

SARS-CoV-2 transmission updates

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Game plan

- ▶ Consider several new articles on transmission in households related to variant type, to age groups of susceptibles, and risk of infection that was related to school mask mandates in one state
- ▶ Finish discussion of plague from last session, and similarities and differences between earlier plague pandemics and Covid-19 pandemic

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Objectives

- ▶ Cite evidence related to household transmission risk (infectivity) by SARS variant
- ▶ Summarize evidence on transmission risk within age groups (including young children to older adults), for non-vaccinated persons in two states
- ▶ Summarize key findings on transmission risk in population-based study in Norway
- ▶ Describe main infection-related outcomes of the observational study on mask wearing in schools

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Why this topic again now?

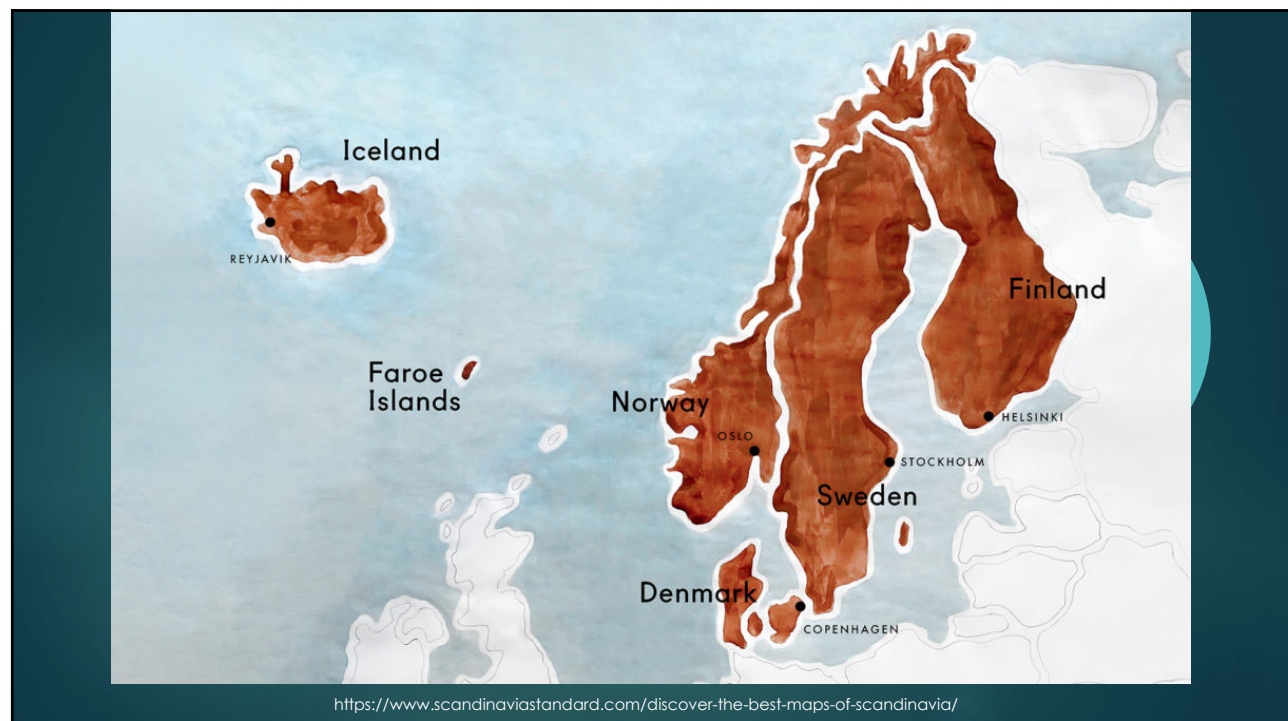
- ▶ Mask mandates are shifting rapidly and our risk levels and Covid-19 rates may move in the wrong direction
- ▶ New data are worth considering re: infection risk, even with few published data on Omicron variant (so far)

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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

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Secondary attack % for Omicron and Delta variants in Norwegian households (Jorgensen et al)

- ▶ Although Norway has very high vaccination coverage and booster coverage, Omicron still spread rapidly there during late 2021 and early 2022
- ▶ Investigators took advantage of Norwegian surveillance system, tracking all residents of Norway from Dec 1, 2021 to Jan 8, 2022 using all PCR test results
- ▶ Excluded single person households and households that had more than one case
- ▶ Secondary cases were identified with a positive PCR test in the same household as an index case

