MERS-CoV: coming to a hospital near you?

Infection prevention and control challenges

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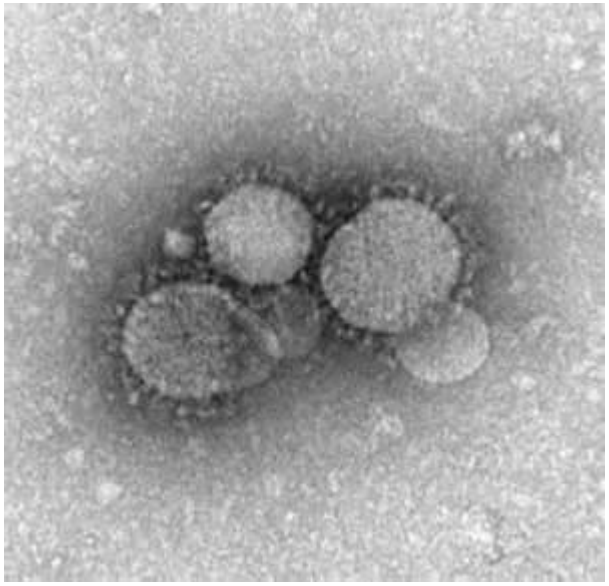
MERS-CoV: introduction

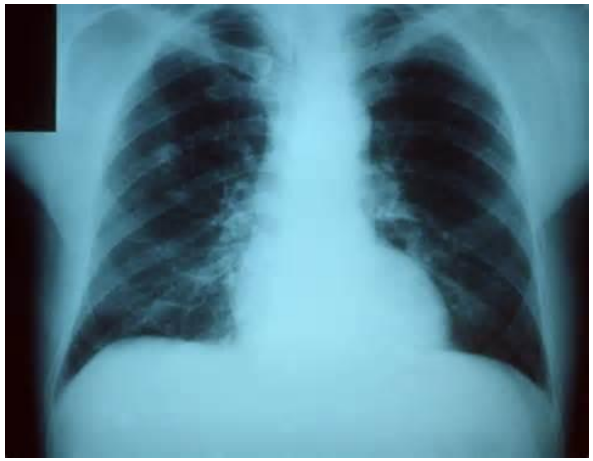


- A novel coronavirus emerged several years ago in the Middle East, called the "Middle East Respiratory Syndrome Coronavirus" (MERS-CoV).[1,2]
- Around 600 cases have been reported worldwide.
- Mortality is unnervingly high (around 30%).
- Strong parallels with the SARS-CoV.

1. Zaki *et al. N Engl J Med* 2012;367:1814-1820.
2. de Groot *et al. J Virol* 2013;87:7790-7792.

Image: MERS-CoV (NIAID)

