



Even more on SARS-CoV-2 transmission

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Game plan

- ▶ Consider an older article on transmission in households, as a reminder of material we have covered before
- ▶ Examine a new article on transmission modelling and HEPA filters
- ▶ Consider some related articles/lay reports on transmission of SARS-CoV-2 among gymnasts, among people attending a small social gathering in Sydney, and among those attending a very large gathering in Liverpool (a quasi-experiment) with follow-up testing and careful community monitoring

Objectives

- ▶ Cite evidence related to household transmission risk (Infectivity) and the high risk groups (susceptibility) from retrospective studies (an objective from an earlier talk)
- ▶ Summarize key findings on transmission modeling study with HEPA filters in a simulated conference room setting
- ▶ Write down key findings from the gymnastics team outbreak and from the social gatherings in Sydney, Australia, and Liverpool, UK, and the aftermath

Take home messages for today

- ▶ Transmission risks and Covid-19 outcomes from real-world events (like large gatherings and small), are not consistently aligned
- ▶ Delta variant appears to be more infectious than other lineages, based on different types of data, although this is hard to measure definitively
- ▶ Indoor sporting events provide easy avenues for viral transmission as demonstrated by the OK gymnastics team/s
- ▶ Encouraging vaccine uptake is a priority task now
- ▶ HEPA filters add an extra level of protection in enclosed settings like conference rooms, based on laboratory-type experiments with aerosols

Take home messages from an earlier talk on this topic (SQ3R approach)

- ▶ Asymptomatic people with SARS-CoV-2 infection account for slightly over half of all transmission
- ▶ Effective control of infection spread will require reducing risk of transmission from asymptomatic, as well as symptomatic, Covid-19 patients

Under most reasonable set of assumptions,
based on meta-analysis (from earlier talk):

- ▶ 59% of all transmission is from asymptomatic persons, both categories of asymptomatic combined
- ▶ From patients who never develop symptoms: account for 24%
- ▶ From patients who eventually develop symptoms: account for 35%

Take home messages from Nov 2020 on household transmission

- ▶ Several well-investigated case-clusters of household transmission from multiple settings now reported with widely disparate findings
- ▶ Behavioral/environmental factors most strongly associated with household transmission in Singapore were sharing a bedroom, engaging >30 minutes of conversation with index case/s
- ▶ Overall attack proportion was low (6%) among household contacts monitored very closely, possibly related to quick removal of index case from home environment to a Singapore hospital
- ▶ In Wuhan household transmission study, attack proportion was higher at 15% of household members who were exposed to a case



Delta variant associated with a gymnastics facility, Apr-May, 2021

- ▶ Delta variant emerged in India and is currently widespread, and possibly, more transmissible than other variants
- ▶ 47 Covid-19 cases linked to a gymnastics facility in OK, all available lab specimens were Delta variant
- ▶ Facility and household attack proportions were 20%, and 53%
- ▶ 85% of cases were unvaccinated (not all gymnasts were eligible)
- ▶ 4 fully vaccinated persons (9%) had Covid-19 in this series of cases

- ▶ (MMWR, 2021)

Gymnastics, cntd

- ▶ Attack proportions among teams/cohorts varied from 8% to 60%
- ▶ Among 7 households with known secondary transmission, attack proportions varied from 80 to 100% (compared to other SARS lineages of 17%)
- ▶ Overall facility-associated attack proportion: 24%

Risk factors for transmission, Gymnast report, MMWR

- ▶ Non-adherence to quarantine and testing guidance
- ▶ Delayed recognition of infection symptoms/signs
- ▶ Non-mask wearing among participants
- ▶ Heavy respiration during competition
- ▶ Non-participants' failure to wear masks when just observing
- ▶ Poor ventilation of facility
- ▶ Staff members training multiple teams/cohorts
- ▶ Low vaccine coverage
- ▶ Inadequate cleaning of surfaces

Take away messages from this study

- ▶ All infected had delta variant
- ▶ Primary case likely occurred in one or more staff or gymnasts with undetected infection in early April
- ▶ More evidence that delta is highly infectious...but definitive studies on that are absent
- ▶ Highly transmissible in indoor sports settings and households
- ▶ Vaccine and other mitigation strategies are important to reduce risk in indoor sports



Ticket-holders who attended the trials did not need to socially distance or wear face coverings

Trial events held in Liverpool to test Covid-19 transmission did not cause any detectable spread of the virus, the city's health chief has said.

