

Reply to “Concerns About Misinterpretation of Recent Scientific Data Implicating Dromedary Camels in Epidemiology of Middle East Respiratory Syndrome (MERS)”

Abdulaziz N. Alagaili,^a Thomas Briese,^b William B. Karesh,^c Peter Daszak,^c W. Ian Lipkin^b

KSU Mammals Research Chair, Department of Zoology, College of Science, King Saud University, Riyadh, Saudi Arabia^a; Center for Infection and Immunity, Mailman School of Public Health, Columbia University, New York, New York, USA^b; EcoHealth Alliance, New York, New York, USA^c

We thank Samara and Abdoun for this opportunity to extend the discussion of Middle East respiratory syndrome coronavirus (MERS-CoV) infection in dromedary camels (DCs) (1). Several research groups working with samples from DCs collected in the Middle East have independently reported findings consistent with ours (2, 3), including the detection of specific antibodies to MERS-CoV (4–14), MERS-CoV nucleic acid (8, 11–16), and the isolation of infectious virus (13–15). One of these reports from Azhar and colleagues provides serological evidence of DC-to-human virus transmission (14). Furthermore, recent publications, abstracts from recent meetings, and news articles in prominent scientific journals reporting results of these meetings indicate the presence of MERS-CoV in DC products, including milk and meat, as well as a higher prevalence of antibodies to MERS-CoV in humans who come into contact with DCs or DC products (17–21).

We agree that the most urgent challenge at present is to investigate the epidemiology of human-to-human transmission. We are also actively pursuing studies focused on the analysis of other animal species for evidence of MERS-CoV infection. Nonetheless, the recent decision of the governments of the Kingdom of Saudi Arabia and Qatar to recommend against consumption of raw DC milk and to exert caution when interacting with DCs is prudent and appropriate. A similar recommendation was issued by the World Health Organization (22).

In short, we stand by the data and conclusions that we have reported in mBio and are pleased that they may have contributed to the adoption of public health policies that will help in the containment of MERS-CoV transmission.

REFERENCES

1. Samara EM, Abdoun KA. 2014. Concerns about misinterpretation of recent scientific data implicating dromedary camels in epidemiology of Middle East respiratory syndrome (MERS). *mBio* 5(4):e01430-14. <http://dx.doi.org/10.1128/mBio.01430-14>.
2. Alagaili AN, Briese T, Mishra N, Kapoor V, Sameroff SC, Burbelo PD, de Wit E, Munster VJ, Hensley LE, Zalmout IS, Kapoor A, Epstein JH, Karesh WB, Daszak P, Mohammed OB, Lipkin WI. 2014. Middle East respiratory syndrome coronavirus infection in dromedary camels in Saudi Arabia. *mBio* 5:e00884-14. <http://dx.doi.org/10.1128/mBio.00884-14>.
3. Briese T, Mishra N, Jain K, Zalmout IS, Jabado OJ, Karesh WB, Daszak P, Mohammed OB, Alagaili AN, Lipkin WI. 2014. Middle East respiratory syndrome coronavirus quasispecies that include homologues of human isolates revealed through whole-genome analysis and virus cultured from dromedary camels in Saudi Arabia. *mBio* 5:e01146-14. <http://dx.doi.org/10.1128/mBio.01146-14>.
4. Reusken CB, Haagmans BL, Müller MA, Gutierrez C, Godeke GJ, Meyer B, Muth D, Raj VS, Smits-De Vries L, Corman VM, Drexler JF, Smits SL, El Tahir YE, De Sousa R, van Beek J, Nowotny N, van Maanen K, Hidalgo-Hermoso E, Bosch BJ, Rottier P, Osterhaus A, Gortázar-Schmidt C, Drosten C, Koopmans MP. 2013. Middle East respiratory syndrome coronavirus neutralising serum antibodies in dromedary camels: a comparative serological study. *Lancet Infect. Dis.* 13:859–866. [http://dx.doi.org/10.1016/S1473-3099\(13\)70164-6](http://dx.doi.org/10.1016/S1473-3099(13)70164-6).
5. Perera RA, Wang P, Gomaa MR, El-Shesheny R, Kandeil A, Bagato O, Siu LY, Shehata MM, Kayed AS, Moatasim Y, Li M, Poon LL, Guan Y, Webby RJ, Ali MA, Peiris JS, Kayali G. 2013. Seroepidemiology for MERS coronavirus using microneutralisation and pseudoparticle virus neutralisation assays reveal a high prevalence of antibody in dromedary camels in Egypt, June 2013. *Euro Surveill.* 18:pii=20574.
6. Meyer B, Müller MA, Corman VM, Reusken CB, Ritz D, Godeke GJ, Lattwein E, Kallies S, Siemens A, van Beek J, Drexler JF, Muth D, Bosch BJ, Wernery U, Koopmans MP, Wernery R, Drosten C. 2014. Antibodies against MERS coronavirus in dromedary camels, United Arab Emirates, 2003 and 2013. *Emerg. Infect. Dis.* 20:552–559. <http://dx.doi.org/10.3201/eid2004.131746>.
7. Hemida MG, Perera RA, Wang P, Alhammadi MA, Siu LY, Li M, Poon LL, Saif L, Alnaeem A, Peiris M. 2013. Middle East respiratory syndrome (MERS) coronavirus seroprevalence in domestic livestock in Saudi Arabia, 2010 to 2013. *Euro Surveill.* 18:20659.
8. Haagmans BL, Al Dhahiry SH, Reusken CB, Raj VS, Galiano M, Myers R, Godeke GJ, Jonges M, Farag E, Diab A, Ghobashy H, Alhajri F, Al-Thani M, Al-Marri SA, Al Romaihi HE, Al Khal A, Bermingham A, Osterhaus AD, Alhajri MM, Koopmans MP. 2014. Middle East respiratory syndrome coronavirus in dromedary camels: an outbreak investigation. *Lancet Infect. Dis.* 14:140–145. [http://dx.doi.org/10.1016/S1473-3099\(13\)70690-X](http://dx.doi.org/10.1016/S1473-3099(13)70690-X).
9. Reusken CB, Ababneh M, Raj VS, Meyer B, Eljarah A, Abutarbush S, Godeke GJ, Bestebroer TM, Zutt I, Muller MA, Bosch BJ, Rottier PJ, Osterhaus AD, Drosten C, Haagmans BL, Koopmans MP. 2013. Middle East respiratory syndrome coronavirus (MERS-CoV) serology in major livestock species in an affected region in Jordan, June to September 2013. *Euro Surveill.* 18:20662.
10. Alexandersen S, Kobinger GP, Soule G, Wernery U. 2014. Middle East respiratory syndrome coronavirus antibody reactors among camels in Dubai, United Arab Emirates, in 2005. *Transbound. Emerg. Dis.* 61: 105–108. <http://dx.doi.org/10.1111/tbed.12212>.
11. Memish ZA, Cotten M, Meyer B, Watson SJ, Alsahafi AJ, Al Rabeeah AA, Corman VM, Sieberg A, Makhdoom HQ, Assiri A, Al Masri M, Aldabbagh S, Bosch BJ, Beer M, Müller MA, Kellam P, Drosten C. 2014. Human infection with MERS coronavirus after exposure to infected camels, Saudi Arabia, 2013. *Emerg. Infect. Dis.* 20:1012–1015. <http://dx.doi.org/10.3201/eid2006.140402>.
12. Chu DK, Poon LL, Gomaa MM, Shehata MM, Perera RA, Abu Zeid D, El Rifay AS, Siu LY, Guan Y, Webby RJ, Ali MA, Peiris M, Kayali G. 2014. MERS coronaviruses in dromedary camels, Egypt. *Emerg. Infect. Dis.* 20:1049–1053. <http://dx.doi.org/10.3201/eid2006.140299>.

