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

AMP: Assess, Modify, Protect

Living Document Version 2.0 Released 2nd July 2021

Authors v. 2.0 update: Tigga Kingston, Winfred Frick, Rebekah Kading, Stefania Leopardi, Rodrigo Medellín, Ian H Mendenhall, Paul Racey, Julie Teresa Shapiro, Amanda Vicente-Santos, Luis Víquez-R, Lisa Worledge.

Authors v 1.0: 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 H Mendenhall, Stuart Parsons, Paul Racey, Danilo Russo, Julie Teresa Shapiro, Amanda Vicente-Santos, Luis Víquez-R, Thong Vu Dinh

Overview

In May 2020, the IUCN Species Survival Commission Bat Specialist Group convened a global panel of scientists with expertise ranging from bat ecology to virology to assess the scientific evidence for the potential of human-to-bat transmission and efficacy of risk mitigation strategies. It was the opinion of the panel that there is a **credible risk of human-to-bat transmission of SARS-CoV-2** and the resulting Strategy (v.1.0, released in June 2020) recommended actions to reduce this risk through "MAP: **Minimizing contact with bats**, **Assessing** the potential risk that the researcher poses to bats and not handling or working with bats if exposure risk is high, and **Protecting** bats by adopting good field hygiene practices -- using masks and gloves when handling bats, and regularly disinfecting equipment that comes in contact with bats, and minimizing time and personnel in contact/proximity with bats.

The panel recognises that our understanding of SARS-CoV-2 has been changing rapidly and has continued to convene throughout 2020 and 2021. Key developments since v1.0 of the guidelines include:

(1) It is now known that humans can transmit SARS-CoV-2 to other animals and the consequences can be devastating. In at least 11 countries across Europe and North American, SARS-CoV-2 was transmitted to mink on farms, spread through these populations, and may have even been transmitted back to farm workers [1,2]. This led to a massive cull of millions of minks [1,2,3]. Detection of SARS-CoV-2 in free-ranging mink may put wildlife at even further risk [4,5]. Humans have also transmitted SARS-CoV-2 to domestic dogs, cats, and ferrets [6], and to zoo animals including captive gorillas, tigers, lions, snow leopards and puma [6].

(2) Since the last version of this document in June 2020, laboratory studies have shown that Egyptian fruit bats (*Rousettus aegyptiacus*) can be infected by SARS-CoV-2 [7] while big brown bats (*Eptesicus fuscus*) cannot [8]. We do not currently know how susceptible any of the other 1400+ bat species are to SARS-CoV-2, although modelling-based analyses suggest that the virus could potentially infect the cells in at least three genera of bats [9].

(3) Vaccines have become available that (a) reduce the risk of contracting COVID-19, (b) reduce symptoms in those who do contract COVID-19 despite being vaccinated -- "breakthrough cases" -- and (c) may reduce spreading in breakthrough cases [10, 11, 12].

However, we are still learning how long vaccines are protective and how protective they are against new variants of SARS-CoV-2.