MERS-CoV: clinical

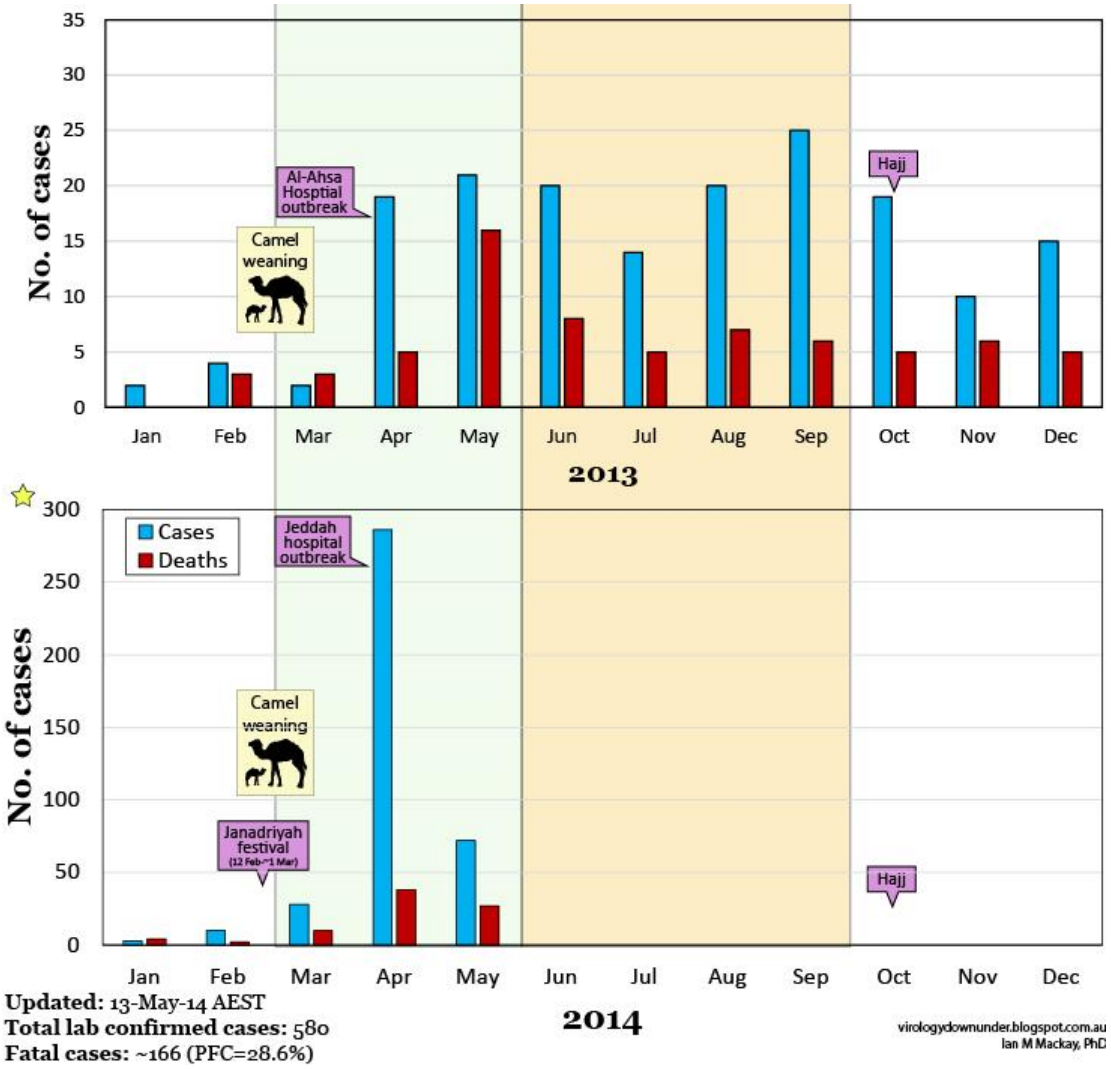


- Characterised by fever progressing to pneumonia.
- Asymptomatic infection can occur.
- Gastointestinal symptoms common.
- Mortality rate high (30%).

Potential for airborne dissemination, gastrointestinal shedding and asymptomaic carriage present infection prevention and control challenges

Hui *et al. Curr Opin Pulm Med* 2014;20:233-41.
http://haicontroversies.blogspot.co.uk/2014/05/mers-primer.html

