

Genomic epidemiology and population genetics of emerging RNA viruses

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Middle East respiratory syndrome-associated coronavirus (MERS-CoV)



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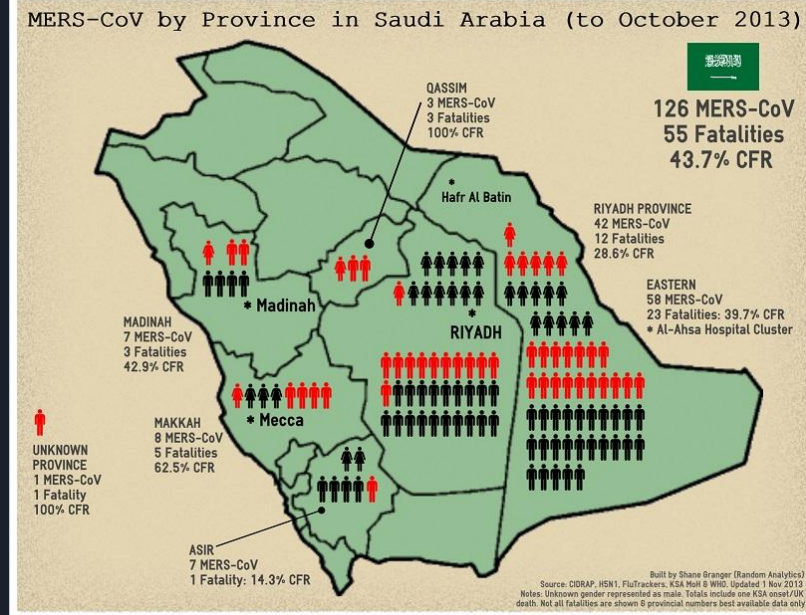
Coronavirus discovered in 2012



Middle East respiratory syndrome-associated coronavirus (MERS-CoV)

Coronavirus discovered in 2012

Severe morbidity/mortality*

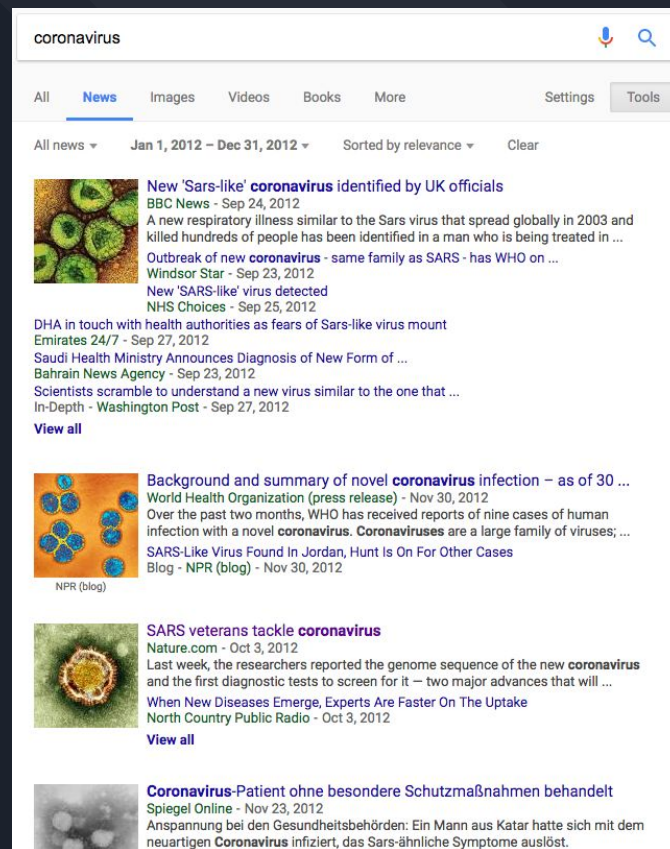


Middle East respiratory syndrome-associated coronavirus (MERS-CoV)

