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MERS-CoV Surveillance in Africa

Almost all human Middle East Respiratory Syndrome (MERS) cases have originated in the Arabian Peninsula, where the MERS-CoV has been found in camels, the most probable source of virus for primary infections (Alagaili et al. 2014). Antibodies to MERS-CoV (or closely related viruses) are also widespread in camels in Egypt, Kenya, Somalia, Ethiopia, and Tunisia and the virus has been detected in camels in Egypt and Nigeria. In some areas in Africa, MERS-CoV appears to have been circulating for several decades in camels. **However, to date, no primary human MERS cases have been reported to have arisen in African countries.** This may be due to biological differences in the strains of MERS-CoV circulating in Africa, variation in human susceptibility, differences in camel husbandry and trade, or lack of surveillance and reporting.

The PREDICT-2 Modeling and Analytics team collated previous evidence of MERS-CoV circulation in camels, and data on camel and human population densities, to estimate the potential human MERS burden in these countries. **We expect there to be potentially thousands of undiagnosed MERS cases in people in Africa, with varying numbers by country,** and with the potential for high burdens in Kenya, Nigeria, the former Sudan (current S. Sudan and Sudan) and Somalia (**Fig. 1**).

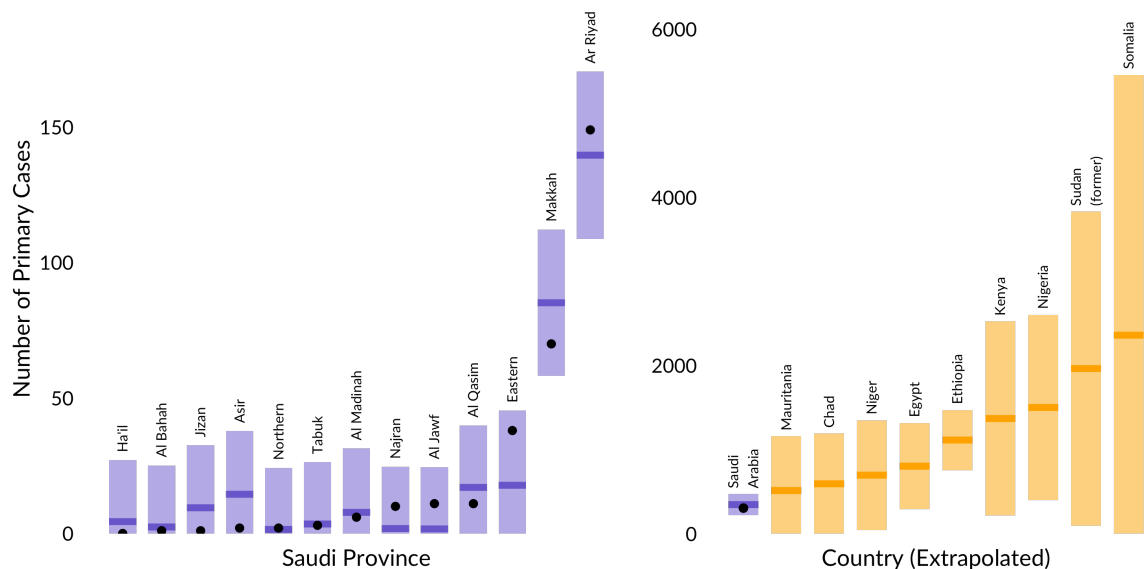


Figure 1 -- Missing MERS cases in Africa: A preliminary model based on regional data in Saudi Arabia (*left*) suggests that the number of primary MERS cases (black dots) can be predicted by the interaction of human and camel populations (prediction ranges in purple). Extrapolating to African countries (*right*, extrapolated ranges in orange) suggests that MERS-CoV would cause many thousands of human cases if it behaved similarly in Africa as in the Arabian peninsula.

We have now developed a model of MERS-CoV circulation dynamics in camel herds (Fig. 2). It suggests that active MERS-CoV infections are most likely to be found in (A) **juvenile camels**, (B) in the months **during and immediately after the calving season**, and (C) **at markets, trade points, and slaughterhouses** where young camels from small herds aggregate. These findings are largely supported by the scant reports from surveillance programs. Collection of additional data would allow us to parameterize these models robustly

and to quantify and forecast disease spillover risk more accurately.

