

IUCN SSC Bat Specialist Group (BSG) Recommended Strategy for Researchers to Reduce the Risk of Transmission of SARS-CoV-2 from Humans to Bats

MAP: Minimize, Assess, Protect

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Authors: Germán Botto Nuñez, Andrew Cunningham, Eric Moise Bakwo Fils, Winfred Frick, Md Nurul Islam, Tracey Jolliffe, Rebekah Kading, Andrzej Kepel, Tigga Kingston, Stefania Leopardi, Rodrigo Medellín, Ian Mendenhall, Stuart Parsons, Paul Racey, Danilo Russo, Julie Teresa Shapiro, Amanda Vicente-Santos, Luis Viquez-R, Thong Vu Dinh

Overview

On 13 April 2020 the IUCN Species Survival Commission Bat Specialist Group recommended the suspension of all field work that involves interactions with bats while it considered the risk of human-bat transmission of SARS-CoV-2. Subsequently, the Bat Specialist Group convened a global panel of experts with expertise ranging from bat ecologists to virologists who have assessed the scientific evidence for human-to-bat transmission and efficacy of risk mitigation strategies.

It is the opinion of the panel that there is a **credible risk of human-to-bat transmission of SARS-CoV-2**, but this risk can be reduced using appropriate mitigation strategies. This guidance document has been developed primarily for researchers. The panel recognises that at this time its recommendations may not be suitable for all stakeholders that come into close proximity or contact with bats. The panel continues to work with those groups to assess their needs and produce stakeholder-specific recommendations.

The panel further recognises that our understanding of SARS-CoV-2 is changing rapidly, and advises researchers that this is a **living document** with updates anticipated.

Background

Bats are natural hosts of alpha- and betacoronaviruses, as shown by the high diversity and prevalence of these viruses in many bat species that have been investigated worldwide. However, there is currently little information on the susceptibility of any bat species to the pandemic SARS-CoV-2, that recently emerged in the human population. The virus is phylogenetically related to SARS-associated-CoVs found in rhinolophid bats, suggesting this bat genus is a natural host of the ancestor of SARS-CoV-2. However, preliminary data coming from experimental infections suggest that bats can be infected by SARS-CoV-2 in its current form. The risk SARS-CoV-2 poses to the health of bats (including endangered and physiologically stressed populations) is not yet known, nor is the potential ability of SARS-CoV-2 to establish and be transmitted from bat-to-bat.

Due to the high circulation of the novel SARS-CoV-2 among humans, it is possible that research or other activities involving close contact with bats might expose the bats to the virus. According to the scarce evidence available, the **risk of bat infection is considered credible**. Given these concerns, it is essential to protect bats by minimizing their exposure to SARS-CoV-2 from humans until more evidence can be obtained.

Hazards

Human-to-bat transmission of SARS-CoV-2

Bats could potentially be exposed to SARS-CoV-2 through infectious **aerosols**, **contact**, or **environmental contamination**. The likelihood of human-to-bat transmission of SARS-CoV-2, also strongly increases in the case of working in or coming from countries with high levels of virus circulation among humans. This increases the potential for personnel conducting research activities to be infected and shedding live virus.

- Aerosol exposure: Close contact with bats (less than 2 meters) during activities conducted by symptomatic or asymptomatic people, with or without handling, increasing the likelihood for airborne transmission of the virus through respiratory droplets. This includes blowing on bats to assess reproductive status or forcing a bat to release a bite.
- Contact exposure: Catching and handling of bats, posing a risk for exposure through contaminated hands or instruments (e.g. nets, holding bags).
- Environmental exposure: Sharing restricted closed areas with bats, such as small cave passages or chambers, or poorly-ventilated rooms. Environmental contamination includes lingering aerosols in confined spaces, or virus particles that may remain infectious on surfaces for a short (unknown) period after someone shedding virus has been present.

Bat-to-bat transmission

The likelihood of SARS-CoV-2 amplification/maintenance through bat-to-bat transmission depends on the susceptibility of the bats to infection, whether the bats develop an effective immune response, and, if infected, the extent of virus shedding. These processes are currently unknown. However, the likelihood of bat-to-bat transmission is predicted to increase in case of:

- Infection of bat populations living in closed areas such as small cave passages or chambers.
- Highly gregarious species.
- Species co-roosting with other species.
- Housing of animals in groups for research purposes.
- Housing of different groups of either the same or different bat species in proximity for research.
- Sharing of non-disposable equipment between animals (bags, feeding stations etc.).
- Bats with comorbidities (i.e., WNS) or under other physiological or environmental stress.