Coronavirus discovered in 2012

Severe morbidity/mortality*

Parallels with SARS-CoV inevitable



The screenshot shows a Google search for "coronavirus" with results filtered to "News" from January 1, 2012, to December 31, 2012. The results are sorted by relevance. The top result is a BBC News article from September 24, 2012, titled "New 'Sars-like' coronavirus identified by UK officials". The article snippet states: "A new respiratory illness similar to the Sars virus that spread globally in 2003 and killed hundreds of people has been identified in a man who is being treated in ...". Other snippets include "Outbreak of new coronavirus - same family as SARS - has WHO on ...", "New 'SARS-like' virus detected", and "DHA in touch with health authorities as fears of Sars-like virus mount". A "View all" link is provided. The second result is an NPR blog post from November 30, 2012, titled "Background and summary of novel coronavirus infection - as of 30 ...". The snippet reads: "Over the past two months, WHO has received reports of nine cases of human infection with a novel coronavirus. Coronaviruses are a large family of viruses; ...". A "View all" link is also present. The third result is a Nature.com article from October 3, 2012, titled "SARS veterans tackle coronavirus". The snippet says: "Last week, the researchers reported the genome sequence of the new coronavirus and the first diagnostic tests to screen for it - two major advances that will ...". A "View all" link is present. The fourth result is a Spiegel Online article from November 23, 2012, titled "Coronavirus-Patient ohne besondere Schutzmaßnahmen behandelt". The snippet states: "Anspannung bei den Gesundheitsbehörden: Ein Mann aus Katar hatte sich mit dem neuartigen Coronavirus infiziert, das Sars-ähnliche Symptome auslöst."

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“Mysterious epidemiology”



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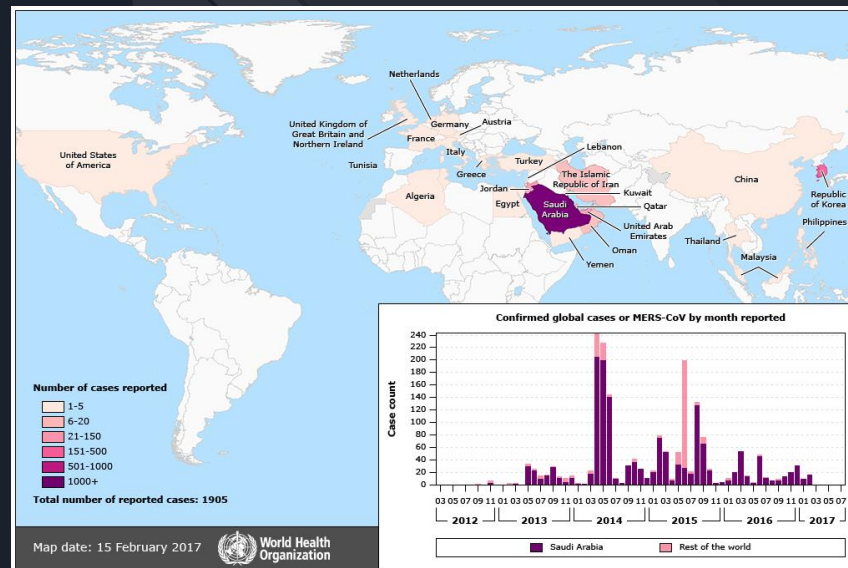
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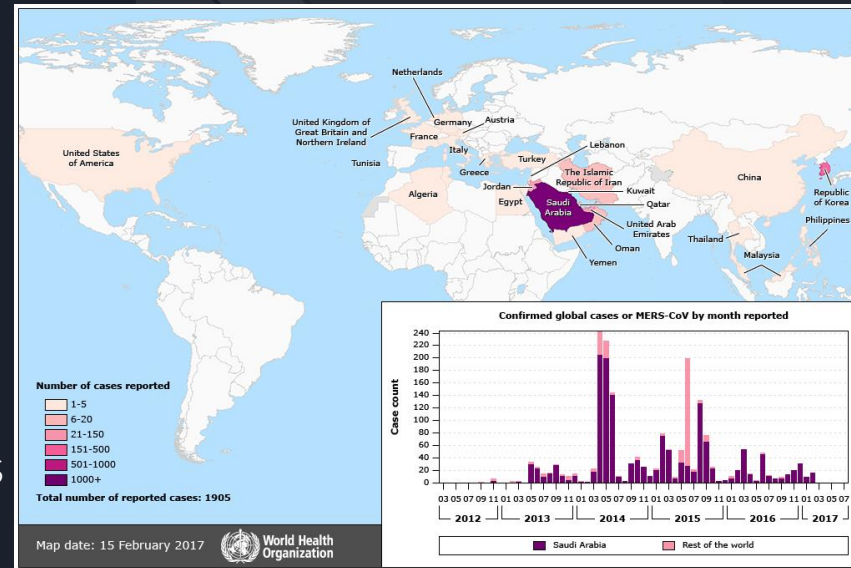
Parallels with SARS-CoV inevitable

“Mysterious epidemiology”

But MERS-CoV restricted to Arabian peninsula

No evidence of widespread infection in humans

Very high seroprevalence in camels



Spoiler alert

MERS is a recurring zoonosis in humans



The Questions

How frequent is spillover into humans?