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Norwegian study, cntd

- ▶ Secondary transmission defined as occurring within 7 days of the index case in that household
- ▶ Logistic regression modelling used with adjustment for some key confounders
- ▶ Variant analyses conducted for most isolates of the index cases...primary interest was in Omicron vs. Delta vs. non-classified variants

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Results, Norway study

- ▶ 31,220 households with one index case
- ▶ 81,000 non-index household members potentially exposed
- ▶ Mean ages of non-index members comparable between variant categories, as was sex distribution
- ▶ Secondary attack proportion within household members was 25% for Omicron, 19% for Delta, and 18% for non-classified
- ▶ Omicron-related OR for secondary infection 1.5 compared to Delta variant
- ▶ OR for non-classified compared to Delta was .93
- ▶ ORs higher for men, unvaccinated, and those older than 30 years

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Remember your epi terms when looking at the next table...

- ▶ A rate has person-time in the denominator, and gives us a sense of the 'force' of a disease in a population.
- ▶ Example: the rate for infection A was 100 per 100,000 person-years
- ▶ A proportion is a proportion and does not have time in the denominator
- ▶ A % is a percent and does not have time in the denominator
- ▶ I do not know why the authors or journal editors allow this to go on, sorry about that

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Table. Polymerase Chain Reaction–Confirmed Secondary COVID-19 Cases in Nonindex Household Members Within 7 Days After Index Case Patient Sampling Date^a

Index case characteristics	No./total	SAR, % (95% CI) ^b	Logistic regression, OR (95% CI) ^c	
			Unadjusted	Adjusted
Overall	15 961/80 957 ^d	19.7 (19.4-20.0)		
Variant				
Delta	7960/41 015	19.4 (19.0-19.8)	1 [Reference]	1 [Reference]
Omicron	2926/11 643	25.1 (24.4-25.9)	1.39 (1.31-1.49)	1.52 (1.41-1.64)
Not classified	5075/28 299	17.9 (17.5-18.4)	0.91 (0.86-0.96)	0.93 (0.88-0.98)
Age group, y				
<18	6730/33 662	20.0 (19.6-20.4)		1 [Reference]
18-30	1838/15 695	11.7 (11.2-12.2)		0.57 (0.52-0.63)
31-40	2718/11 291	24.1 (23.3-24.9)		1.45 (1.32-1.58)
41-50	2448/10 301	23.8 (23.0-24.6)		1.49 (1.35-1.63)
>50	2227/10 008	22.3 (21.4-23.1)		1.39 (1.26-1.52)
Sex				
Female	7311/39 441	18.5 (18.2-18.9)		1 [Reference]
Male	8650/41 516	20.8 (20.4-21.2)		1.14 (1.09-1.20)
Vaccinated				
No	8889/43 503	20.4 (20.1-20.8)		1.39 (1.29-1.50)
Yes	7072/37 454	18.9 (18.5-19.3)		1 [Reference]

Jørgensen, Silje B., et al. "Secondary Attack Rates for Omicron and Delta Variants of SARS-CoV-2 in Norwegian Households." *JAMA*.

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Potential limitations of Norway study

- ▶ Perhaps all who tested positive on home kits did not get PCR test later and would not come into the surveillance system
- ▶ Asymptomatic cases could be missed
- ▶ Sampling for variant analysis was not random

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Mask-required vs. Mask-optional policies, Arkansas, Aug-Oct 2021 (MMWR 2022;71)

- ▶ Impact of policies requiring mask wearing in school settings has not been widely evaluated
- ▶ In fall of 2021, some Arkansas school districts mandated masks in K-12 grades...others had no mask requirements or partial requirements, involving students and staff
- ▶ Community-level Covid incidence (and prevalence) is important to consider in studies such as this one, that has main focus on disease occurrence in schools
- ▶ Adjustment for vaccine coverage also important consideration

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Methods, Arkansas study

- ▶ Categories of full, partial, or no mask mandates in Arkansas public school districts
- ▶ Incidence rate ratios (using new cases per 100,000 person-weeks) were calculated for students K-12 in school districts
- ▶ Comparative interrupted time series model among students and staff members used for 26 districts that began the school year without mask mandates and then shifted over

