MERS-CoV project oustside Peninsula Arabia

Phase 1: mapping the virus in Asia & Africa

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One of the major paradoxes of the MERS-CoV epidemiology is the apparent lack of human cases in large parts of Africa where the virus and an animal host, the dromedary camel, are present. Understanding the differences between Africa and the Arabian Peninsula (where MERS is now endemic) would provide crucial understanding on how to reduce zoonotic infection.

Objectives:

- **Serological** and **Virological** mapping of the virus in Africa and central Asia in camel populations (dromedary and bactrian)
- Describe risk factors in camels herds associated to **antibodies** and **virus** occurrence
- **Sampling** = (1) sear + (2) swabs + (3) questionnaires

1 Serological analyses *(Hong Kong University):*

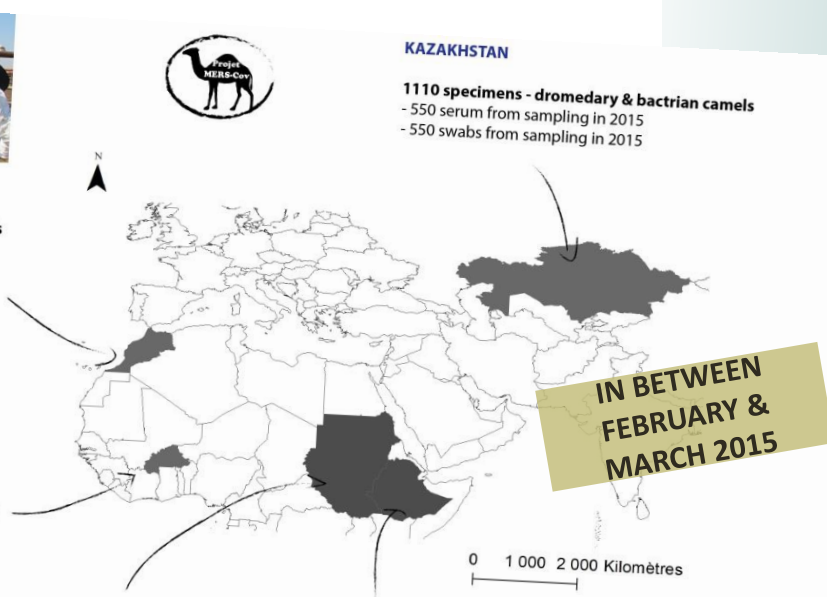
- MERS-CoV pseudotype neutralization assay for screening and positives confirmed (as needed) by neutralization assays

2 Virological analyses *(Hong Kong University):*

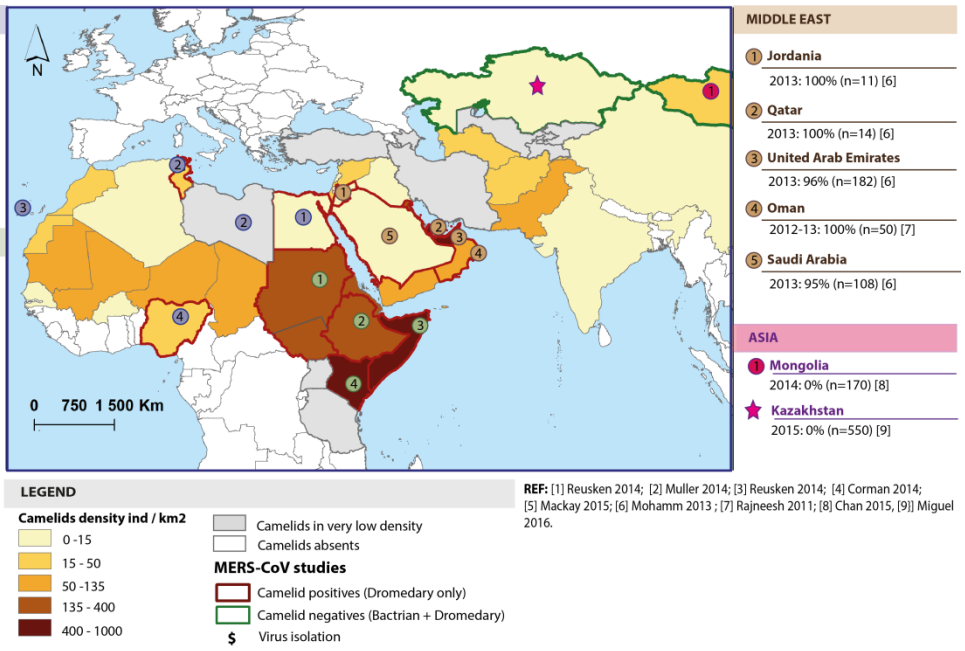
- Screening by real-time reverse transcription PCR E gene of MERS-CoV
- Confirmation by ORF (open Readinf Frame) in 1a gene
- Pan-coronavirus PCR which picks up other coronaviruses that may be present in the specimens

3 Statistical analyses *(Cirad)*:

- Correlative approach with explanatory variables to explain the response variable i.e. positives & negatives serological / virological results with data from questionnaires to characterise the risk factors
- Generalized linear models
- Statistical modelling of force of infection



MERS in Camels: overview of the literature



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Addressing these questions is crucial for developing recommendations for animal and human health institutions and countries.