BSG Mitigation of Human-to-Bat Transmission Strategy: Minimize, Assess, Protect (MAP)

The likelihood of transmission depends on a cascade of steps:

- 1: the person must be infected and must shed virus (known to occur with both symptomatic and asymptomatic infections)
- 2: the bat must be exposed to the shed virus
- 3: the bat must be susceptible to infection

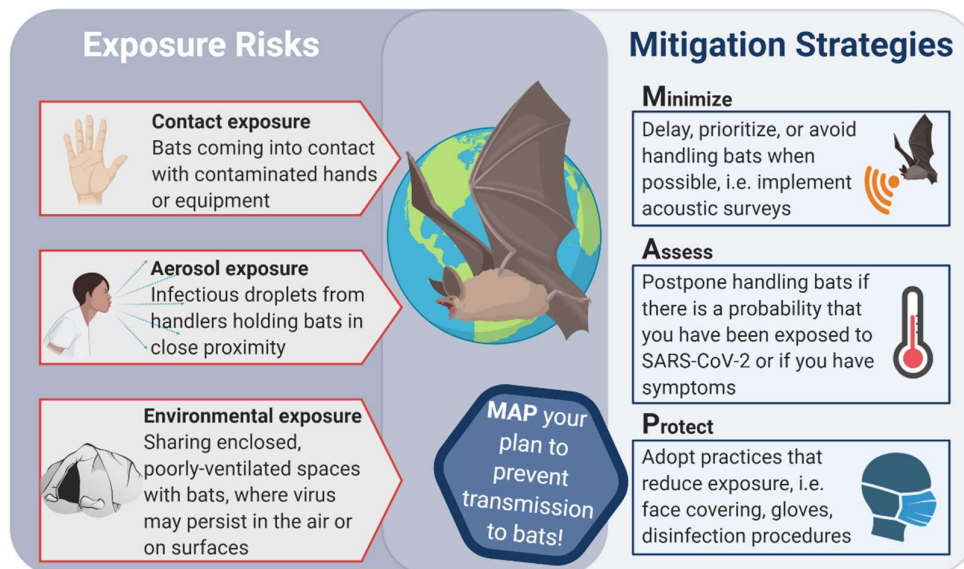
Among these, we have limited information about bat susceptibility to the pathogen. However, steps 1 and 2 can be managed to strongly reduce likelihood of transmission to bats, regardless of bat susceptibility. Preventing initial exposure of bats to SARS-CoV-2 is also the most critical point of intervention, because if SARS-CoV-2 establishes in bat populations it will be nearly impossible to eradicate it.

Recommendations provided mitigate **human-to-bat** exposure. This is largely based on knowledge of human-to-human transmission. Guidance for good field hygiene that reduces risks of bat-to-bat transmission of pathogens (e.g., *Pseudogymnoascus destructans*) or bat-to-human transmission are given in **BOX 1: FIELD HYGIENE**.

We recommend that researchers adopt the **BSG Minimize, Assess, Protect** mitigation strategy and “**MAP**” your plan to prevent human-to-bat transmission:

1. **Minimize** research activities until more is known about exposure, infectivity and transmissibility of SARS-CoV-2 from humans-to-bats
2. **Assess** the risk you may pose of exposing bats to SARS-CoV-2 and avoid contact with bats
3. **Protect** bats by modifying practices to reduce exposure

Preventing human-to-bat transmission of SARS-CoV-2



1. MINIMIZE research activities through prioritization, delay, replacement, or reduction.

The BSG recognizes the diverse pressures on researchers to resume their programs. Nonetheless, we recommend that researchers prioritize activities that are essential to bat conservation, animal health or public health and consider options to delay, replace or reduce non-essential activities.

1.1. Delay

Researchers should seriously consider whether it is possible to delay some research activities until more is known about the risk of human-to-bat transmission of SARS-CoV-2, or a vaccine that would prevent human-to-bat transmission is available to personnel. In particular, researchers should consider delaying the start of new projects requiring close proximity to bats. Note that the BSG will be updating guidelines as more information becomes available.

1.2. Replace

Whenever possible, researchers should implement non-invasive approaches over animal handling, such as acoustic surveys, emergence counts, observational studies, or environmental samples for pathogen surveillance.

1.3. Reduce

- Reduce the number of sites and individual bats involved in each study to the minimum needed for valid statistical inference. Ad hoc sampling of bats, capture of bats for teaching purposes etc., should be discouraged.
- Reduce the size of the team (including researchers, students, and other supporting personnel) to the minimum required for the purpose of the study.
- Reducing the duration of close contact with bats may also reduce the probability of exposure of the bats to an infectious dose of the virus.