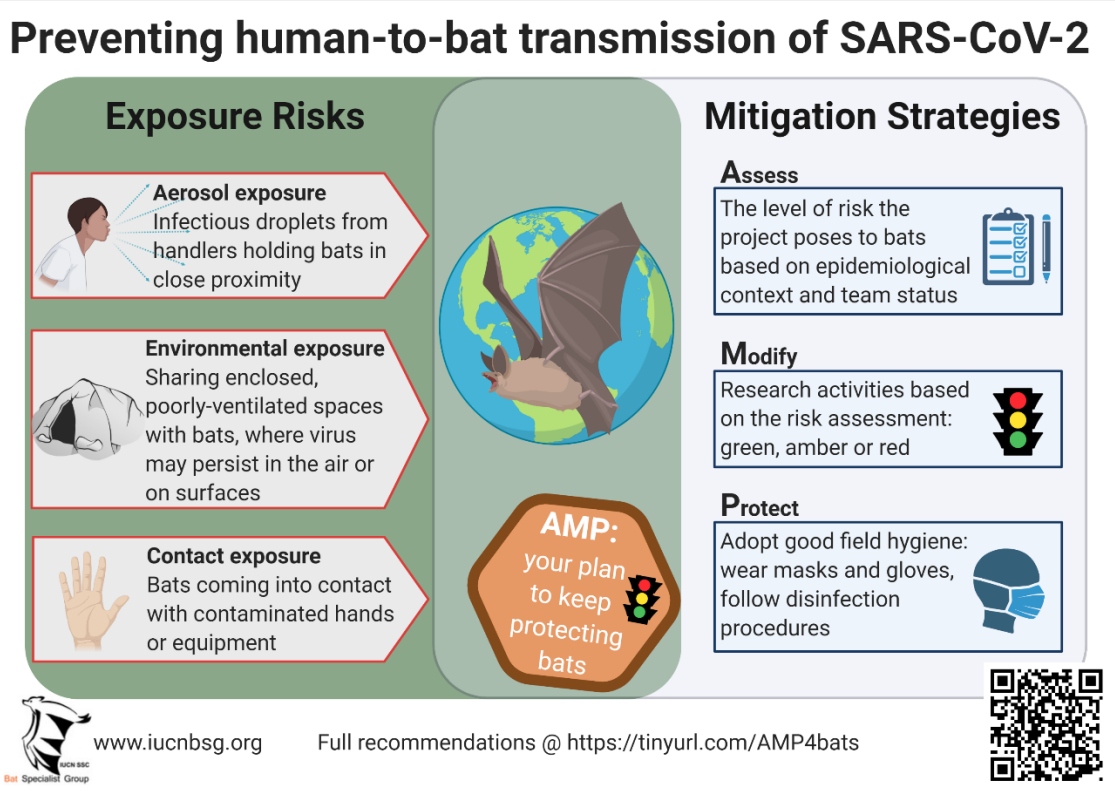
(4) Infection and vaccination rates around the world are increasingly diverging. This presents different and changing levels of risk among and within countries.

(5) It is now understood that COVID-19 transmission is primarily airborne [13] via aerosols and that face masks play a critical role in reducing viral transmission [14].

The panel continues to recognize that there is a **low but credible risk of human-to-bat transmission of SARS-CoV-2** and that this risk can be reduced using mitigation strategies, which now also include vaccination. However, because of rising infection rates in some countries, and accelerating vaccination rates in others, the unequal distribution of vaccines worldwide, the emergence of variants, and uncertainties regarding the need for vaccine boosters, the **distribution of risk is geographically and temporally variable.** The panel also recognizes the need for bat research to safely resume wherever possible whilst being mindful of relevant governmental guidance.

To this end, in our Guidelines and Recommendations v2.0 we have re-ordered and updated core actions of the MAP strategy. We invite researchers to adopt the **BSG Assess, Modify, Protect** strategy to "**AMP"** up the return to bat research while minimizing the risk of human-to-bat transmission:

1. **Assess** the level of risk the project poses to bats based on epidemiological context and team status.
2. **Modify** research activities based on risk assessment in (1).
3. **Protect** bats by adopting good field hygiene practices -- wearing masks and gloves when handling bats, regularly disinfecting equipment that comes in contact with bats, and minimizing time in contact/proximity with bats.



BSG Mitigation of Human-to Bat Transmission Strategy: Assess, Modify, Protect (AMP)

(1) ASSESS the probability that you or your team might expose bats to SARS-CoV-2 during the project.

1.1 Assess project risk category based on epidemiological context.

We ask researchers to use a traffic-light system to characterize the overall risk of any given project as high (red), medium (amber) or low (green). Assessment should be based on the epidemiological context and team-level vaccination status. Researchers should consult national and local information sources about epidemiological context (some tools are provided below) and query their team (both researchers and any support staff).