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cirad AGRICULTURAL RESEARCH FOR DEVELOPMENT

NIH

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Phase 1: First results

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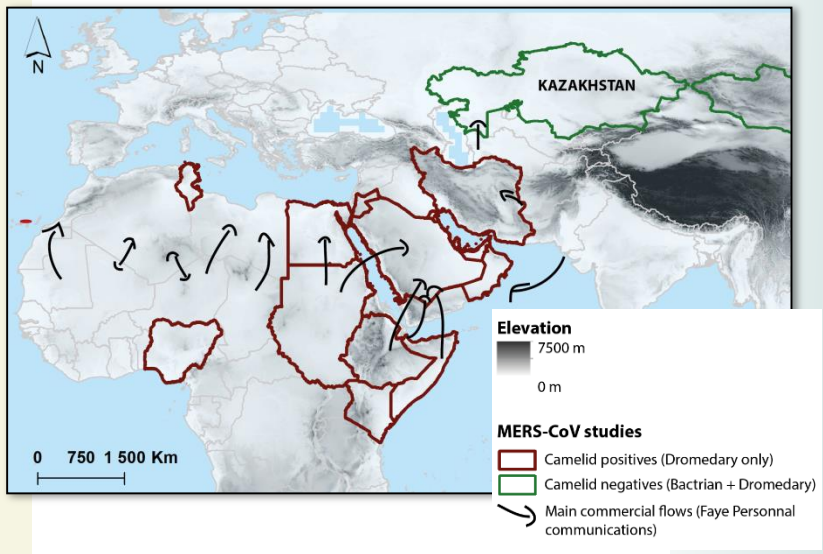
1 Absence of MERS in Camelids, Kazakhstan, 2015

(see Miguel et al EID 2016) Hypotheses:

- The low camel densities in Turkey and Iran may constitute a barrier for the spread of MERS-CoV via camel movements from the Middle East or Africa to Central Asia
- The mountain chain in Western Turkey and Northern Iran constitute a natural barrier and has restrained trade flows between central Asia and Middle East
- Bats are the true natural reservoir of MERS-CoV with the virus spilling over to dromedaries. If so, the geographic range of MERS-CoV infection in dromedaries may be determined by the distribution of bat populations



2 Serological and Virological prevalences

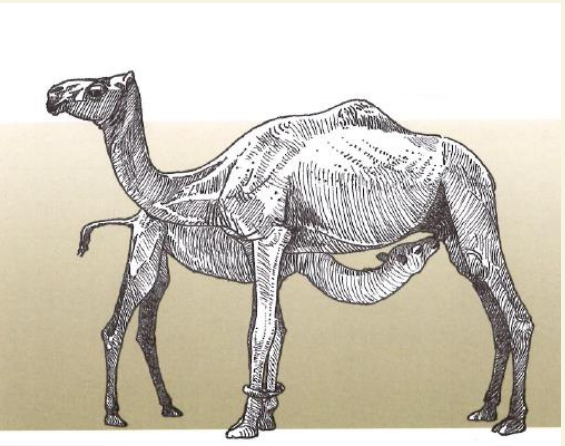
Serological results	Morocco (% positive)	Burkina Faso (% positive)	Ethiopia (% positive)	Sudan (% positive)	Kazakhstan (% positive)
Dromedary Camels	352 (**50-100%**)	647 (**76%**)	1091 (**94%**)	117 (**91%**)	455 (**0%**)
Bactrian Camels	-	-	-	-	96(**0%**)

- **High rate of seroprevalence in Africa**
- **Virus circulation in high proportion mainly in the horn of Africa**

Virological results	Specimen no.	*MERS-CoV pos	pos %
Morocco	381	3	**0,78%**
Burkina Faso	451	25	**5,54%**
Ethiopia	621	65	**10,47%**
Kazakhstan	550	0	**0%**

*: MERS-CoV positive confirmed by both UpE and ORF1a assays

3 Risk factors



- The virus is circulating in farms and abattoirs; mainly because young animals are slaughtered in abattoirs for the meat
- More females have antibodies as compared to males but the virus is equally detected
- Young animals have less antibodies and more virus than older animals
- More individuals are detected with antibodies in large herds
- Nomad and mixed lifestyles are more at risk compared to sedentary

		Serology	Virology
Sample type	Abattoir		Abattoir
	Farm		Farm
Sex	Female		Female
	Male		Male
Function	Meat		Meat
	Milk		Milk
	Transport		Transport
Age structure	0-2,5		0-2,5
	2,5-10		2,5-10
	10-30		10-30
Herd size	0-50		
	100-150		
	200-300		
Life style	Mixed		
	Nomad		
	Sedentary		

Significant factors are highlighted with colors

These firts results are opening numerous question on the virus dynamic in the camel herds and the way(s) of transmission: Air borne? Maternal? Environmental? The role of female, young camel, density and mobility are particularly highlighted!