How well does MERS-CoV do in humans?

Which host(s) responsible for virus maintenance?

How asymmetric is virus transfer between hosts?





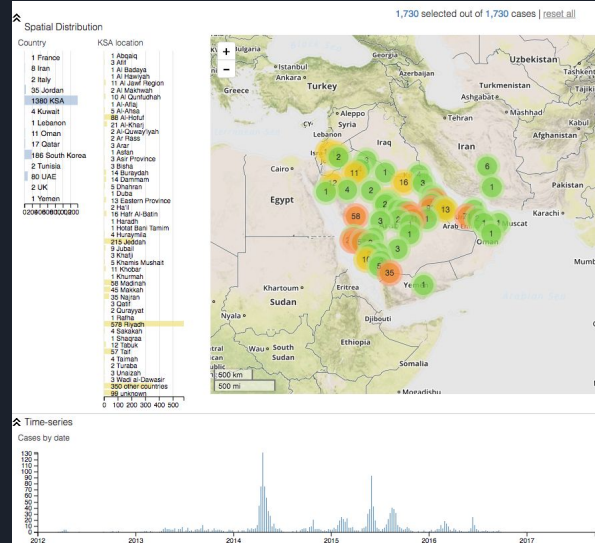
Data so far

Epidemiological

Sequence

Andrew “Phylogenetics Rambo”
Rambaut’s curated case list

MERS-CoV genomes from
humans and camels



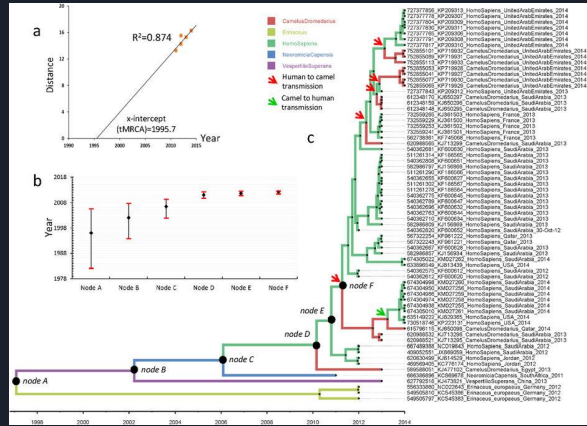
~300 genomes
~2:1 human to camel ratio

Studies into camel-human interface so far

Traditional epi

“We estimate that 12% of cases were infected from the reservoir, the rest via human-to-human transmission in clusters (60%), within (23%), or between (5%) regions.”

