. aureus on the surfaces of the automobile (Gresham et al. 2000). Coating the driver's seat with 10% silver ion preservatives can be an effective measure to eliminate the presence of these infectious microorganisms collected from these areas (Subhan et al. 2021).

9. ZOONOTIC DISEASES

Zoonotic diseases can inherently be transmitted between animals and humans as shown in Fig. 1 (Bridge et al. 2011). Recent epidemics, such as viral hemorrhagic fever, anorexia, and beriberi, have underscored the significant impact of these diseases on human health (Kuhn et al. 2003). Their rise is linked to global trade, human migration, and environmental degradation (Boguslavsky et al. 2022).

10. BACTERIAL ZOONOSIS

10.1. ESCHERICHIA COLI

Escherichia coli is a common bacterium that belongs to the family Enterobacteriaceae (Blood 1995). While it is typically commensal in both humans and animals and verocytotoxin-producing strains of E. coli can cause distinct illnesses in humans such as dysentery, Enterohemorrhagic Escherichia Coli-Associated Colitis, and diarrhea-associated (D+) hemolytic uremic syndrome, but do not generally cause noticeable diseases in animal hosts (Moatsou 2014).

10.2. LISTERIOSIS

Listeriosis is a bacterial infectious disease caused by Listeria monocytogenes (Schlech III 2000). The main source of the disease is contaminated food. It primarily affects older individuals, people with acquired immune deficiency syndrome (AIDS), and pregnant women, leading to miscarriages and premature births (Pradhan et al. 2023).

10.3. ANTHRAX

Bacillus anthrax, the pathogen responsible for anthrax, is a spore-forming gram-positive bacillus commonly found in the soil of endemic regions (Chikthimmah 2006). Anthrax is caused by toxins containing protective antigens, virulence factors, and edema factors (Lapointe et al. 2004). Genetic engineering, along with a potent single-domain antibody (sdAb) derived from llamas and nanobodies, has been tested in mice and has shown promising results in protecting them against anthrax (Steeland et al. 2016).

10.4. TUBERCULOSIS

Tuberculosis is an infectious disease that primarily affects the lungs and is caused by a type of bacteria (Long et al. 1999). It is caused by the bacterium known as Mycobacterium tuberculosis (Gobin 1996).