MERS-CoV: prevalence

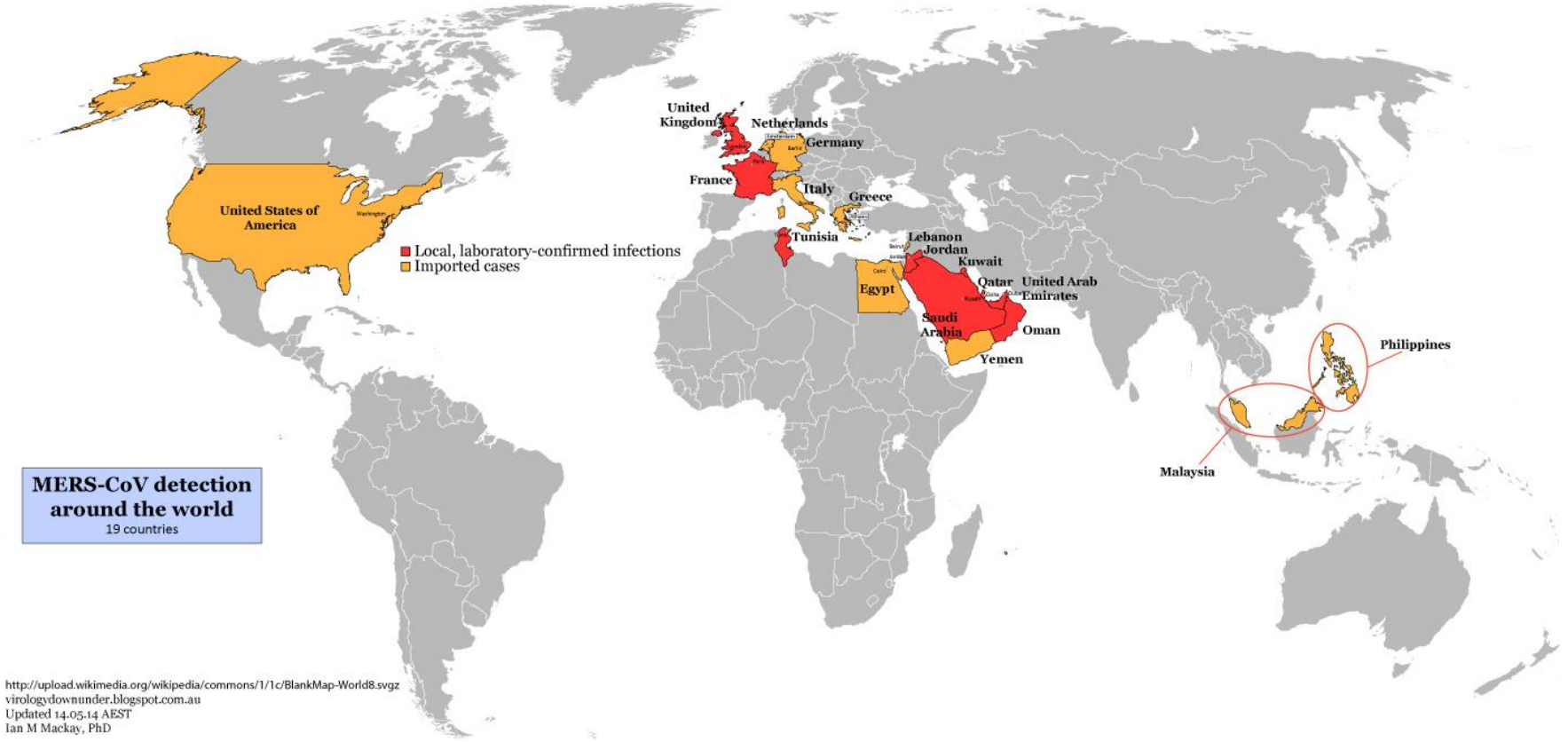


http://virologydownunder.blogspot.co.uk/

MERS-CoV: what's going on?

1. Reporting spike?
2. Localized outbreak in Saudi Arabia?
3. Bottom of a global epi curve?

MERS-CoV: global spread



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MERS-CoV: winging around the world