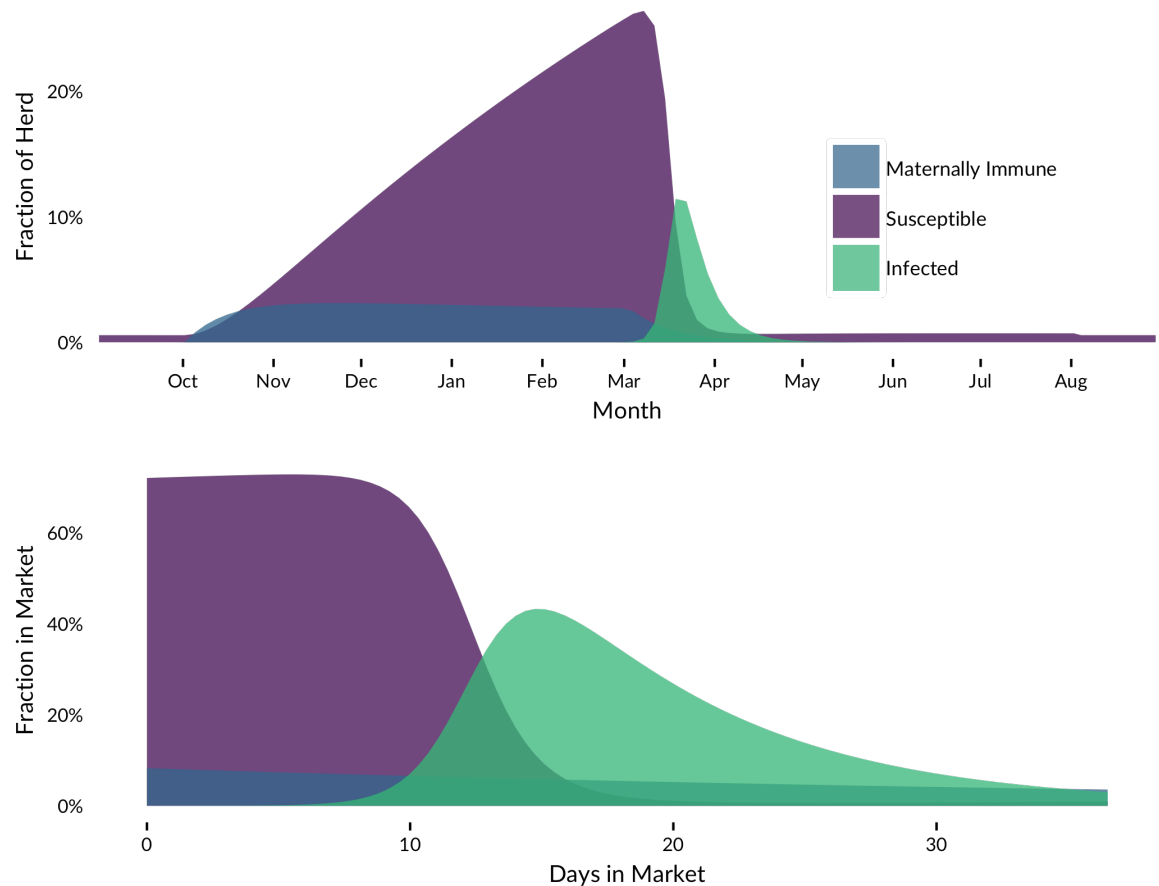


Figure 2 -- Preliminary MERS dynamic modeling: Our model indicates that the fraction of juveniles infected with MERS will spike shortly after the calving season (Oct-Feb, *top*), when enough naive juveniles have been born to cause small epidemics within herds. These dynamics are highly sensitive to herd size, however, and will vary depending on husbandry practices. When young camels are brought to market (*bottom*), the high proportion of susceptibles in this group can lead to large, fast outbreaks and many infectious camels. These dynamics are sensitive to the age of camels brought to market and the time of year.

These analyses suggest surveillance of both camel herds and humans workers in contact with camels should be prioritized to:

- African countries with large camel populations (Egypt, Ethiopia, Kenya, Nigeria, Sudan, and Somalia);
- Markets, slaughterhouses, and trade points where camels originating from different herds mix;
- During calving season (which varies by country), and the months immediately afterwards.

In addition to MERS-CoV screening in camel and human populations, including the following measurements with disease surveillance programs would be valuable:

- camel herd sizes, distributions and demographic make-up,
- rates of off-take of camels from herds for both sale and slaughter,
- size and demographic make-up of camels sent to market, and

- behavioral surveillance of human-camel contact.

These data will support better modeling the circulation of MERS-CoV in camel populations so as to more precisely identify the locations, periods, and conditions that result in high spillover risk.

REFERENCES

Alagaili, A. N., T. Briese, N. Mishra, V. Kapoor, S. C. Sameroff, E. de Wit, V. J. Munster, et al. 2014. "Middle East Respiratory Syndrome Coronavirus Infection in Dromedary Camels in Saudi Arabia." *mBio* 5 (2). American Society for Microbiology: e00884-14-e00884-14. doi:[10.1128/mbio.00884-14](https://doi.org/10.1128/mbio.00884-14).