Example epidemiological tools:

- Johns Hopkins University -- International Comparison of Positivity Rates and Tests Per Capita https://coronavirus.jhu.edu/testing/international-comparison
- University of Oxford -- https://ourworldindata.org/coronavirus
- 91-DIVOC allows interactive visualization of data from either Johns Hopkins, University of Oxford, or both -- https://91-divoc.com/pages/covid-visualization/

We recognize there are many caveats around completeness and accuracy of reporting, but nonetheless researchers should work to answer as many of the following questions for which data are available, and as are needed to develop a clear perception of risk. We do not give absolute cut-offs for high, medium, and low risk, but give examples of extremes at the time of document preparation (June 2021).

Questions and Indicators	Risk		
	High	**Medium**	**Low**
(1) What is the epidemiological status of the research teams' home country or region?			
(a) Indicators of **COVID-19 circulation rates** in the population country include: **(i) Infection rate** For example: daily (or weekly) average number of new cases/100,000 inhabitants over a rolling time period. e.g., *Daily* new confirmed cases based on a rolling 7-day average/100,000 inhabitants as of 24 June 2021 -- highest rates were ~ 40--143 cases/100,000 inhabitants. At peak, the United Kingdom >88, France >83, United States >76, Germany ~30, India >28, whereas Australia ~2. (Source:	High	Medium	Low

Questions and Indicators	Risk		
	High	**Medium**	**Low**
https://ourworldindata.org/coronavirus. Note many countries report the 7-day incidence which is the *total* of the last week). **(ii) Positive-test rate** For example: daily (or weekly) average share of COVID-19 tests that are positive. e.g., *Daily* positive share based on a 7-day rolling average at peak Ukraine 50%, UK 30%, USA 20%, India 22%. Researchers might also explore the trajectory of infection rates over time to determine if a country is in a peak ("wave") or decline. **(iii)** Other possible indicators of epidemiological status include **Hospitalization rate** **Fatality rate** **(b) Proportion of population vaccinated** e.g., As of 24 June 2021, >40% of the US and UK population are fully vaccinated, but in many nations this is < 5%.	High High Low	Medium Medium Medium	Low Low High
(1) Overall rating for epidemiological risk (home)	High	Medium	Low
(2) What is the epidemiological status of the research country or region? If research country or region is the same as home country or region (1) repeat selections made in (1) here.			
(a) Indicators of current **COVID-19 circulation rates** in the population country include: **(i) Infection rate** For example: daily (or weekly) average number of new cases/100,000 inhabitants over a rolling time period. **(ii) Positive-test rate** For example: daily (or weekly) average share of COVID-19 tests that are positive. **(iii)** Other possible indicators of epidemiological status include **Hospitalization rate** **Fatality rate**	High High High	Medium Medium Medium	Low Low Low

Questions and Indicators	Risk		
	High	**Medium**	**Low**
(b) Proportion of population vaccinated	Low	Medium	High
(2) Overall rating for epidemiological risk (research site)	High	Medium	Low
<u>(3) How many members of the research team are fully vaccinated?</u> Fully vaccinated means completed the vaccination series and the period to full vaccine protection has been reached. Research team refers to people who will be in direct contact with bats.	None or a few	Some	All
<u>(4) How many of the support staff are fully vaccinated?</u> Fully vaccinated means completed the vaccination series and the period to full vaccine protection has been reached. Support staff includes field assistants, laborers, porters, field station support etc, who will be in direct contact with the research team.	None or a few	Some	All
OVERALL RISK Based on assessments of the 4 categories: (1) epidemiological context -- home; (2) epidemiological context -- research site; (3) vaccination status -- research team; (4) vaccination status -- support staff. If **4/4** green -- LOW RISK, but measures to PROTECT bats still required. If **3 or 4** of the 4 categories are red -- HIGH RISK, adopt MAP strategy If **2 or less** red (e.g., all amber, or 2 red + 2 green) -- RISK that can be mitigated, proceed with caution.	HIGH RISK (3 or 4 RED)	RISK (1 or 2 RED)	LOW RISK (ALL GREEN)