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Address correspondence to W. Ian Lipkin, wil2001@columbia.edu.

13. Hemida MG, Chu DK, Poon LL, Perera RA, Alhammadi MA, Ng H, Siu LY, Guan Y, Alnaem A, Peiris M. July 2014. MERS coronavirus in dromedary camel herd, Saudi Arabia. *Emerg. Infect. Dis.* <http://dx.doi.org/10.3201/eid2007.140571>.
14. Azhar EI, El-Kafrawy SA, Farraj SA, Hassan AM, Al-Saeed MS, Hashem AM, Madani TA. 4 June 2014. Evidence for camel-to-human transmission of MERS coronavirus. *N. Engl. J. Med.* <http://dx.doi.org/10.1056/NEJM0a1401505>.
15. Raj VS, Farag EA, Reusken CB, Lamers MM, Pas SD, Voermans J, Smits SL, Osterhaus AD, Al-Mawlawi N, Al-Romaihi HE, AlHajri MM, El-Sayed AM, Mohran KA, Ghobashy H, Alhajri F, Al-Thani M, Al-Marri SA, El-Maghraby MM, Koopmans MP, Haagmans BL. August 2014. Isolation of MERS coronavirus from a dromedary camel, Qatar, 2014. *Emerg. Infect. Dis.* <http://dx.doi.org/10.3201/eid2008.140663>.
16. Nowotny N, Kolodziejek J. 2014. Middle East respiratory syndrome coronavirus (MERS-CoV) in dromedary camels, Oman. *Euro Surveill.* 19:20781.
17. Roos R. 5 June 2014. As MERS cases keep coming, Saudis to test camels. *CIDRAP News* <http://www.cidrap.umn.edu/news-perspective/2014/06/mers-cases-keep-coming-saudis-test-camels>.
18. Enserink M. 6 June 2014. MERS virus found in camel milk. *Science/AAAS News* <http://news.sciencemag.org/asiapacific/2014/06/mers-virus-found-camel-milk>.
19. Farag E. 2014. Seroprevalence of Middle East respiratory syndrome coronavirus (MERS-CoV) among humans and animals in the central animal market and slaughterhouses in Doha, Qatar—2014. Presented at Endemic and Emerging Viral Diseases of Priority in the Middle East and North Africa (MENA)—A Scientific Workshop to Promote Research Collaborations, Doha, Qatar.
20. Pasha S. 2014. Screening of camels for MERS-CoV at Laewaina Camel Hospital. Presented at Endemic and Emerging Viral Diseases of Priority in the Middle East and North Africa (MENA)—A Scientific Workshop to Promote Research Collaborations, Doha, Qatar.
21. Reusken CB, Farag EA, Jonges M, Godeke GJ, El-Sayed AM, Pas SD, Raj VS, Mohran KA, Moussa HA, Ghobashy H, Alhajri F, Ibrahim AK, Bosch BJ, Pasha SK, Al-Romaihi HE, Al-Thani M, Al-Marri SA, AlHajri MM, Haagmans BL, Koopmans MP. 2014. Middle East respiratory syndrome coronavirus (MERS-CoV) RNA and neutralising antibodies in milk collected according to local customs from dromedary camels, Qatar, April 2014. *Euro Surveill.* 19:p=20829ii.
22. **World Health Organization.** 13 June 2014. Update on MERS-CoV transmission from animals to humans, and interim recommendations for at-risk groups. http://www.who.int/csr/disease/coronavirus_infections/MERS_CoV_RA_20140613.pdf.