One Health risk assessment: lessons from SARS, MERS-CoV and COVID-19

François Roger,
Flavie Goutard

The emergence of SARS, MERS-CoV and COVID-19 has underscored the interconnection of human and animal compartments—including domestic animals and wildlife—in diverse ecosystems, shaping disease dynamics (Figure 1). However, these many dimensions have yet to be fully integrated into a cohesive One Health approach for managing health risks. For example, MERS-CoV, a zoonotic pathogen with a high fatality rate, is primarily transmitted from dromedary camels to humans (Figure 2). Scientific understanding of how ecological dynamics and species interactions shape MERS-CoV transmission is still limited, which hampers effective prevention and control efforts. Similarly, COVID-19 demonstrated that without systematic One Health integration at each stage of response, timely and effective intervention is challenging.

A proactive One Health approach is essential during the earliest stages of crises like COVID-19 and MERS-CoV to clarify pathogen origins and transmission pathways. Such clarity can significantly enhance efforts to control the spread of outbreaks and prevent future ones.

One Health relies on long-term collaboration across human, animal and environmental health sectors and extends beyond times of crisis. Effective implementation would deepen our understanding of interspecies transmission and support more robust prevention strategies. For instance, early integrated surveillance during the initial COVID-19 outbreak could have helped identify SARS-CoV-2 reservoirs and shed light on transmission pathways, thus enhancing response efforts.

A unified risk assessment framework under the One Health umbrella—referred to as "One Health risk assessment"—could also be implemented (Figure 3). Doing so would enable the anticipation of future pandemics and make health systems more flexible. Such a framework would improve responses at key points of transmission, promote interdisciplinarity, and advance integrated health governance on a global scale.

References

Azhar E.I., El-Kafrawy S.A., Farraj S.A., Hassan A.M., Al-Saeed M.S. *et al.* 2014. Evidence for camel-to-human transmission of MERS coronavirus. *New England Journal of Medicine*, 370(26), 2499–2505. https://doi.org/10.1056/NEJMoa1401505

Delahay R.J., de la Fuente J., Smith G.C., Sharun K., Snary E.L. *et al.* 2021. Assessing the risks of SARS-CoV-2 in wildlife. *One Health Outlook*, 3, 7. https://doi.org/10.1186/s42522-021-00039-6

Funk A.L., Goutard F.L., Miguel E., Bourgarel M., Chevalier V. *et al.* 2016. MERS-CoV at the animal–human interface: Inputs on exposure pathways from an expert-opinion elicitation. *Frontiers in Veterinary Science*, 3, 88. https://doi.org/10.3389/fvets.2016.00088

Guan Y., Zheng B.J., He Y.Q., Liu X.L., Zhuang Z.X. *et al.* 2003. Isolation and characterization of viruses related to the SARS coronavirus from animals in southern China. *Science*, 302(5643), 1351–1354. https://doi.org/10.1126/science.1087139

Irving A.T., Ahn M., Goh G., Anderson D.E., Wang L.F. 2021. Lessons from the host defences of bats, a unique viral reservoir. *Nature*, 589(7842), 363–370. https://doi.org/10.1038/s41586-020-03128-0

WHO, FAO, WOAH. 2020. Joint risk assessment operational tool (JRA OT): An operational tool of the tripartite zoonoses guide. Taking a multisectoral, one health approach: A tripartite guide to addressing zoonotic diseases in countries. World Health Organization. https://www.who.int/ publications/i/item/9789240015142

Worobey M., Levy J.I., Malpica Serrano L., Crits-Christoph A., Pekar J.E. *et al.* 2024. The Huanan seafood wholesale market in Wuhan was the early epicenter of the COVID-19 pandemic. *Science*, 377(6609), 951–959. https://doi.org/10.1126/science.abp8715