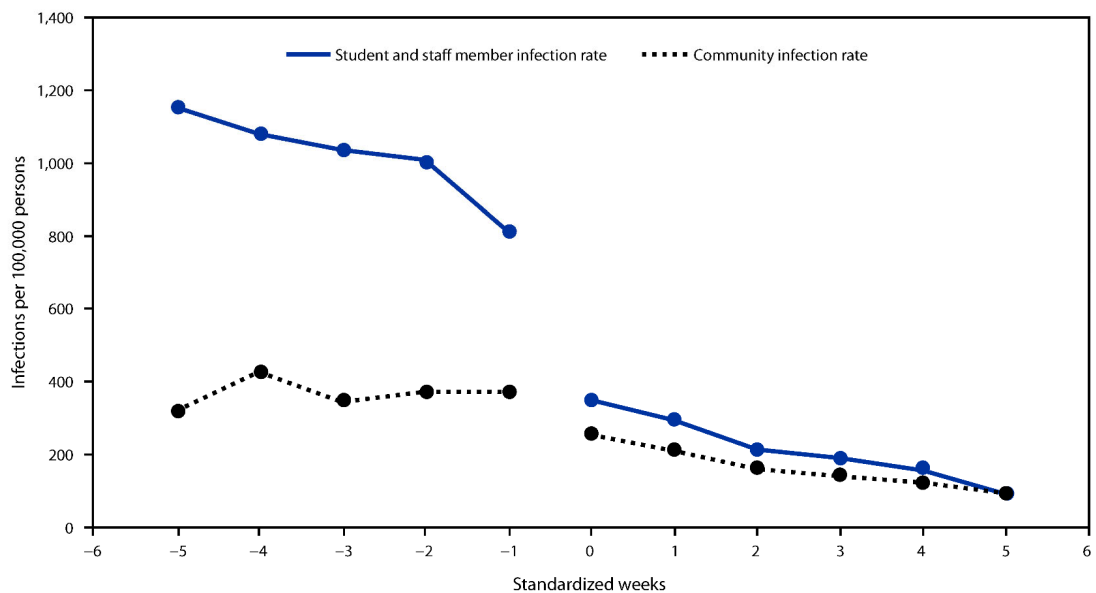
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Results, Arkansas study

- ▶ 233 public school districts, half had no mask policy
- ▶ Incidence in schools exceeded incidence in communities
- ▶ School incidence dropped as community incidence declined, no matter what the policy
- ▶ Covid incidence was 23% lower in districts with full mask policies compared to no mask policy
- ▶ When districts moved from no-mask to making policy, incidence rates in schools dropped within a week (even tho community rates may have decreased at same time, the drop in school rates outpaced the drop in community rates)
- ▶ Protective effect of mask wearing was consistent across all analyses

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FIGURE 2. Student and staff member and community SARS-CoV-2 infection rates before and after* implementation of school mask requirement — 26 school districts, Arkansas, August–October 2021



Donovan, Catherine V. "SARS-CoV-2 Incidence in K–12 School Districts with Mask-Required Versus Mask-Optional Policies—Arkansas, August–October 2021." *MMWR. Morbidity and Mortality Weekly Report* 71 (2022).

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Potential limitations, Arkansas study

- ▶ No information on other prevention strategies in the schools, like ventilation system presence and/or efficiency
- ▶ No information on other school-based prevention programs
- ▶ Compliance with masking not observed
- ▶ Pre- and post- mask implementation analysis based on a small sample of districts (26)
- ▶ Data were obtained during time of Delta variant predominance
- ▶ No school-based testing programs during the time of this report

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Household transmission and clinical features of SARS-CoV-2 infections (McLean, Feb 2022)

- ▶ Case series with closed cohort perspectives on new infections in household members of index cases
- ▶ Examine age differences in transmission risk from primary cases and household contacts
- ▶ Participants in Nashville and western Wisconsin
- ▶ Index cases were followed 14 days to ascertain symptoms and signs, and secondary transmission to family/household contact, with frequent testing of contacts
- ▶ Secondary infection risks by age of index case and contact estimated using GEE techniques
- ▶ Caveat: this study is full of 'old news', as it predates Delta variant and includes all non-vaccinated participants