2. ASSESS probability you are shedding SARS-CoV-2 and may expose bats

2.1 Regularly assess the probability that you may be shedding SARS-CoV-2 and avoid contact with bats when infected or potentially exposed to SARS-CoV-2

All personnel (researchers, technicians, students etc.) at high risk for infection with SARS-CoV-2 should avoid any activity with bats. This includes:

- All personnel diagnosed with COVID-19 in the last 14 days.
- All personnel showing symptoms typical of COVID-19, such as fever above 37.5 °C / 98.6°F, cough, fatigue or anosmia (loss or reduction of the ability to smell and taste) in the last 14 days.
- All personnel with known contacts with people diagnosed with COVID-19 or showing typical symptoms within the previous 14 days.
- Where available, periodic screening of personnel for the shedding of SARS-CoV-2 should be implemented in order to minimize the likelihood of transmission during activities and to eventually detect possible exposure of animals, should a person be found positive within 14 days of activities with bats.

- If travel to the field significantly elevates exposure risk, personnel should rigorously take steps to minimize exposure from other people wherever possible and consider avoiding fieldwork for 14 days following arrival at the field site. Personnel should carefully self-monitor for symptoms.

In addition, researchers should consider minimizing activities with bats according to the epidemiological situation of their region or country. Epidemic peaks elevate the risk of human-to-bat transmission from asymptomatic cases. We recognize that knowledge on the local epidemiology of SARS-CoV-2 is highly dependent on the diagnostic capabilities of each country. In cases where no information is available, the risk should be considered high.

2.2 Assess the probability that you may expose bats to SARS-CoV-2

Research activities carry different levels of exposure probability -- risk increases with the duration of the interaction, proximity of the researcher, and air circulation.

- Observational research, such as acoustic monitoring, roost counts, environmental pathogen sampling (in the absence of bats) carries no to minimal probability of exposing bats, providing observers are > 2 m from bats at all times and are not displaying symptoms such as coughing or sneezing. Symptomatic people are more likely to contaminate the environment.
- Extraction of bats from nets or harp traps presents some probability of exposure; this increases during processing of captured bats as there is sustained proximity and direct handling and use of measuring equipment, etc.
- Enclosed settings increase the potential for aerosol build up. Subterranean surveys, behavioral or performance trials in indoor labs, and bats held in captive colonies are high exposure risk settings, especially if activities are sustained.

3. PROTECT bats by adopting practices that reduce bats' exposure.

There are several precautions which can be taken to reduce animal exposure to human respiratory pathogens (including SARS-CoV-2) during fieldwork, including:

- **Avoid contact when possible:** Whenever handling is not required, personnel should maximize distancing from animals.
- **Wear a face covering:** The use of face masks or coverings should be mandatory either when handling bats or in proximity (< 2m) to bats or in restricted closed environments. [see **BOX 2: FACE COVERINGS**]
- **Do not blow on bats:** To examine nipples, fur coloration or to break bites, use alternatives such as blunt-ended dissecting scissors to part fur, or wash bottles with a fine nozzle to blow air (https://en.wikipedia.org/wiki/Wash_bottle).

- **Practice hand hygiene**: Washing and disinfecting hands before starting work, including before touching equipment that will come into contact with the bats, and at the end of work.
- Use **nitrile or latex gloves** when handling bats of equipment that will come into contact with bats. **Change or disinfect gloves** regularly [See **BOX 3: DISINFECTANT**]

IN PRACTICE: CHANGING or DISINFECTING GLOVES. The purpose of wearing gloves is to protect the bat from you, specifically from contaminants on your hands. Contaminants come from your breath, face, mask. Use common sense and self-awareness to evaluate the trade-off between glove changes/disinfection and timely treatment of bats in nets/traps and awaiting processing. Adjusting a face covering, touching your face, sneezing, coughing etc., can transfer contaminants to your gloves, so it is advisable to then change or disinfect.

- **Avoid touching your face**: Avoid touching the face or mask/face covering during work. If this does happen, carefully wash and disinfect hands afterwards (even in the presence of gloves), to prevent contamination of hands (or gloves) and equipment, thus minimizing transmission to the bat.
- **Disinfect equipment**: All reusable equipment including nets, containers, bags or calipers that have been in direct contact with bats should be disinfected between uses to promote good field hygiene [**BOX 1: FIELD HYGIENE; BOX 3: DISINFECTANTS**].