Social 'experiment' in Liverpool

- ▶ 13,000 people attended two nightclubs, a business meeting, and/or a music festival as a 'quasi experiment'
- ▶ Attendees had to show negative Covid test to enter
- ▶ Attendees asked to return PCR test results afterwards (modest compliance with that request)
- ▶ Only 11 had positive test results after the social events, despite no masks, no social distancing, singing, and other forms of 'bad behavior'
- ▶ Investigators raised the possibility that those positives may have acquired infection after the events
- ▶ Community rates did not go up post events (reported by BBC)



Sydney outbreak June 19, 2021

- ▶ 30 people attended a birthday party, 6 vaccinated, 24 unvaccinated people
- ▶ One of the party-goers apparently exposed to SARS-CoV-2 that had come into the country via international flight crew (the limo driver who transported that airline crew had a central role in epidemic)
- ▶ All unvaccinated persons got delta variant, none of the vaccinated
- ▶ Household transmission occurred rapidly from the 24 infected persons, with fast transmission into other types of venues
- ▶ Sydney locked down, as well as other provinces and jurisdictions
- ▶ New infections in Melbourne, another major population center, traced via Sydney

July 20, 2021

2:06 AM PDT

Last Updated a day ago

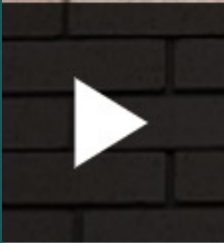
Healthcare & Pharmaceuticals

More than half of Australia's population under COVID-19 lockdowns

4 minute read

Renju Jose, Jonathan Barrett





Sydney extends lockdown to fight Delta outbreak

Take home lessons from Sydney

- ▶ Vaccines work
- ▶ Delta variant may be more infectious than other variants of SARS-CoV-2, but this is very hard to test
- ▶ Australia has not been quick to purchase and administer vaccine...about 9% of country is vaccinated, leaving them at high risk for disaster in absence of severe mitigation strategies
- ▶ In a naïve population, SARS-CoV-2 can move fast...we have seen that before in other countries

(c) Event of exhaling

Infected
person

Exhaled air predominantly with aerosols



Large droplets



HEPA aerosol study design, MMWR

- ▶ Simulated conference room setting with 4 participants: an 'exhaler', speaker/conference leader facing the exhaler, and two meeting attendees sitting next to the exhaler
- ▶ Dummies could be fitted with masks and tested with and without masks
- ▶ Measurements of aerosols done at the area of the mouths of the dummies in the room; measures on the interior side of the mask were possible with these specialized dummies
- ▶ Two HEPA filters placed in different parts of the room, and at different heights above the floor
- ▶ Ventilation system in operation (at standard transfer volumes of air)