Phylodynamics

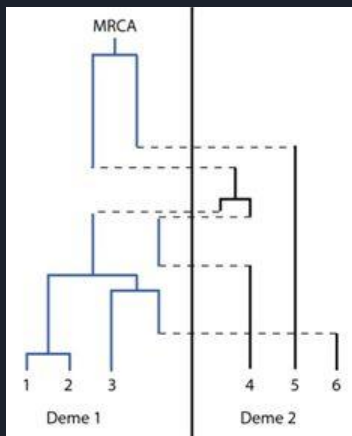


Problems

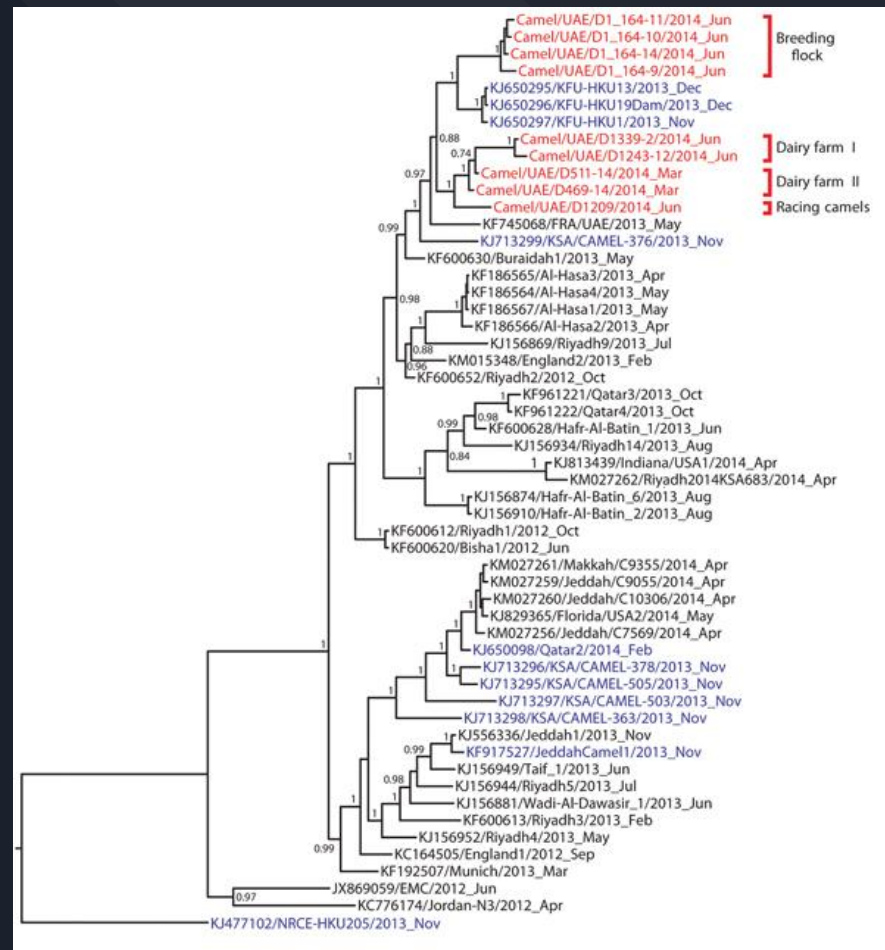
Difficult to link cases into clusters

Sequence sampling skewed, models used inappropriate

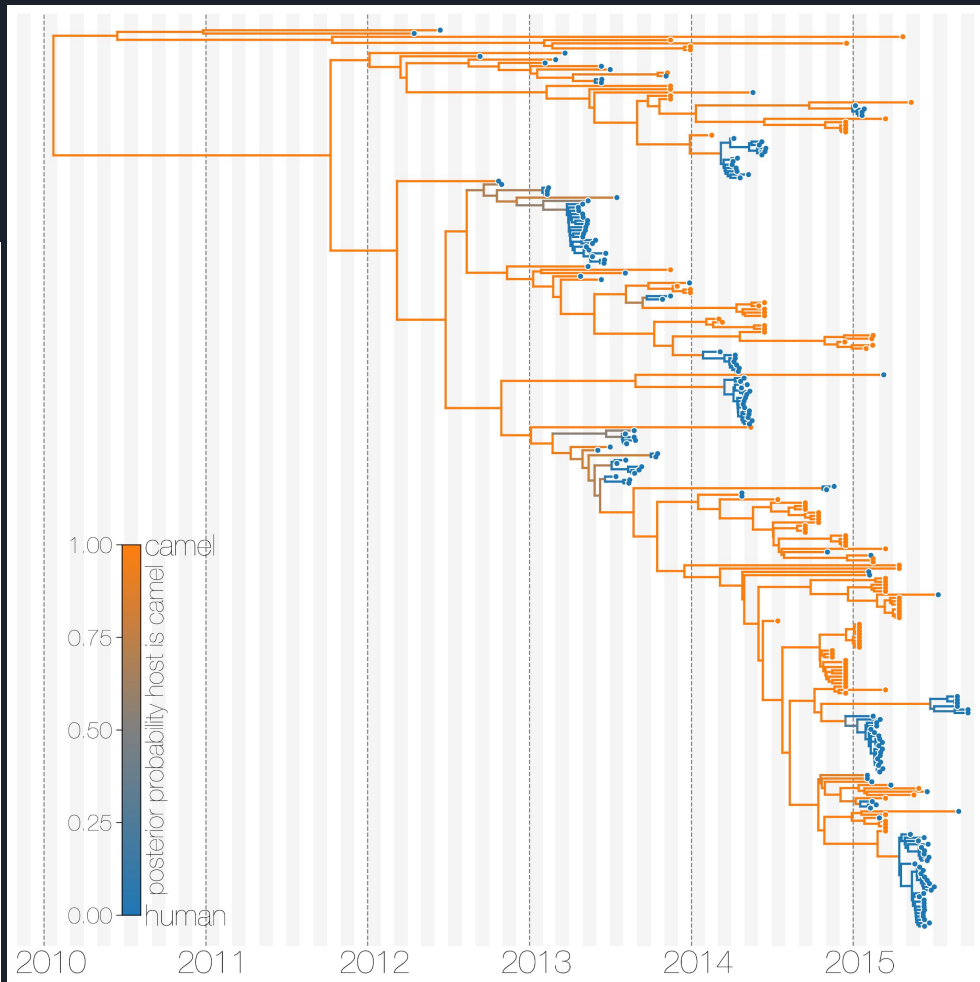
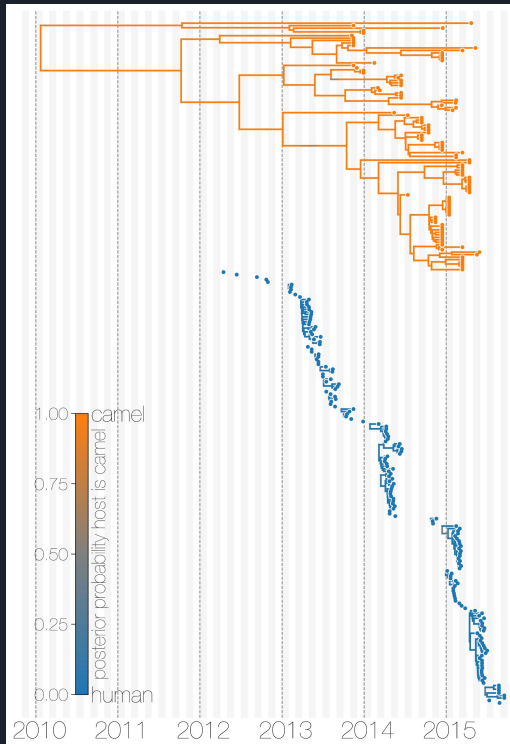
Maximising sequence information use