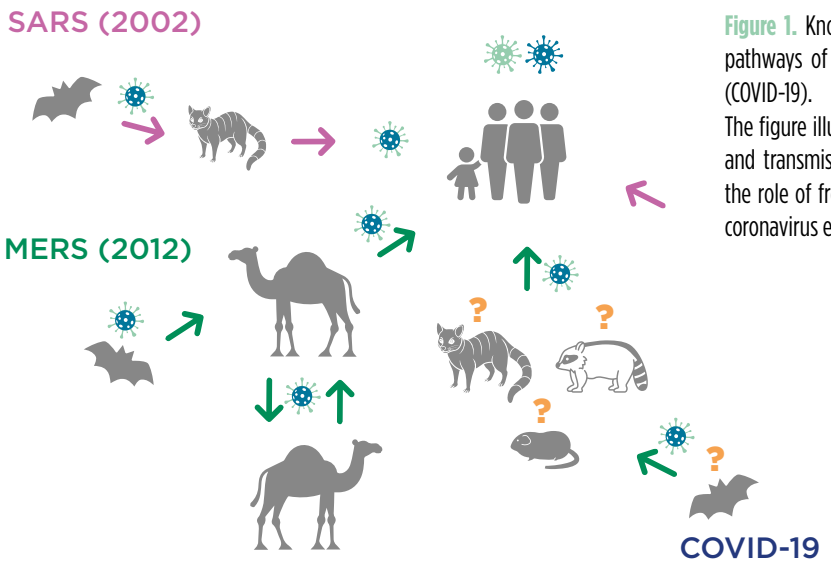

Figure 1. Knowledge and hypotheses on the origins and spillover pathways of SARS-CoV (SARS), MERS-CoV (MERS) and SARS-CoV-2 (COVID-19).
The figure illustrates potential animal reservoirs, intermediate hosts and transmission routes leading to human infection, emphasizing the role of free and captive wildlife as well as domestic animals in coronavirus emergence.

Infected dromedary camels

	Direct contact	Indirect contact	Milk	Raw meat	Urine	Mean confidence	Kendall's W
Number of experts	*14*	*11*	*9*	*7*	*8*	*3.8**	-
Relative importance	14	4	2.5	1.2	1	3.8	0.56*

Camel workers

Figure 2. Example of MERS-CoV transmission pathways from infected dromedaries to camel workers based on expert opinion. The table shows the relative importance of different exposure routes as assessed by a panel of experts, with each route evaluated for its perceived risk. The number of experts assigning importance to each route and the mean confidence scores reflect the level of consensus on these risks. Direct contact was deemed the highest risk route, with a strong mean confidence rating of 3.8, indicating a moderate agreement among experts (Kendall's W = 0.56). From: Funk *et al.* 2016.

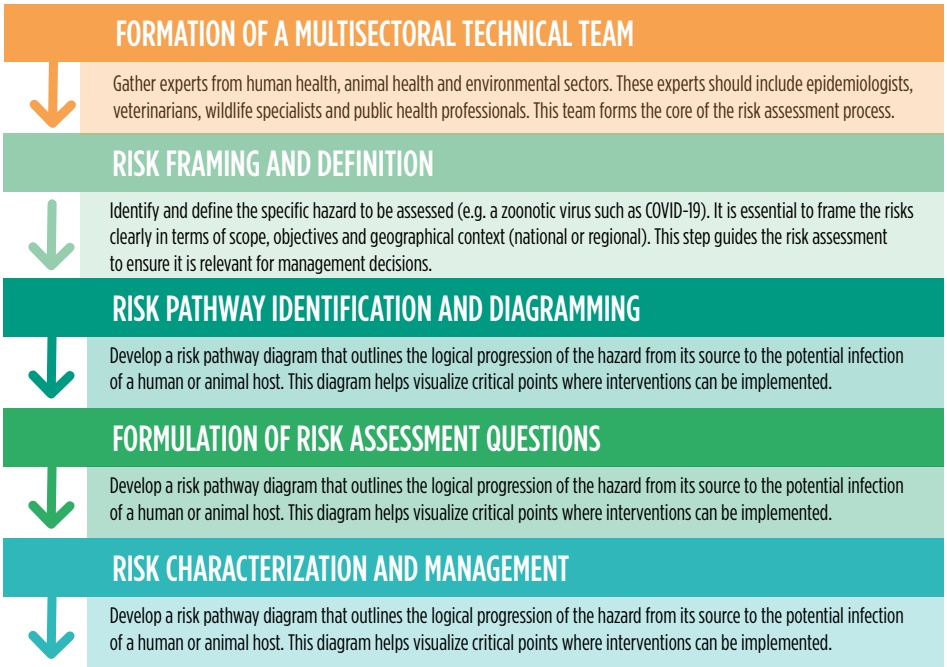

Figure 3. Comprehensive approach to One Health risk assessment. From: WHO *et al.* 2020.