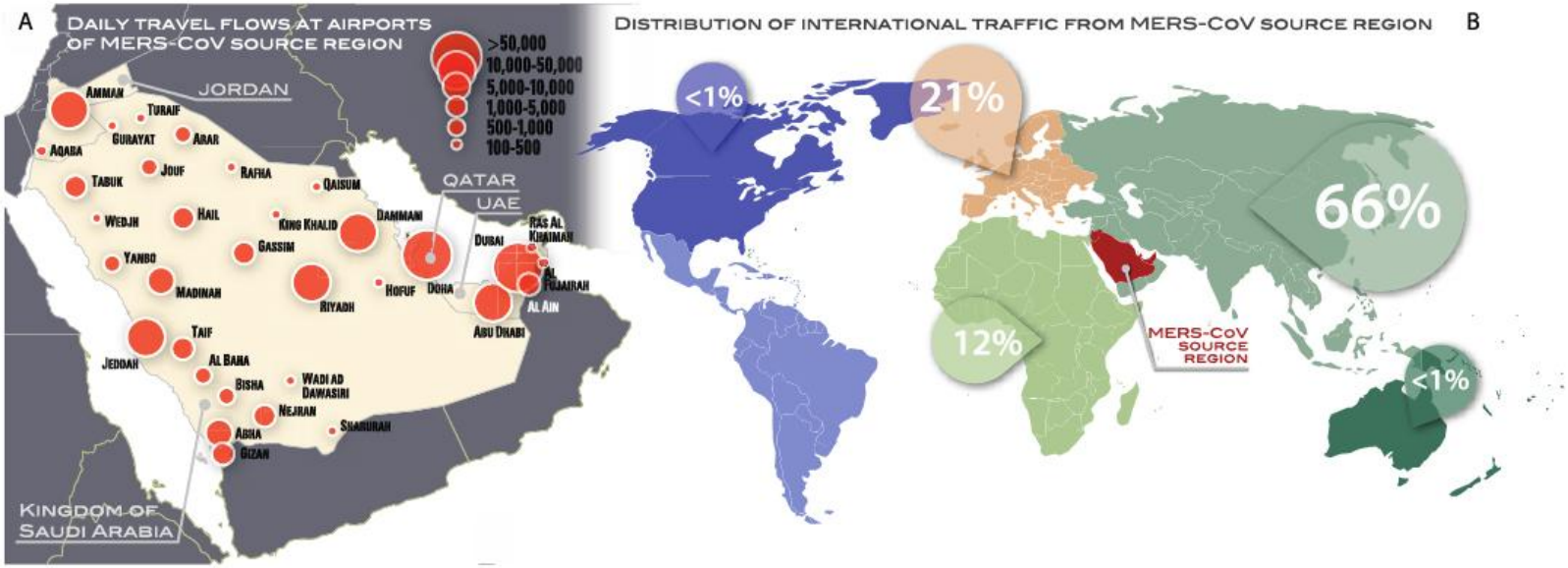
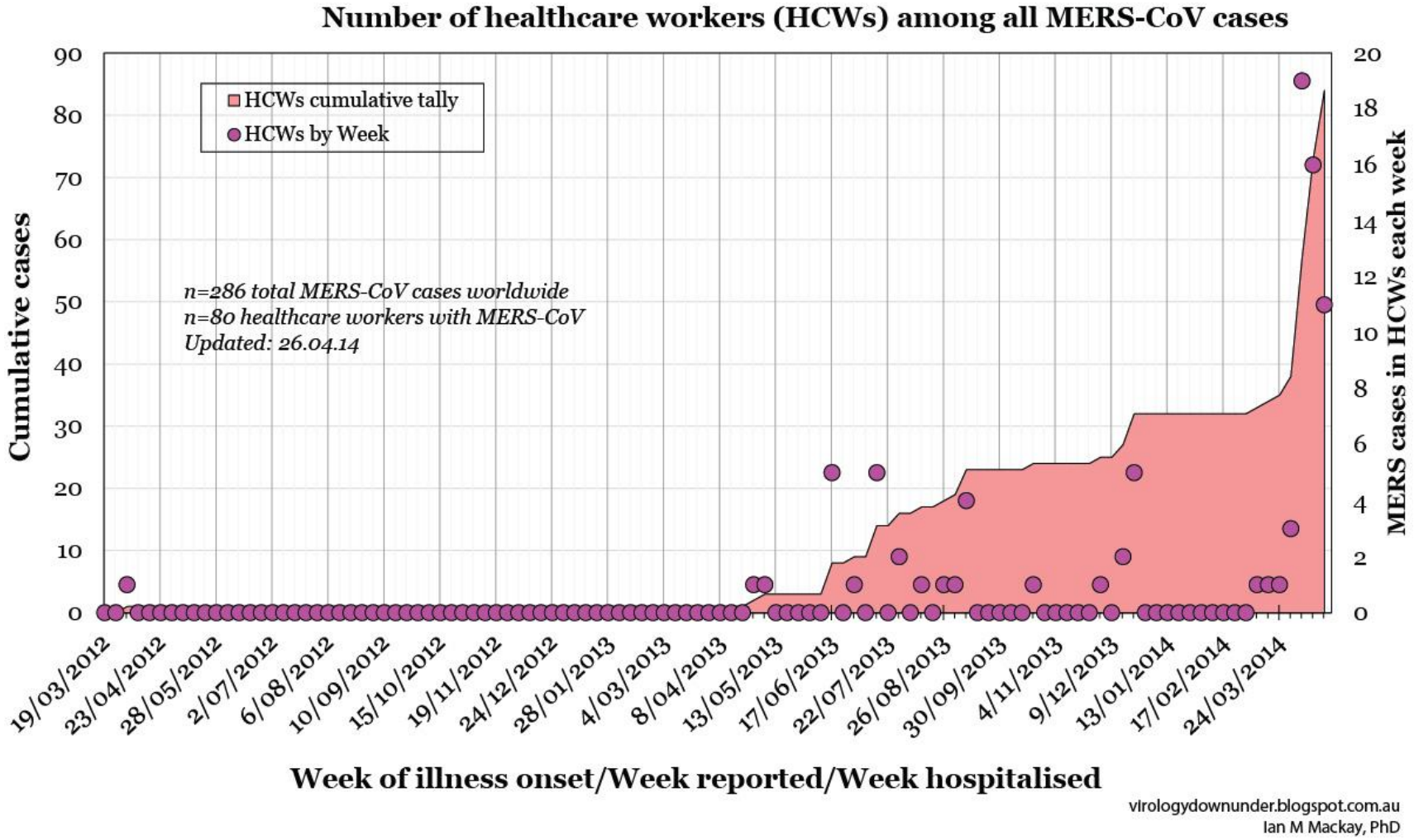