1.2 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:

- Any personnel diagnosed with COVID-19 in the last 14 days.
- Any 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. Additionally, runny nose and sore throat are reported symptoms of the Delta variant.
- Any personnel with known contacts with people diagnosed with COVID-19, or people showing typical symptoms, within the last 14 days.
- Where available, periodic screening of personnel for the shedding of SARS-CoV-2 should be implemented 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 traveling to the field significantly elevates exposure risk, personnel should take rigorous steps to minimize exposure from other people wherever possible and get tested for SARS-CoV-2 upon arrival. Alternatively, avoid fieldwork for 14 days following arrival at the field site. Personnel should carefully self-monitor for symptoms.

(2) MODIFY research based on project and individual risk category.

Based on the traffic-light risk category identified in (1) ASSESS, researchers should consider modifying their program as follows.

2.1 RED: High risk adopt the full **MAP** strategy and **Minimize** research through **delay** and **replace** activities involving contact with bats with those that do not, such as acoustic surveys, emergence counts, observational studies, or environmental samples for pathogen surveillance. If contact projects are **essential for the conservation of bats**, work to **reduce** contact with bats by:

- Reducing 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.
- Reducing 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.

2.2 AMBER: Risk that can be mitigated. Proceed with caution:

- Work to **reduce** contact with bats as above (2.1).

- Avoid starting new projects that require continuity of sampling.
- Fully implement **PROTECT** measures (see below).
- Regularly **ASSESS** the epidemiological context and status of individual team members**.**
- If possible, conduct regular antigen tests to properly assess the epidemiological risk in your team, and follow up with PCR tests as needed (see CDC Guidance on Antigen Testing for SARS-CoV-2).
- Avoid social contact outside the research team in the week before fieldwork, and for the duration of fieldwork.
- **Prepare exit strategies**, should the risk category change to RED.

2.3. GREEN: Low risk.

- Projects resume/start.
- Fully implement **PROTECT** measures.
- Regularly monitor and **ASSESS the epidemiological context** and **status of individual team members.**
- If possible, conduct regular antigen tests to properly assess the epidemiological risk in your team.
- Have **contingency strategies** for any change to AMBER (or even RED) risk category.

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

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

- **Avoid contact when possible:** Handling time should be minimized. Whenever handling is not required, personnel should maximize distancing from animals.
- **Wear a face covering:** The use of face masks should be mandatory either when handling bats; in proximity (< 2m) to bats; or in any 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:** Wash and disinfect 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 or 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, 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 a 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].

BOX 1: BEST PRACTICES FOR FIELD HYGIENE

Field hygiene represents a set of best practices using standard, simple measures to minimize the risk that research activities result in pathogen pollution, the human-facilitated moving or transferring of pathogens between species and sites (Cunningham et al. 2003). Pathogen pollution to new species or regions can cause severe population declines and threaten species with regional or global extinction. For example, chytridiomycosis has been estimated to have caused the decline of 501 amphibian species worldwide, including 90 extinctions (Scheele et al. 2019), while in North America estimates of population declines in bats caused by white-nose syndrome (WNS) have been over 90% for some species (Cheng et al. 2021). Impacts of deadly pathogens on wildlife have 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***

BOX 1: BEST PRACTICES FOR FIELD HYGIENE

- Become familiar with the region where you will be conducting fieldwork, and if any special considerations have to be taken into account regarding risks and threats to and from bats (e.g., WNS in North America, Nipah in south and southeast Asia, etc.).
- Field safety and hygiene protocols specific to bat research should include up-to-date vaccinations and titers for rabies and vaccinations for SARS-CoV-2. Be aware that vaccination schemes may take months to implement, plan accordingly.
- 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). Disinfect leather gloves that are too large to fit under nitrile gloves. Helpful tip: Black nitrile gloves are a better color for photos. Nitrile gloves are more resistant than latex gloves.
  - Face coverings to reduce respiratory transmission. Best practices include FFP3, FFP2, N95 and KN95 facial masks. When these options are unavailable, surgical masks can be used as they provide comparable protection for the bats (but lower protection for the researchers). Dual-layer cloth masks or face covers (covering the mouth and nose) can be substituted for surgical masks in countries or situations where respirators or surgical masks are not available. Materials used as a filter should allow unobstructed breathing, should not saturate with moisture easily and not extrude fibers or other materials that might be inhaled. DO NOT USE VALVED MASKS. The valve is allowing the exhalation of unfiltered breath.
  - 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:

- Separate your spaces: **Do not eat, drink or smoke in the proximity of bats** or on the same surfaces where you are handling bats.
- Designate a field member to be the “field hygiene monitor”, and make sure everyone in the team understands the field protocol.
- Do a daily symptom check with all staff prior to handling bats.
- Do not handle animals if you are feeling ill.
- Only trained personnel with up-to-date SARS-CoV-2 and rabies vaccinations should handle bats.
- Disinfect surfaces and equipment used to process bats with 70% ethanol or equivalent as often as possible [see **BOX 3**].
- 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.
- Do NOT eat while wearing gloves.
- Correctly put on, remove, and dispose of any PPE (gloves, masks, etc). Guidance is here for: gloves, masks, full PPE.
- Place bats individually in bags.

BOX 1: BEST PRACTICES FOR FIELD HYGIENE

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

Post Fieldwork:

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

Literature Cited

Cheng et al. 2021 The scope and severity of white-nose syndrome on hibernating bats in North America. Conservation Biology. https://doi.org/10.1111/cobi.13739

Cunningham et al. 2003. Pathogen pollution: defining a parasitological threat to biodiversity conservation. Journal of Parasitology 89 (Suppl.) pp S78-83.

Scheele et al. 2019. Amphibian fungal panzootic causes catastrophic and ongoing loss of biodiversity. Science 363:1459-1463. https://doi.org/10.1126/science.aav0379

Useful References:

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

BOX 2: **FACE COVERINGS TO REDUCE RESPIRATORY TRANSMISSION.**

Best practices include FFP3, FFP2, N95 and KN95 facial masks.

When these options are unavailable, surgical masks could be used as they provide comparable protection for the bats (but lower protection for the researchers). 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.

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

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

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_86KIf0myAISrkQGgXJN2z39ttRnr52vMTp8QxX-q3DuyWgffAaAtIrEALw_wcB

BOX 3. DISINFECTANT RECOMMENDATIONS

Cleaning and disinfecting skin, clothes and equipment are necessary to minimize exposure of bats and humans to pathogens. 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 United States Fish and Wildlife Service White Nose Syndrome decontamination protocols. There are several additional resources on disinfectants listed at the end of this document.

(1) 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

(2) Submersible clothing and equipment e.g., bat bags, mist nets, harp trap bags.
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	

BOX 3. DISINFECTANT RECOMMENDATIONS

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

(3) Non-submersible equipment (calipers/rulers/field tables/harp traps)

If possible, clean surfaces with soap and water first before disinfecting. Harp traps: clean lines, 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

BOX 3. DISINFECTANT RECOMMENDATIONS
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-inthe-context-of-covid-19 Centers for Disease Control: Chemical Disinfectants-Guidelines for Disinfection and Sterilization in Healthcare Facilities https://www.cdc.gov/infectioncontrol/pdf/guidelines/disinfection-guidelines-H.pdf 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

Cook, J.D., Grant, E.H.C., Coleman, J.T., Sleeman, J.M. and Runge, M.C., 2021. Evaluating the risk of SARS-CoV-2 transmission to bats using a decision analytical framework. [Preprint] Available from bioRxiv https://doi.org/10.1101/2021.05.28.446020