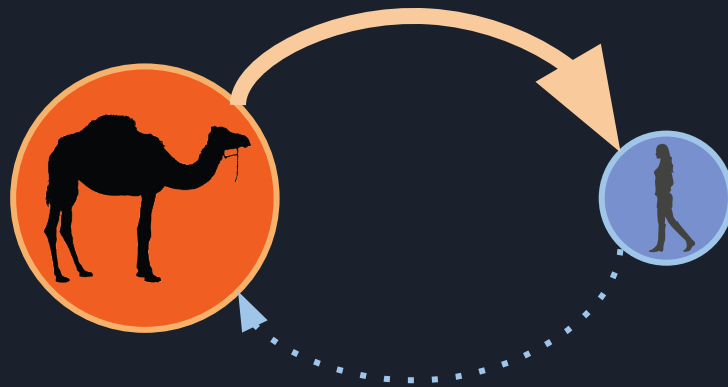
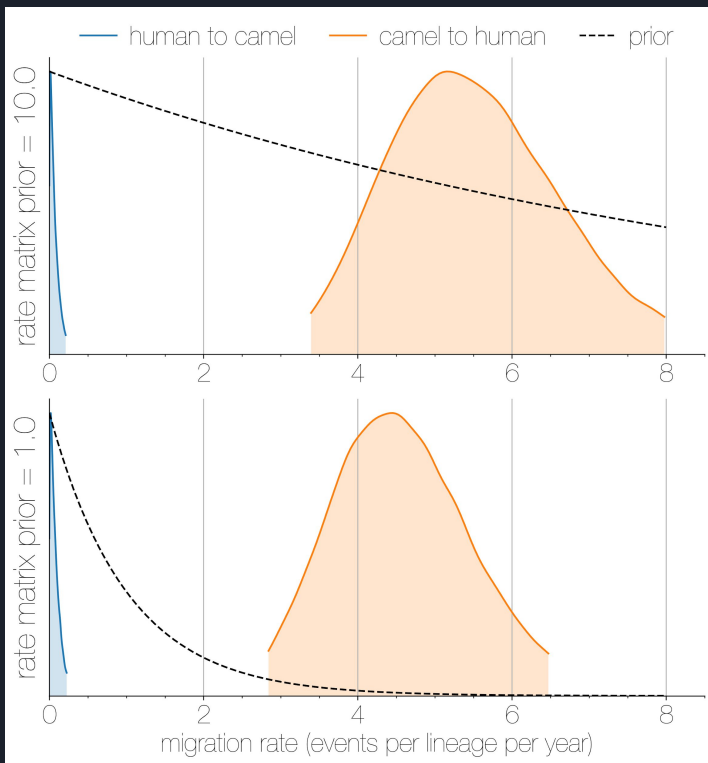
Structured coalescent
(MultiTypeTree, MTT)
in BEAST2