Figure 3. Air traffic capacity of the MERS-CoV source region and its international destinations.

http://virologydownunder.blogspot.co.uk/

Chiara Poletto, Camille Pelat, Daniel Levy-Bruhl, Yazdan Yazdanpanah, Pierre-Yves Boelle, Vittoria Colizza, Assessment of the MERS-CoV epidemic situation in the Middle East region. arXiv:1311.1481 [q-bio.PE]0

MERS-CoV: healthcare worker risk



http://virologydownunder.blogspot.co.uk/

MERS-CoV: is anywhere safe?

- May 2 2014: first reported US case
  - Munster, Indiana
  - Riyadh (Saudi Arabia) -> London -> Chicago -> Indiana
- May 11 2014: second reported US case
  - Orlando, Florida
  - Jeddah (Saudi Arabia) -> London -> Boston -> Atlanta -> Orlando
- Both were healthcare providers who had been working in Saudi Arabia.

Prevention and control: CDC guidelines

Airborne & contact precautions

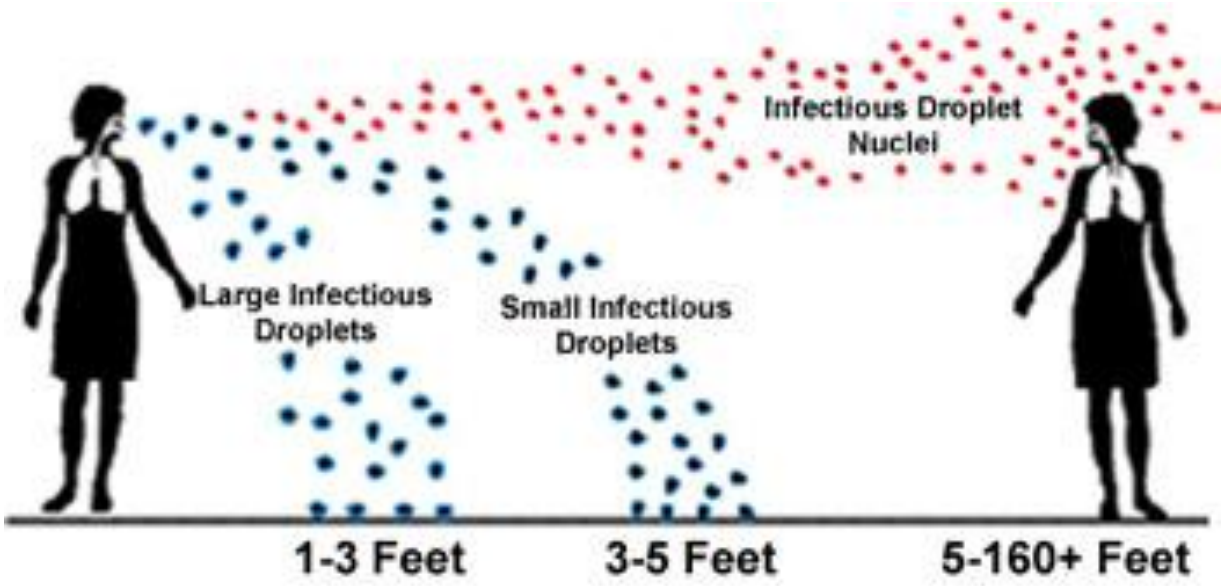
Airborne infection isolation room (AIIR) where possible

Gloves, gowns, eye protection, N95 mask + hand hygiene

Standard environmental disinfection

http://www.cdc.gov/coronavirus/mers/infection-prevention-control.html

Prevention and control: droplet or airborne?



- MERS-CoV is a respiratory viruses, so the most important route of transmission is likely to be droplet spread through close contact with infected individuals.
- However, airborne transmission cannot be ruled out (hence the CDC recommendation for airborne precautions).
- Recent data indicate that small droplet nuclei may be emitted most of the time by influenza infected patients, which justifies airborne precautions.[1]

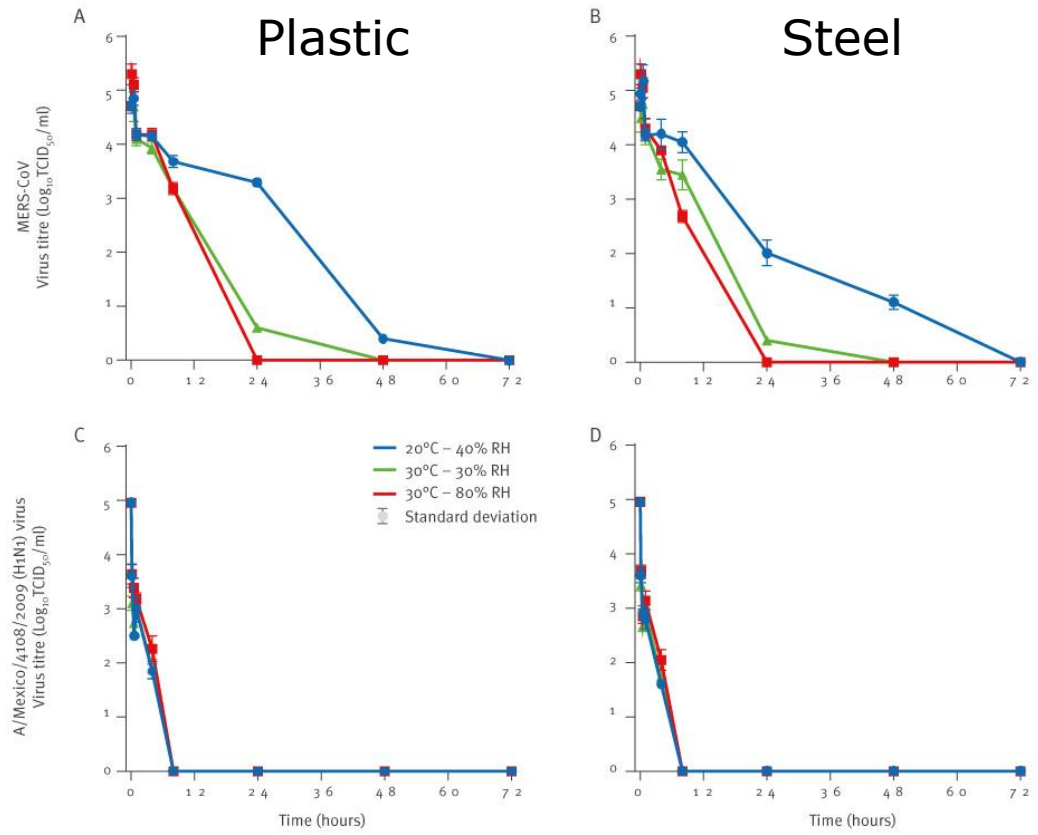
Bischoff *et al. J Infect Dis* 2013;207:1037-46.

