SEABCRU Recommendations for Personal Protective Equipment (PPE) and Health Safety while Conducting Bat Research

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Background Information on Bats and Disease

Bats, along with most other wild mammals, are known to carry diseases that can potentially infect people, including a number of viruses[1,2]. In Southeast Asia, some known bat-borne viruses that infect humans include: Nipah virus, SARS-coronavirus, Ebola Reston virus, and lyssaviruses (e.g. rabies). These 'zoonotic' viruses (=they jump from animal species to humans) can have a very high fatality rate, for example between 40-80% of people infected with Nipah virus have died[3,4]. Therefore, while the risk of becoming infected with a bat-borne disease may be low in common situations, the consequence (or impact) of these diseases can be very high. Reducing exposure to zoonotic diseases by wearing appropriate personal protective equipment while working with bats is thus an important preventative measure that should be taken.

It should be noted that bats themselves may also affected by emerging diseases which can be a major threat to biodiversity and conservation. The most important current example of this is White Nose Syndrome, a fungal disease that has killed **millions** of bats in North America[5]. Taking appropriate measures to clean field equipment and dedicated clothing can also reduce the risk of spreading diseases that may impact bat populations.

Examples of Zoonotic Diseases Known from Bats in Asia

Flying foxes (*Pteropus* spp.) are the primary natural host for **Nipah virus**, and evidence for the virus has been found in *Pteropus* and other bat species from Bangladesh, Cambodia, China, India, Indonesia, Malaysia, Thailand, and Vietnam[6-14]. A significant proportion of bats (10-30%) in any given colony show signs of past Nipah infection[15], and virus can be excreted in the saliva and urine of infected bats. In Bangladesh, there is direct transmission of Nipah virus from bats to humans via date palm sap contaminated with bat urine and saliva[11,16]. **Lyssaviruses** (rabies related viruses) are known to be excreted in saliva, transmitted by bites, and have been found in bats from Thailand[17]. Bats are known to carry a diversity of **Filoviruses** (e.g. Zaire or Reston Ebola virus)[18] including bat species from the Philippines and Bangladesh[19,20], and the virus may be transmitted through contact with blood and possibly feces[21,22]. **SARS-related coronaviruses** are found in Rhinolophid and other bats from China and throughout the world, and are likely transmitted via the feces of bats[23,24]. Many other new viruses have recently been found in bats[1,25], <u>but it's not yet known what their affects on human health are</u>. Therefore, in the case of limited knowledge, we recommend taking a **precautionary approach** and protecting oneself with the assumption that there is some risk.

Potential Transmission Routes

There are two likely routes of transmission to humans. **First**, direct contact of feces, urine, saliva or blood from a bat. This could happen via a bite from a bat, or

through bat excreta (e.g. feces or urine) getting into the mucosal membrane (eye, mouth, nose) of a person. **Second**, through inhalation of aerosolized feces or urine. It is possible that any virus found in bat feces or urine could be contracted in this manner, so precaution should be taken when handling these samples or in environments where you may be exposed to aerosolized feces or urine.

Understanding Risk
Based on available data, **the likelihood of a bat virus being transmitted to humans is very low.** For example, only 9 in 10,000 (0.1%) of bats tested for European Bat Lyssavirus were positive for virus[26], but over that same period two people died and both were bat researchers. Following the WHO risk assessment protocol, this would be categorized as a "very unlikely" risk, with <5% probability[27]. **However, the consequence of getting infected with a disease is very high.** For example, >70% of people infected with Nipah virus in Bangladesh have died[4]. Because the consequences may be very severe, we recommend using protective measures to further reduce the probability of contacting a disease. These actions include wearing **Personal Protective Equipment (PPE)** while working with bats or collecting samples from bats, and practicing general safety procedures in handling animals.

Assessing Risk and Appropriate Personal Protective Equipment (PPE)

There is not a one size fits all solution to PPE, and you should modify what you wear based on your level of risk of exposure to bat saliva, urine, feces, or blood. In **Figure 1**, we present a flow chart to illustrate how PPE may differ when doing different bat research activities.

Examples of different levels of exposure:
High level of exposure: A high risk of exposure would include: working under a very active and large roost of bats with falling urine and feces. Another example would be working in a closed area/cave with a large population of bats and lots of aerosolized feces and urine. In these situations additional protection would include a tyvek suit to minimize exposure of skin and clothing. **PPE Set A**

Other examples of high risk include working with species known to harbor lethal, zoonotic viruses, e.g. Nipah virus, Ebola, or SARS-coronavirus, and especially when working in areas where there have been known human or animal outbreaks due to bat-borne viruses. In these cases, one should take extra precautions and consult with emerging disease professionals. However, one should always also keep in mind that bats do not necessarily show any signs of illness when carrying viruses, so precaution should be taken even when working with apparently health animals[28].

Low level of exposure: A lower risk of exposure would include working under or around a flying fox roost with very few bats and when bats are not active. Conducting research in areas of foraging sites where bats are present at very low densities would also be low risk. **PPE Set B or C**

When handling bats: We recommend wearing dedicated clothing (=long sleeve shirt and pants that stay at the field site, and/or are dedicated to wear only when doing field work), covered shoes, nitrile gloves, a mask (N95 or P100), and eye protection (safety goggles or glasses). **PPE Set B**

All personnel working with bats should first complete their pre-exposure prophylaxis rabies vaccine, and should get their titer checked every two years thereafter – getting booster shots when need. The US Centers for Disease Control and Prevention (CDC) website is a good source for information on rabies.

Recommended Personal Protective Equipment (PPE) sets from Figure 1:

PPE Set A (High exposure to bat fluids likely)

- ☐ Tyvek suit (or disposable rain coat over dedicated clothing)
- ☐ Eye protection (goggles or safety glasses)
- ☐ Mask (N95 or P100 respirator or comparable)
- ☐ Gloves (Thick nitrile gloves for handling bats, otherwise latex okay for roost samples)
- ☐ Covered shoes (that can be disinfected)
- ☐ Boot covers (optional depending on activity)

PPE Set B (Handling bats or probable fluid exposure)

- ☐ Dedicated clothing (= long sleeve shirt, long pants that are removed after finishing field work and not worn home)
- ☐ Eye protection (goggles or safety glasses)
- ☐ Mask (N95 or P100 respirator or comparable)
- ☐ Gloves (Thick nitrile gloves for handling bats, otherwise latex okay for roost samples)
- ☐ Covered shoes (that can be disinfected)

PPE Set C (Lower exposure to bat fluids)

- ☐ Dedicated clothing (= long sleeve shirt, long pants that are removed after finishing field work and not worn home)
- ☐ Mask (N95 or P100 respirator or comparable)
- ☐ Gloves (latex okay)
- ☐ Covered shoes (that can be disinfected)

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SEABCRU PPE Recommendations

Figure 1