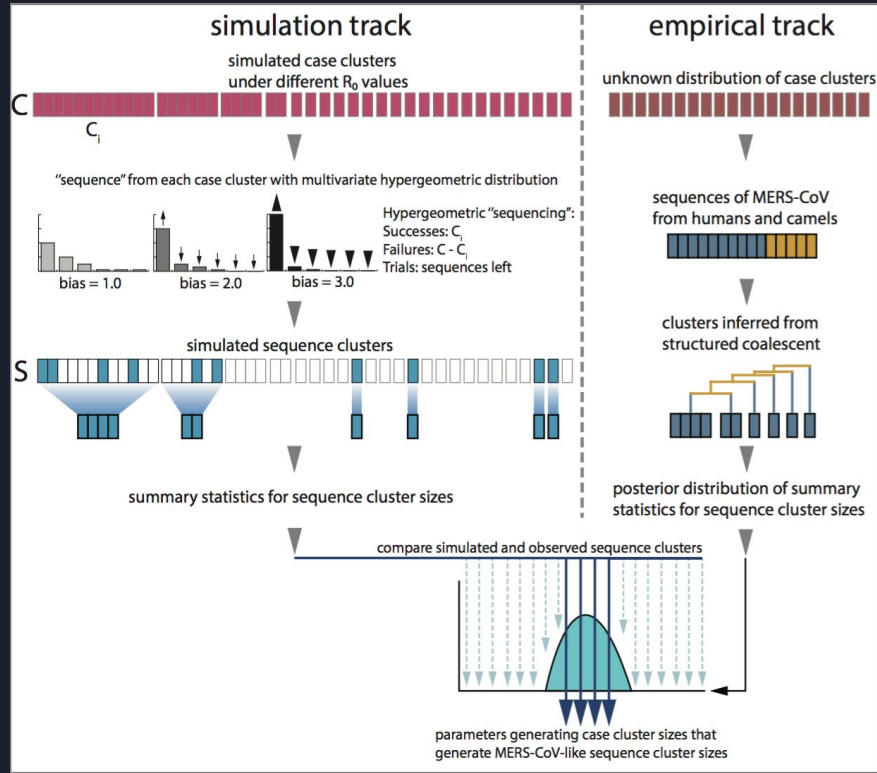
Sure enough...