Prevention and control: fomite transmission?

- Contact transmission, including direct or indirect contact with contaminated surfaces does occur in some cases based on findings from other influenza and coronaviruses (such as SARS-CoV).[1,2]
- SARS-CoV and surrogates can survive on dry surfaces for weeks, and is better able to do so than related human coronaviruses.[1,3]
- MERS-CoV has been shown to survive on dry surfaces for hours; studies evaluating extended survival times / conditions currently lacking.[5]
- In addition to survival on dry hospital surfaces, aerosols of human coronaviruses and influenza viruses can survive in the air for long periods of time. For example, a human coronavirus aerosol was able to survive for 6 days in one study.[6]

1. Geller *et al. Viruses* 2012;4:3044-3068.
2. Hota. *Clin Infect Dis* 2004;39:1182-1189.
3. Casanova *et al. Appl Environ Microbiol* 2010;76:2712-2717.
4. Kramer *et al. BMC Infect Dis* 2006;6:130.
5. van Doremalen *et al. Eurosurveillance* 2013;18.
6. Ijaz *et al. J Gen Virol* 1985;66:2743-2748.

Prevention and control: MERS-CoV survival



MERS-CoV

Influenza A

van Doremalen *et al. Eurosurveillance* 2013;18.

A role for automated room disinfection?