IN PRACTICE: CRITICAL ACTION: Clearly track all activities and the personnel involved in the research, in order to have clear information on sites and bats that could have been exposed to the pathogen, should a researcher be diagnosed with the disease.

IN PRACTICE: Field Hygiene and Personal Protective Equipment (PPE) protect you from possible exposure to bat-borne pathogens. These guidelines focus on protecting bats from SARS-CoV-2 borne by people, but they also provide a foundation for protecting researchers from bat-borne pathogens. At minimum, researchers should use gloves when handling bats, use face coverings when in proximity, follow field hygiene practices and have dedicated field clothes.

BOX 1: FIELD HYGIENE

Field hygiene represents a set of best practices using standard, simple measures to minimize the risk that research activities result in moving or transferring pathogens between species and sites. Pathogen transfer to new species or regions can cause severe population declines and threaten species with regional or global extinction (e.g. White-nose Syndrome in bats, Chytridiomycosis in amphibians). Impacts of deadly pathogens on wildlife has raised awareness of the importance of field hygiene for researchers to ensure that our activities do not cause unintended harm. Research conditions are context-dependent, and our guidance represents **general and basic best practices for field hygiene for standard bat survey work involving capture and handling of bats.** Special considerations and needs should be developed with your institutional guidance on environmental health and safety protocols.

Before Fieldwork:

- Check with your institution regarding animal care and use protocols, permits, and ***develop a field safety and hygiene protocol***
- Field safety and hygiene protocols specific to bat research should include:
 - Vaccinations and titers for rabies are up-to-date
- Recommended basic field hygiene supplies for bat research include:
 - Spray bottle with 70% ethanol for cleaning gear and surfaces
 - Containers for disposal of gloves, sharps, or other contaminated materials
- Basic PPE considerations for capture and basic handling of bats include
 - Gloves (leather gloves for large bats, nitrile for small bats and non-handling hand). Consider putting a nitrile glove over your leather glove or disinfecting leather gloves. Black nitrile gloves are a better color for photos.
 - Face coverings or respirators (without exhale valve, see **BOX 2**)
 - Dedicated field clothes (long-sleeve shirt and pants/trousers)

Activities such as preparing specimens, taking blood or tissue samples, entering caves require additional PPE, safety and field hygiene practices.

During Fieldwork:

Basic field hygiene considerations include:

- Disinfect surfaces and equipment used to process bats with 70% ethanol or equivalent (see **BOX 3**)
- Separate your spaces: **Do not eat, drink or smoke in the proximity of bats** or on the same surfaces where you are handling bats.
- Wash or sanitize your hands as often as possible: before and after using gloves, before and after bathroom visits, and during breaks.
- Avoid touching your face with your gloves on.
- Do NOT eat while wearing gloves.
- Correctly don, remove, and dispose of any PPE (gloves, masks, etc).

Post Fieldwork:

- Disinfect your field and personal equipment at the end of a research expedition and before moving between regions [See **BOX 3**].
- Properly dispose of biohazard waste (materials contaminated with blood, urine and/or feces, used gloves, and sharps) following local government guidelines.

Useful References:

CDC Guidance on PPE: <https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>

BOX 2: FACE COVERINGS.

Different PPE to reduce respiratory transmission can be used, among which non-valved FFP3 and N95 respirators provide the highest safety for both the bat and the operator.

DO NOT USE VALVED MASKS. This valve is allowing the exhalation of unfiltered breath.

If FFP3 and N95 respirators are unavailable, surgical masks could be used as they provide comparable protection for the bats (but lower protection for the operators). Dual-layer cloth masks or face covers (covering the mouth and nose) could be used in substitution of surgical masks, in countries or situations where respirators or surgical masks are not available, to reduce exposure to the bats. Materials used as a filter should allow unobstructed breathing, should not saturate easily with moisture and not extrude fibers or other materials that might be inhaled.

To be efficient, respirators such as N95 and FFP3 require proper fitting.

Useful References:

Leung, N.H.L., Chu, D.K.W., Shiu, E.Y.C. *et al.* Respiratory virus shedding in exhaled breath and efficacy of face masks. *Nat Med* 26, 676–680 (2020). <https://doi.org/10.1038/s41591-020-0843-2>

CDC information on understanding the difference between different types of masks and respirators: <https://www.cdc.gov/niosh/npptl/RespiratorInfographics.html>

World Health Organization advice and technical guidance on fabric face mask use: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks?gclid=Cj0KCQjwz4z3BRCgARIsAES_OVcnx_86Klf0myAISrkQGgXJN2z39ttRnr52vMTp8QxX-q3DuyWgffAaAtlrEALw_wcB

BOX 3. DISINFECTANT RECOMMENDATIONS (part 1 of 3)

Cleaning and disinfecting skin, clothes and equipment are necessary to minimize exposure of pathogens to both bats and humans. Disinfection agents should be broadly effective, acting against a wide spectrum of microbes, be non-irritant to skin, and be applied/used according to manufacturer's instructions.