Olival, K.J., Cryan, P.M., Amman, B.R., Baric, R.S., Blehert, D.S., Brook, C.E., Calisher, C.H., Castle, K.T., Coleman, J.T., Daszak, P. and Epstein, J.H., 2020. Possibility for reverse zoonotic transmission of SARS-CoV-2 to free-ranging wildlife: A case study of bats. PLoS Pathogens, 16(9), p.e1008758. https://doi.org/10.1371/journal.ppat.1008758

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

Cox-Witton, K., Baker, M. L., Edson, D., Peel, A. J., Welbergen, J. A., & Field, H. (2021). Risk of SARS-CoV-2 transmission from humans to bats–An Australian assessment. One Health, 13, 100247. https://doi.org/10.1016/j.onehlt.2021.100247

Brazilian Society for the Study of Bats (Sociedade Brasileira para o Estudo de Quirópteros) recommendations (PT): https://12f39ab0-4181-55ad-362e-ca03f322a37e.filesusr.com/ugd/053d6e_93f7a050336e44b8a16011a2bde5cc25.pdf

Literature Cited

[1] Fenollar et al. 2021. Mink, SARS-CoV-2, and the Human-Animal Interface. Frontiers in Microbiology. https://www.frontiersin.org/articles/10.3389/fmicb.2021.663815/full

[2] Oreshkova et al. 2020. SARS-CoV-2 infection in farmed minks, the Netherlands, April and May 2020. Eurosurveillance. https://doi.org/10.2807/1560-7917.ES.2020.25.23.2001005

[3] Enserink. 2020. Coronavirus rips through Dutch mink farms, triggering culls. Science. https://doi.org/10.1126/science.368.6496.1169

[4] Shriner et al. 2021 SARS-CoV-2 exposure in escaped mink, Utah, USA. Emerging infectious Diseases. https://doi.org/10.3201/eid2703.204444

[5] Aguiló-Gisbert et al. 2021. First description of SARS-CoV-2 infection in two feral American mink (*Neovison vison*) caught in the wild. Animals. https://doi.org/10.3390/ani11051422

[6] World Organisation for Animal Health (OIE). 2021. Events in Animals. https://www.oie.int/en/what-we-offer/emergency-and-resilience/covid-19/

[7] Schlottau et al. 2020. SARS-CoV-2 in fruit bats, ferrets, pigs, and chickens: an experimental transmission study. The Lancet: Microbe. https://doi.org/10.1016/S2666-5247(20)30089-6

[8] Hall et al. 2020. Experimental challenge of a North American bat species, big brown bat (*Eptesicus fuscus*), with SARS-CoV-2. Transboundary Emerging Diseases. https://onlinelibrary.wiley.com/doi/10.1111/tbed.13949

[9] Luan et al. 2020. Spike protein recognition of mammalian ACE2 predicts the host range and an optimized ACE2 for SARS-CoV-2 infection. Biochemical and Biophysical Research Communications. https://doi.org/10.1016/j.bbrc.2020.03.047

[10] Richterman et al. 2021. Indirect protection by reducing transmission: ending the pandemic with SARS-CoV-2 vaccination, Open Forum Infectious Diseases. https://doi.org/10.1093/ofid/ofab259

[11] Thompson et al. 2021 Interim estimates of vaccine effectiveness of BNT162b2 and mRNA-1273 COVID-19 vaccines in preventing SARS-CoV-2 infection among health care personnel, first responders and other essential and frontline workers -- eight US locations, December 2020-March 2021. MMWR Morb Mortal Wkly Rep 2021. http://dx.doi.org/10.15585/mmwr.mm7013e3

[12] Shah et al. 2021 Effect of vaccination on transmission of COVID-19: an observational study in healthcare workers and their households. [Preprint] Available from MedRxiv https://doi.org/10.1101/2021.03.11.21253275

[13] Zhang, R et al. 2020. Identifying airborne transmission as the dominant route for the spread of COVID-19. Proceedings of the National Academy of Sciences. https://doi.org/10.1073/pnas.2009637117

[14] Chu et al. 2020 Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. The Lancet. https://doi.org/10.1016/S0140-6736(20)31142-9