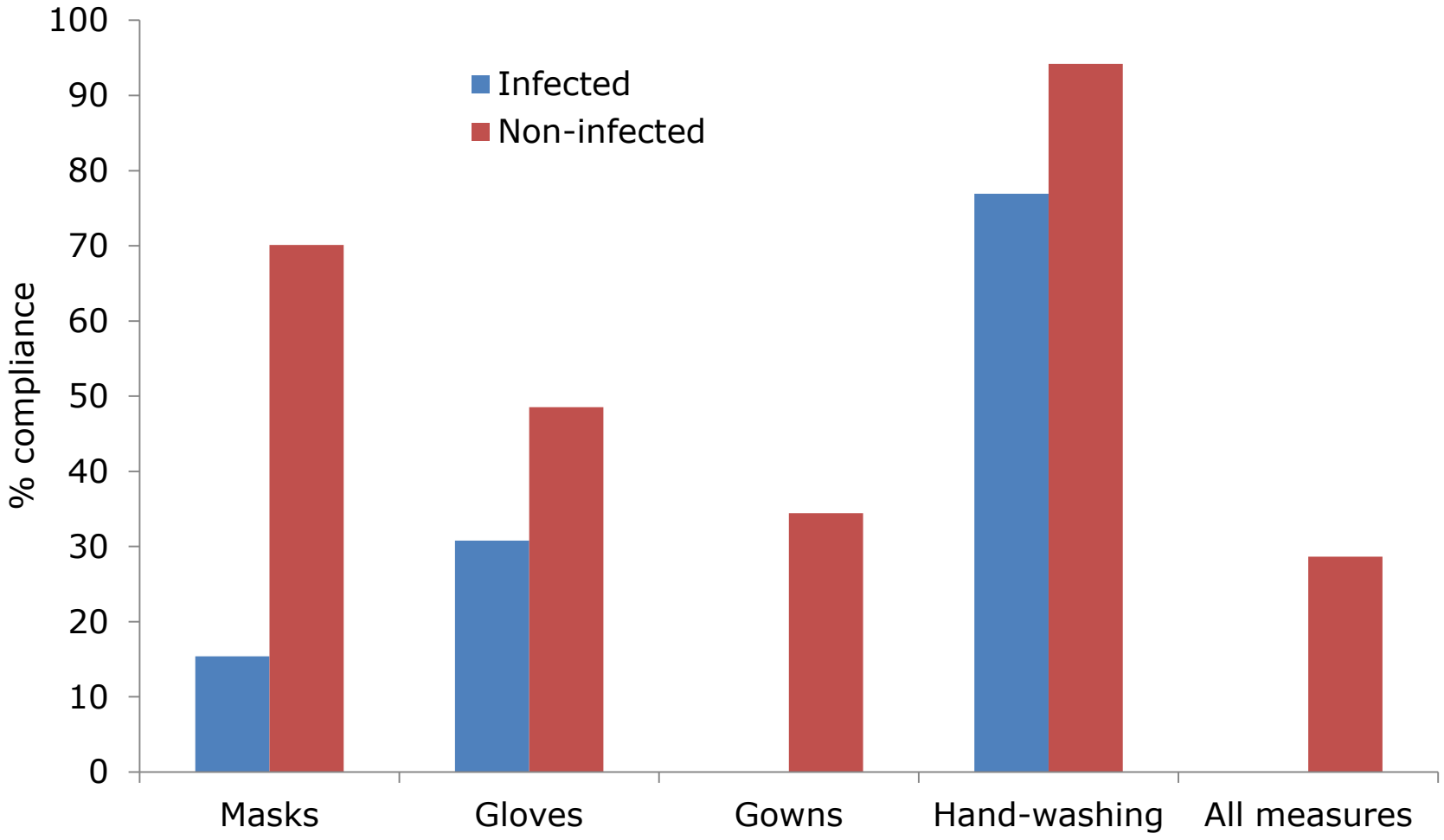
- A range of disinfectants are effective against human coronaviruses, including alcohol, quaternary ammonium compounds, bleach and other disinfectants.[2]
- However, studies with other organisms have demonstrated that conventional methods consistently fail to eliminate contamination with pathogens that can survive on surfaces such as *C. difficile*, MRSA and norovirus.[2]
- Hydrogen peroxide vapor (HPV) is effective *in vitro* for the inactivation of influenza and coronaviruses (see table below) and eliminates pathogens from hospital surfaces.[3,4]
- HPV also inactivates pathogens from the air, so would be effective for eliminating persistent MERS-CoV aerosols.

Virus (strain)	**Log_{10} reduction in virus titer ($TCID_{50}$) ± (SD) after HPV Exposure**		
	25 mL*	**27 mL***	**33 mL***
TGEV (SARS-CoV surrogate)	>5.05 (0.19)	>4.94 (0.19)	>5.28 (0.69)
Avian influenza virus (H9N9)	>4.08 (0.58)	>4.50 (0.25)	>4.83 (0.29)
Swine influenza virus (H3N2)	>3.83 (0.14)	>4.92 (0.63)	>4.75 (0.50)

Data from Goyal et al.[4]

1. Hulkower *et al. Am J Infect Control* 2011;39:401-407.
2. Otter *et al. Infect Control Hosp Epidemiol* 2011;32:687-699.
3. Otter *et al. J Hosp Infect* 2013;83:1-13.
4. Goyal *et al. J Hosp Infect* 2014;86:255-9.

Prevention and control: theory and practise



Seto *et al. Lancet* 2003;361:1519-20.

MERS-CoV: summary

1. MERS-CoV is a respiratory virus with a high mortality rate.

2. Human-to-human transmission seems to be uncommon currently.

3. However, global prevalence is increasing.

4. The best way to protect you and your patients is to comply with CDC guidelines: apply strict airborne and contact precautions.

Other sources for information

- CDC MERS pages
- WHO MERS pages
- Virology Down Under blog (images used with permission of Dr Ian MacKay)
- Controversies in HAI blog