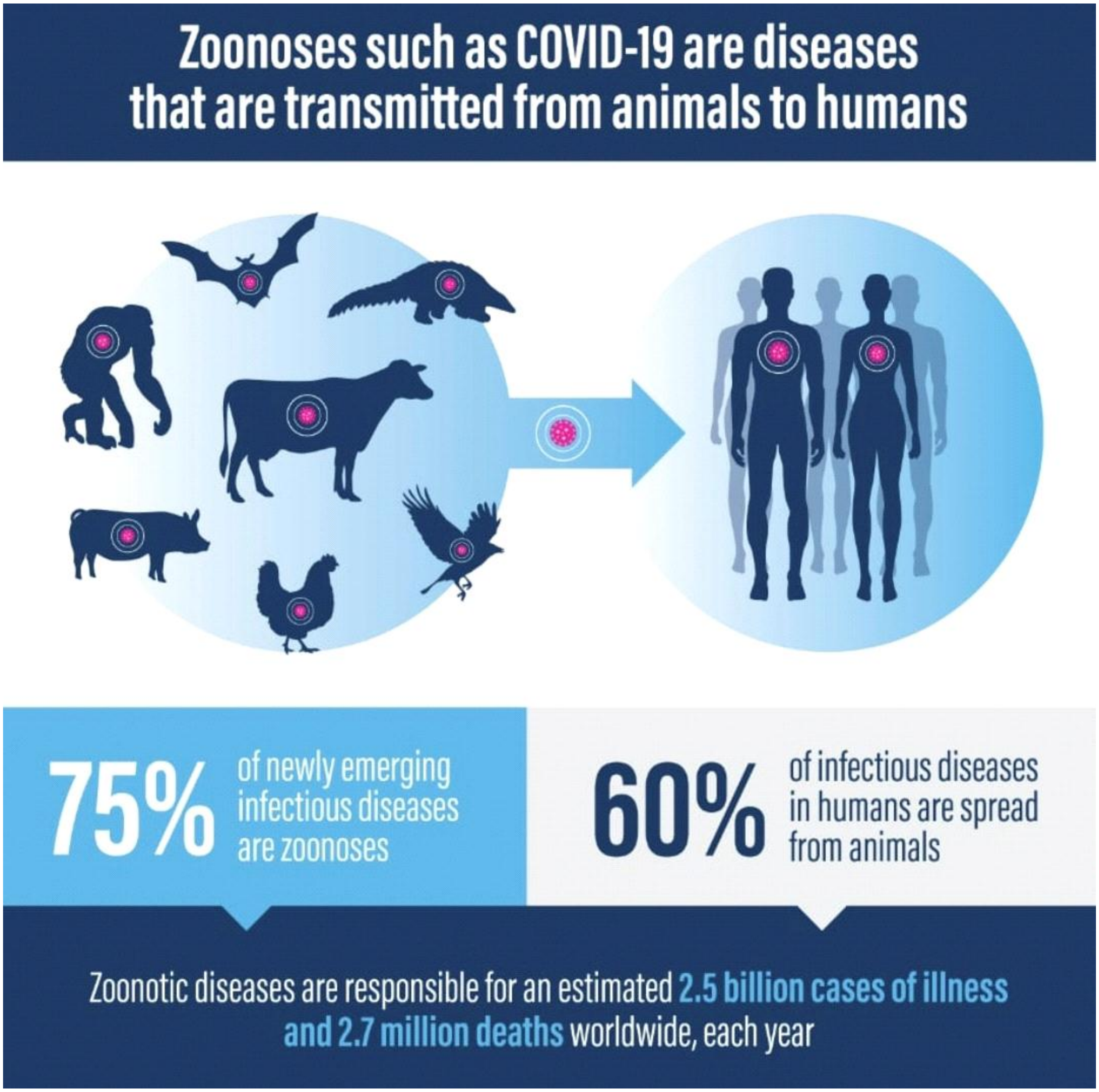

Fig. 1: Transmission of Zoonotic Diseases from Animals to Humans.

While the bacteria commonly target the lungs, tuberculosis can also affect other parts of the body such as the kidneys, brain, and spine. It spreads through the air when an infected person coughs, sneezes, or spits (Gupta 2020). Tuberculosis can be treated with medications such as Isoniazid, Pyrazinamide, and Rifampin (Aguilar Diaz et al. 2023).

10.5. CAMPYLOBACTERIOSIS

Campylobacteriosis is primarily caused by the bacterium Campylobacter jejuni (Hermans et al. 2012). Birds are commonly carriers of this bacterium without displaying any clinical signs, and it serves as a major source of foodborne illness, leading to symptoms similar to stomach flu in people worldwide. VHH, which binds to Campylobacter jejuni, has been isolated for its potential to improve thermal and hydrolytic stability, to inhibit the movement of Campylobacter jejuni through its flagella, thus potentially preventing or significantly reducing its colonization in the gut of birds (Levy 2013). These VHHs may have applications in both treatment and diagnostic tools (Funari et al. 2011).

10.6. VIRAL ZOONOSIS

10.6.1. INFLUENZA

Influenza A (H3N2), a member of the RNA family Orthomyxoviridae, consists of over 150 subtypes, distinguished by variations in the outer proteoglycans, Influenza hemagglutinin (HA), and neuraminidase (Krake 2013). IAV is diverse, including avian influenza, canine influenza, equine influenza, and human influenza. Several nanobodies specifically targeting influenza have shown heightened affinity against the amino acids Matrix protein 2-Influenza A virus and neuraminidase (Lukosaityte 2022).