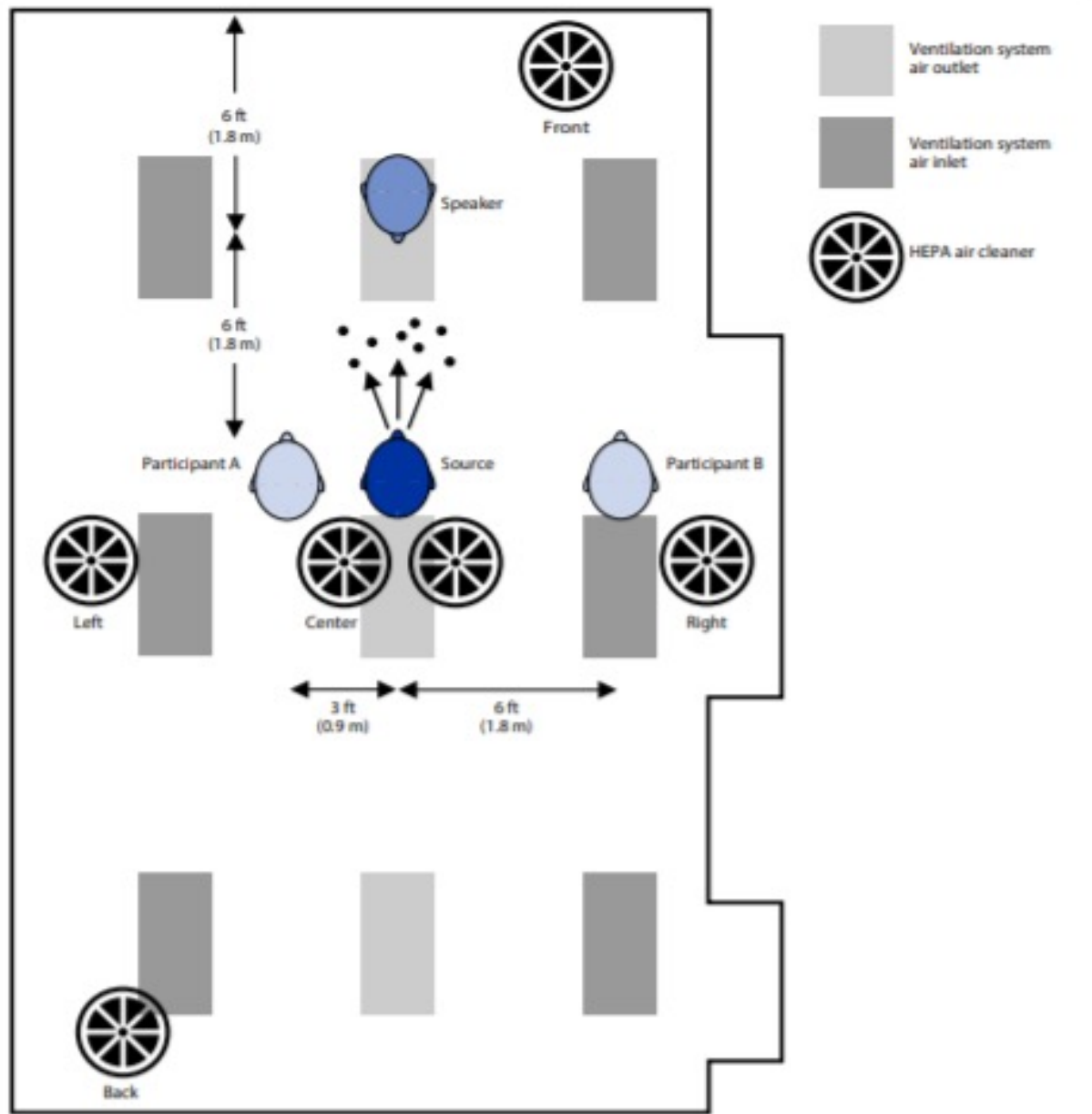
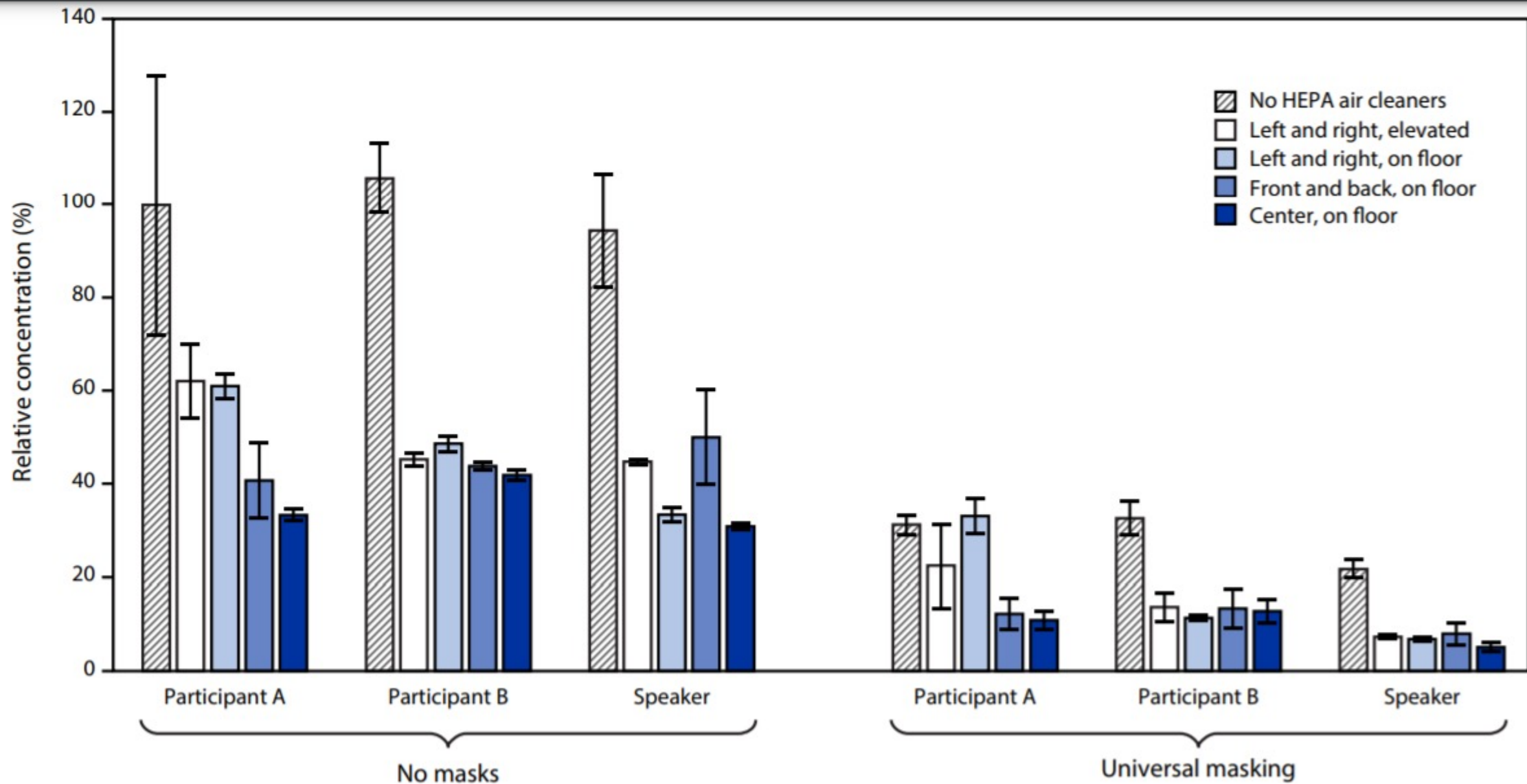