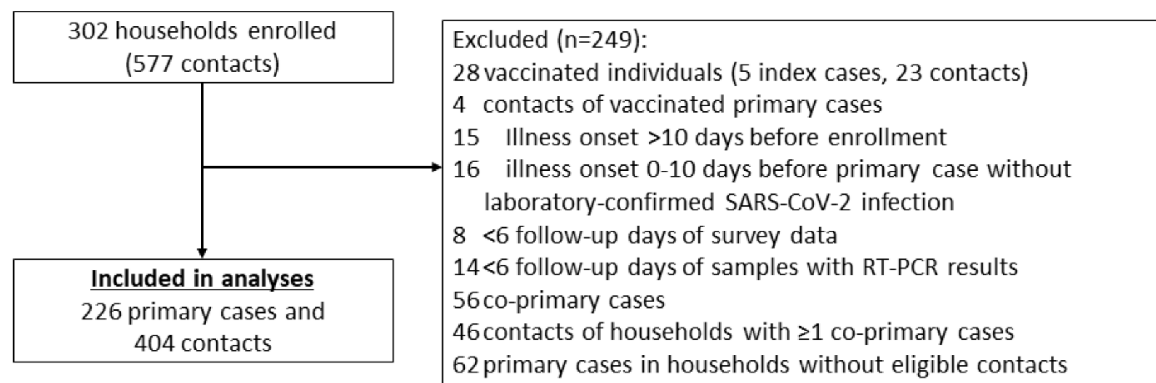
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Results, household transmission

- ▶ 226 index cases, 400 household contacts
- ▶ 198 secondary cases in household members (49%)
- ▶ At least one household contact was infected in 58% of households
- ▶ Age group-specific infections of household members ranged from 36% to 53%
- ▶ Secondary transmission was highest among index-contact pairs aged 65 and above (76%) and children 5 to 11 (69%)
- ▶ 19% of secondary infections in household members were asymptomatic

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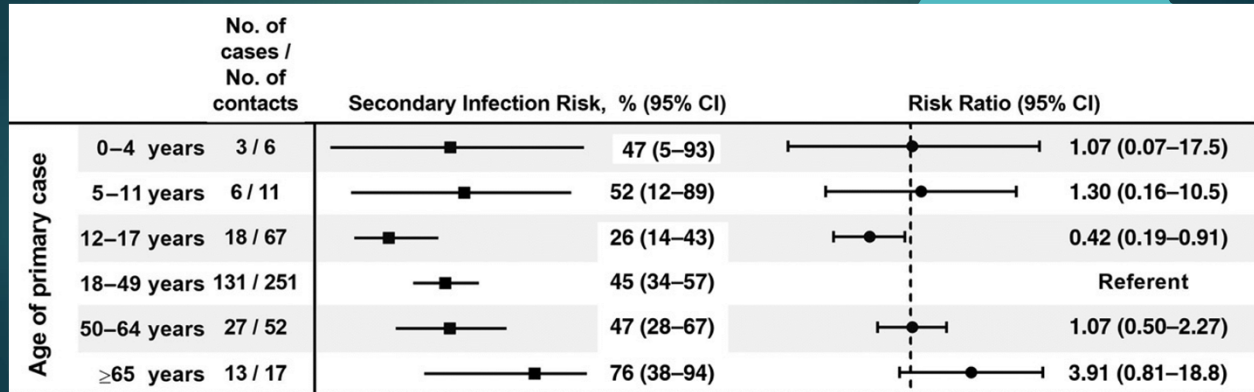
Figure 1. Households and individuals enrolled in a prospective study of SARS-CoV-2 household transmission — Tennessee and Wisconsin, April 2020–April 2021.



McLean, Huong Q., et al. "Household Transmission and Clinical Features of SARS-CoV-2 Infections." *Pediatrics* 149.3 (2022).