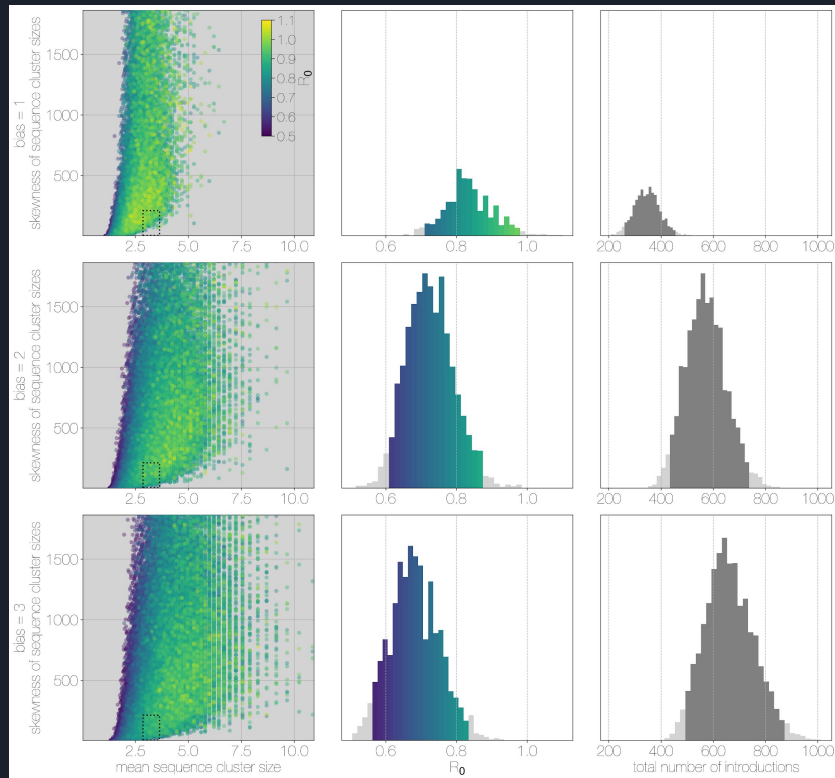
Not caused by prior



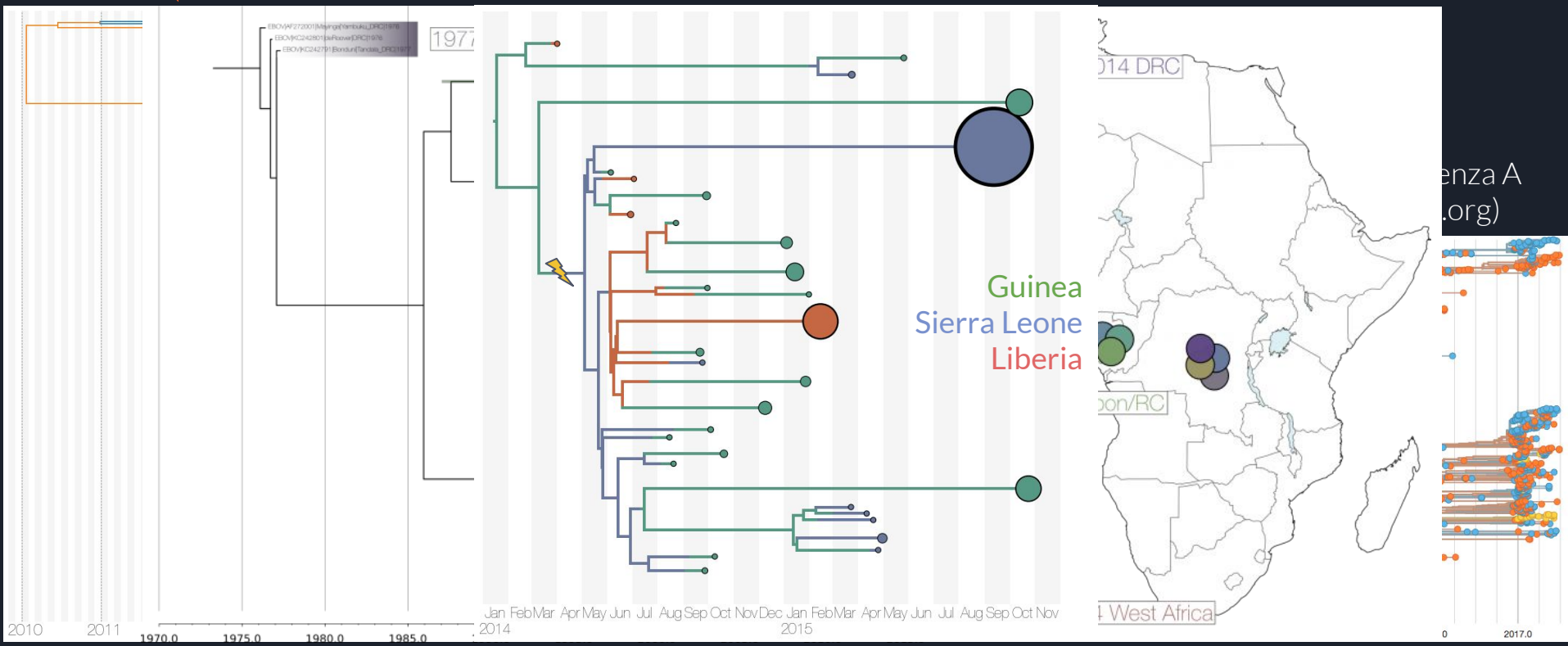
How good (bad) is MERS-CoV in humans?



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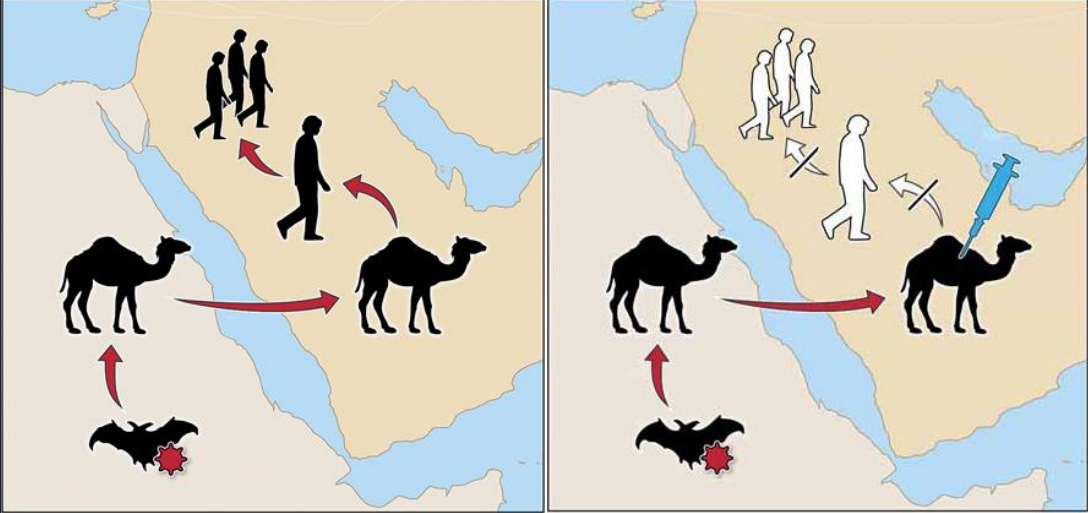


Adaptation to human adaptation/mis-assigned recombinants?