TABLE. Mean aerosol concentrations and standard deviations measured at the mouth of each simulator over 60 minutes at varying HEPA air cleaner locations, by masking status — United States, 2021

Simulator/Masking status	Mean aerosol concentrations at four HEPA air cleaner locations, % (SD)				
	No air cleaner	Left and right (elevated)	Left and right (floor)	Front and back (floor)	Center of room (floor)
No masks					
Participant A	99.8 (28.3)	62.1 (8.2)	61.0 (2.9)	40.7 (8.4)	33.3 (1.5)
Participant B	105.8 (7.7)	45.2 (1.7)	48.6 (1.9)	43.8 (1.2)	41.9 (1.4)
Speaker	94.4 (12.6)	44.7 (0.9)	33.4 (1.8)	50.0 (10.5)	30.8 (1.1)
Participants and speaker combined*	100.0 (12.1)	50.7 (3.3)	47.7 (1.6)	44.8 (5.7)	35.3 (1.3)
Universal masking					
Participant A	31.2 (2.4)	22.5 (9.2)	33.1 (4.0)	12.2 (3.6)	10.9 (2.3)
Participant B	32.7 (3.9)	13.7 (3.5)	11.4 (0.9)	13.4 (4.5)	12.8 (2.7)
Speaker	21.7 (2.2)	7.3 (0.7)	6.8 (0.7)	8.1 (2.7)	5.1 (1.2)
Participants and speaker combined*	28.5 (2.8)	14.5 (4.3)	17.1 (1.7)	11.2 (3.6)	9.6 (2.1)

Abbreviations: HEPA = high efficiency particulate air; SD = standard deviation



Abbreviation: HEPA = high efficiency particulate air.

* The aerosol concentrations were measured at the mouths of two simulated participant receivers and simulated speaker receiver for 60 minutes while the simulated infected participant source exhaled aerosols into the room.

† The legend indicates the locations of the HEPA air cleaners in the room. Each bar is the mean of four experiments. Error bars show the standard deviations.

Take home messages from HEPA study

- ▶ HEPA filters add (at least potentially) another layer of protection from inhaling aerosols (that have SARS-CoV-2 attached, by way of extension of our thinking)
- ▶ HEPA filters with masking of individuals indoors do even more to reduce inhalation of aerosols in this setting
- ▶ Even controlled laboratory experiments such as this one, do not take into account different mask materials, air current patterns in the room, mixing of air, particle size, movement in the room, vaccination status of the dummies, etc....so limitations are still apparent
- ▶ The investigators did not use SARS-CoV-2 laden particles of different sizes, and they may behave differently

Quiz

- ▶ Should school systems require HEPA filters be added to the classroom setting/s? What additional information would help you decide whether to allocate scarce resources to that end?
- ▶ What kind of study would you design to demonstrate that Delta, or any other variant, is more efficiently transmitted than the original lineage of coronaviruses in this pandemic?
- ▶ If forced to attend a party in an international venue, given just two choices, would you pick Liverpool or Sydney as the host venue?

References

- ▶ Fang Li et al. Household transmission of SARS-CoV-2 and risk factors. Lancet, Jan 18, 2021 www.thelancet.com/infection
- ▶ Dougherty K, Mannell M, Naqvi O, Matson D, Stone J. SARS-CoV-2 B.1.617.2 (Delta) Variant COVID-19 Outbreak Associated with a Gymnastics Facility — Oklahoma, April–May 2021. MMWR Morb Mortal Wkly Rep 2021;70:1004–1007.
DOI: [http://dx.doi.org/10.15585/mmwr.mm7028e2external icon](http://dx.doi.org/10.15585/mmwr.mm7028e2external%20icon).
- ▶ Forbes magazine on Sydney outbreak (on line)
- ▶ Lindsley WG, Derk RC, Coyle JP, et al. Efficacy of Portable Air Cleaners and Masking for Reducing Indoor Exposure to Simulated Exhaled SARS-CoV-2 Aerosols — United States, 2021. MMWR Morb Mortal Wkly Rep 2021;70:972–976.
DOI: <http://dx.doi.org/10.15585/mmwr.mm7027e1>
- ▶ (thanks to Grazia)