10.7. FOOT AND MOUTH DISEASE

Foot and mouth disease is a highly contagious illness with the potential for transmission among susceptible animals (Paton et al. 2009). Effective vaccination can be employed for managing FMD outbreaks in FMD-free zones. Elevated levels of nanobodies targeting specific serotypes have been utilized in research by combining them with semiconductor nanocrystals and hydroxyl magnetic flux (Dubé et al. 2009; Chakravarty 2021).

10.8. RABIES

The rabies virus belongs to the group of negative-sense RNA viruses, within the family Rhabdoviridae, causing a fatal neurological disease known as rabies, which affects mammals (Suschak 2019). To reduce the impact of the rabies virus, the World Health Organization recommends administering the rabies vaccine along with local administration of human or equine rabies immunoglobulins in the event of severe bleeding wounds (Keshwara et al. 2019). In the case of intralingual rabies infection models in rats, the combined action of VHH and immunization has shown a symbiotic response in providing defense. However, the primary challenge in treating or managing rabies lies in the neurotropic nature of the rabies virus, making it difficult to access once it has entered the central nervous system (Kakooza-Mwesige et al. 2019). At this stage, only molecules capable of crossing the blood-brain barrier and penetrating nerve cells can effectively inhibit the infection (Moodley et al. 2015).

11. CONTROL OF ZOONOTIC DISEASES

Zoonosis poses a significant global health threat (Contini et al. 2020). Approximately 55-65% of human diseases are infectious, with about 80% of these being zoonotic (Spielman et al. 1985). Managing zoonotic diseases involves understanding the interactions between humans, animals, and the environment, necessitating coordinated efforts across various government sectors to implement effective control measures (Sallnow et al. 2022). Vigilant monitoring is crucial to prevent and control zoonotic diseases, enabling the timely detection of toxins, affected individuals, animals, carriers, and infectious areas, thus curbing their spread (Jerolmack 2008). This approach facilitates the adaptation of management strategies to tackle emerging and recurring diseases, improving both human and animal health outcomes, controlling diseases effectively, and reducing morbidity and mortality rates (Suckow et al., 2023). Various forms of surveillance can be employed for the control of zoonoses (Foreman et al. 2017)

• Microbial inspection is used to identify and differentiate various microbes (Benskin et al. 2009).
• Pre-symptomatic investigation aims to detect the presence of microbes in the blood plasma of both humans and animals by observing the immune response (Shurtleff 2015).
• Disease inspection helps to monitor disease trends through data analysis based on symptoms, although it may not always detect the presence of specific microbes (Jung et al. 2022).
• Threat inspection is utilized to identify potential points of transmission for disease spread (Benedict 2008). These control strategies may not fully address the intricate characteristics of certain chronic diseases (Cascio et al. 2011).

To prevent and manage epidemic diseases like zoonotic diseases, international organizations and observers have emphasized the interconnectedness of humans, animals, and the environment, introducing the concept of the One Health theory (Nierenberg 2005). This theory aims to comprehensively understand global health challenges. By promoting collaboration among veterinarians, paramedics, agronomists, virologists, ecologists, immunologists, and public health authorities, the One Health theory ensures holistic well-being for animals, humans, and the environment (Okello et al. 2014). The pet lovers and animal owners have to fallow the treatment and vaccination instruction mention in Fig. 2.

Fig. 2: Treatment and Vaccination Instruction for Animal Owners.

12. CONCLUSION

Healthcare workers' bags can carry germs, particularly for women who often place their bags on shelves and tables without cleaning them. It's crucial to clean bags, especially those made of fabric, daily. White coats, commonly worn in hospitals, can also spread germs and should be regularly washed and replaced every year. Mobile phones are another potential source of disease transmission, and regular cleaning of both phones and hands can help prevent the spread of germs. Similarly, drink cans should be cleaned before use, just like how we clean fruit baskets. Cars can also harbor germs, and using a silver ion coating can be effective in killing them. Scientists are currently researching nanoparticles as potential for the treatment of bacterial, viral and parasitic zoonotic diseases.

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