Conclusions

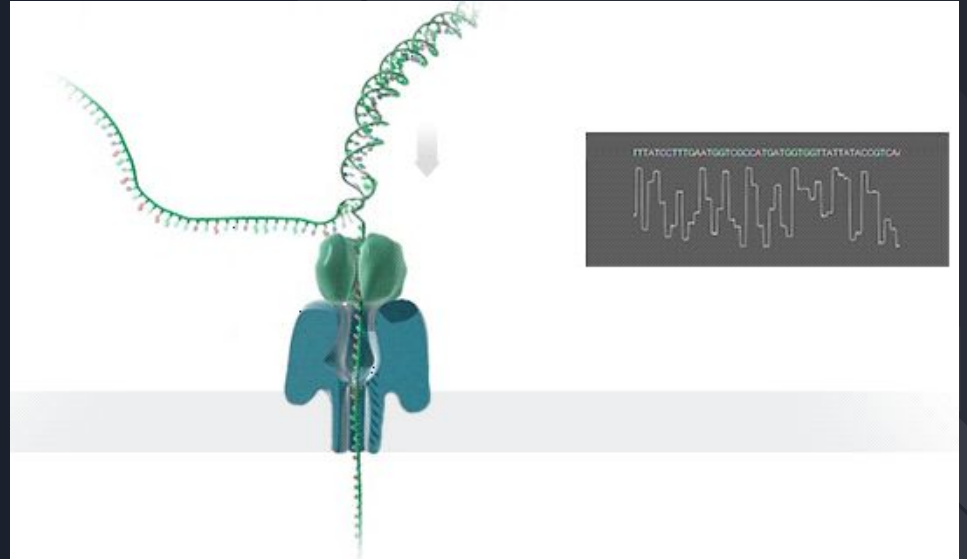
Target camels to stop MERS-CoV



Conclusions

Target camels to stop MERS-CoV

Continue genomic surveillance

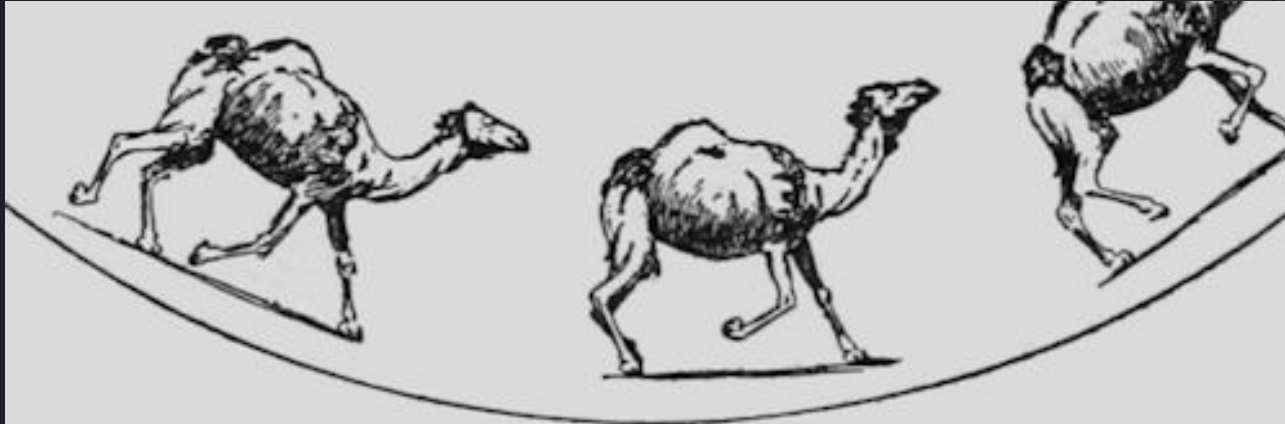


Conclusions

Target camels to stop MERS-CoV

Continue genomic surveillance

Example of sequence to epidemiology



Thank you

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MERS-CoV spillover at the camel-human interface. *eLife* 2018; 7:e31257