Prior to handling bats, researchers should ensure that all equipment has been disinfected. The tables below are not an all-inclusive list of available disinfectants, but represent recommendations from the Government of Western Australia, Department of Biodiversity, Conservation and Attractions SOP [Managing Disease Risk in Wildlife Management](#) and the [USF&WS White Nose Syndrome decontamination protocols](#). There are several additional resources on disinfectants listed at the end of this document.

Application of disinfectants to skin and gloves (external use only)

Name of agent	Concentration	Usage	Concern
Alcohol-based hand rubs and sprays	70-90%	Rub on hands	May dry skin and irritate open wounds
F10 SC veterinary disinfectant (liquid or gel)	1:100 dilution in water	Spray on hands/gloves and rub for >30 seconds	
Povidone iodine (Betadine)	Comes as 10% concentration	Apply to skin	Eye irritation.
Dilute Chlorhexidine (Savlon or Hibitane)	Use according to manufacturer's instructions		Less effective on bacteria and ineffective in presence of organic material

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BOX 3. DISINFECTANT RECOMMENDATIONS (part 2 of 3)

Application of disinfectants to clothing/bat bags/mist nets.

Mist nets: Disinfect nets for 10 minutes, rinse in water, and hang dry

Name of agent	Concentration	Usage	Concern
Virkon	1:200	Soak for >10 minutes, then rinse in water and dry	
F10 SC veterinary disinfectant (liquid or gel)	1:250 dilution in water	Soak clothes for 30 minutes, then rinse in water and dry	
Bleach (hypochlorite bleach)	10% bleach (1 part bleach : 9 parts water)	Soak for 10 minutes, then rinse in water and dry	Corrosive at high concentrations. Do not mix with ammonia compounds.
Launder items		Keep clothing in water with detergent that is > 50°C or 122°F for >20 minutes	Difficulty maintaining temperature if hand washing

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BOX 3. DISINFECTANT RECOMMENDATIONS (part 3 of 3)

Application of disinfectants to non-submersible equipment (calipers/rulers/field tables/harp traps)

Clean surfaces with soap and water first before disinfection, if possible. Harp traps: clean lines/bag, soak parts in disinfectant (if possible) for 10 minutes, then rinse and dry

Name of agent	Concentration	Usage	Concern
3% Quaternary ammonium (Lysol)	1:128 ratio in water	Contact time based on manufacturer recommendations. Rinse with water, then air dry	Irritant
Virkon	1% solution (1:100 with 10g to 1L water)	Contact time based on manufacturer recommendations. Rinse with water, then air dry	Don't expose metal items for greater than 10 minutes. May leave slight pink color on plastic items
Bleach (hypochlorite bleach)	10% bleach (1 part bleach : 9 parts water)	Contact time based on manufacturer recommendations (>10 minutes preferred). Rinse with water, then air dry	Corrosive at high concentrations. Do not mix with ammonia compounds.
Ethanol	70-90%	With ethanol as a disinfectant, the contact time is important and the higher the %, the faster it will evaporate	Flammable

World Health Organization: Cleaning and disinfection of environmental surfaces in the context of COVID-19

<https://www.who.int/publications/i/item/cleaning-and-disinfection-of-environmental-surfaces-in-the-context-of-covid-19>

Centers for Disease Control: Chemical Disinfectants-Guidelines for Disinfection and Sterilization in Healthcare Facilities

<https://www.cdc.gov/infectioncontrol/guidelines/disinfection/disinfection-methods/chemical.html>

Environmental Protection Agency (EPA), USA: List of disinfectants for use against SARS-CoV-2

<https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2-covid-19>

Additional Research and Recommendations on the Risk of Human-to-Bat Transmission of SARS-CoV-2

USGS report: <https://pubs.er.usgs.gov/publication/ofr20201060>

EUROBATS recommendation: <https://www.eurobats.org/node/2602>

Wildlife Health Australia:

https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/Public%20health/Novel_coronavirus-2019.pdf

[https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/COVID-19_Aust_bat_carers_researchers_12May2020.pdf]