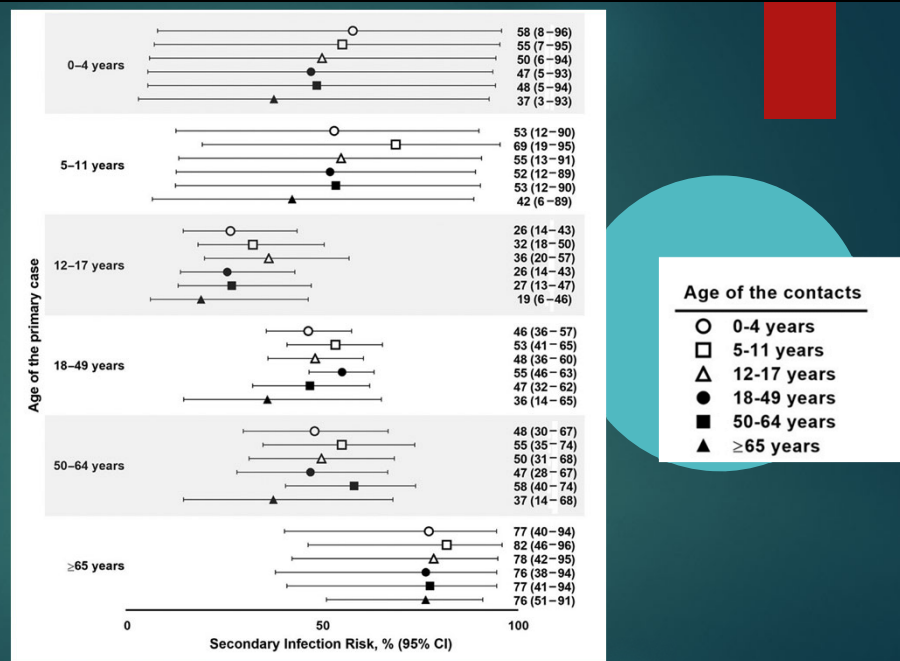
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Age of primary case was an important factor in transmission to other household members (note small group sizes by age group)



McLean, Huang Q., et al. "Household Transmission and Clinical Features of SARS-CoV-2 Infections." *Pediatrics* 149.3 (2022).

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McLean, Huang Q., et al. "Household Transmission and Clinical Features of SARS-CoV-2 Infections." *Pediatrics* 149.3 (2022).

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A few take away messages from the TN and WI study

- ▶ Children and adults of all ages can transmit SARS-CoV-2
- ▶ Children and adults of all ages can get SARS-CoV-2
- ▶ No statistically significant differences in susceptibility by age group, from pre-school to older adults
- ▶ Compared to most other published studies, household transmission was very high (particularly compared to the studies from Asia)
- ▶ Data likely to be different for different variants
- ▶ Data likely to be radically different among vaccinated
- ▶ No unusual findings were reported re: symptoms and signs by age group compared to earlier studies

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Potential limitations related to TN and WI study

- ▶ Perhaps infections did not all come from index case in a household, but from community spread
- ▶ Delayed identification of index cases might have resulted in incomplete capture of transmission events
- ▶ Substantial variability of masking in various households
- ▶ Racial homogeneity of participants limits generalizability
- ▶ Intensity of exposures within the home was not standardized or even measured
- ▶ Small sample sizes

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Take home messages for today

- ▶ Household transmission in Norway study was higher than typically reported from other countries, with more risk associated with Omicron variant
- ▶ Household transmission in TN and WI was very high compared to most other studies, potentially related to frequent testing of household contacts
- ▶ Covid incidence was lower in school districts with mask mandates, and rates in schools dropped when school districts moved from no mandate to full mask wearing mandate
- ▶ From the two state study, all age groups are susceptible to Covid, and are at risk to pass it on to household members (in the pre-Delta and Omicron era)

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Quiz

- ▶ What kind of study would you design to demonstrate that Delta, Omicron, or any other variant, is more efficiently transmitted than the original lineage of coronaviruses in this pandemic?
- ▶ What is the advantage of a population-based approach to epidemiologic investigations, compared to a clinic-based or other frame of reference?
- ▶ What do you consider to be the most important question/s about SARS-Cov-2 transmission...that currently lack clarity?

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references

- ▶ Jørgensen, Silje B., et al. "Secondary Attack Rates for Omicron and Delta Variants of SARS-CoV-2 in Norwegian Households." *JAMA* (2022).
- ▶ Donovan, Catherine V. "SARS-CoV-2 Incidence in K–12 School Districts with Mask-Required Versus Mask-Optional Policies—Arkansas, August–October 2021." *MMWR. Morbidity and Mortality Weekly Report* 71 (2022).
- ▶ McLean, Huong Q., et al. "Household Transmission and Clinical Features of SARS-CoV-2 Infections." *Pediatrics* 149.3 (2022).