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Pediatrics



# Infection Prevention in the COVID era: a Pediatric Perspective

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# Disclosures

- I have no conflicts of interest to disclose

# Learning Objectives

- Compare attitudes and practices during different epidemics
- Describe the current COVID epidemiology
- Discuss the evidence behind current infection prevention practices
- Discuss the importance of infection prevention

# Hindsight is 20/20: the Yellow Fever story

- Mosquito borne flavivirus that causes hepatitis, encephalitis, hemorrhage and often is fatal
  - No available effective antiviral therapy
- We don't usually think about it because it exists mostly in tropical areas of Africa and South America
- Epidemics used to be frequent in North America
  - Could kill 20% of a city's population in a few months

# Yellow Fever Early US

- Late 1800s-1900s waves of epidemics hit the northern ports, then settled in the South
- Epidemiology unknown at that time leading to fear
  - Travel
  - Social distancing
- Blamed immigrants
- Politicians attacked each other
- Fights about quarantine
- Increased racial discrimination
- Controversy over treatment recommendations

# Yellow Fever Story

- People believed miasmas or fomites likely the cause
- Cuba 1880s: Carlos Finlay postulated that mosquitos were the cause
  - Laughed to scorn by the medical community and populace in the US
- US invades Cuba and for every 1 soldier that dies in battle, 13 die from yellow fever

# Yellow Fever Story

- Walter Reed's team in early 1900s proves mosquitos were the vector of the disease
  - Fomite vs mosquito trials
  - Fumigate and remove standing water and Yellow Fever is largely eradicated in the area
- Takes years for this to be accepted in the US, but eventually leads to eradication of the disease in the US
- Now a vaccine is available
- Virus persists in sylvatic cycle with occasional outbreaks in humans

# COVID Pandemic: Remember when

- It's an isolated cluster of animal to human infection
- It doesn't transmit human to human
- It won't leave China
- It left China but it isn't pandemic
- It's not in the US
- It's not contagious before onset of symptoms
- We don't need to test aggressively
- Masks don't help or aren't needed
- Health care workers should always wear an N95
- Children don't get infected
- Children don't infect others
- Children don't get severe infection
- Is it transmitted by droplet, airborne?
- Quarantine? Isolate? How long?
- What do we do in clinic, hospital, home, school, work?



# COVID-19: Unprecedented cooperation and research

- Isolation and sequencing of the virus
- Development of vaccines
- Better understanding of epidemiology
- Antiviral development
- We still have a long way to go

# COVID: What do the numbers tell us?

- 15.6 million children have tested positive
- 18% of all positives are children
  - Children make up 22% of the population
- These numbers underestimate true case numbers since not all children become symptomatic, and not all get tested
  - Seroprevalence study estimates that 96% of children have antibody from either vaccine or prior infection
    - Qualitative so can't determine level of protecting antibody
    - 0-4 year old group: 88%

# COVID and Children

- 2223 pediatric COVID-19 related deaths
- MIS-C
  - 9480 patients
  - 79 deaths
  - Cases are rare now
- Post COVID conditions: 2-66% depending on the definition or study
- Children are 2.5 times more likely to be diagnosed with new onset diabetes 30 days or more after infection with SARS-CoV-2

# What version do we have now?

- Cruising through the alphabet
- Omicron
  - XBB.1.5 is the most common
  - Other Omicron variants
- Most of the antibody based medications for pre/post exposure prophylaxis/treatment aren't active against the current variants

# COVID Transmission

- Can occur in absence of symptoms
- Presymptomatic vs asymptomatic
  - 1-2 days prior to onset of symptoms
    - Similar to influenza
  - Why many still argue for universal mask use
- Viral load decreases rapidly after symptom onset
  - Antigen test positivity may correlate with viable virus

# How long is someone contagious: viable virus?

- Multiple early studies showed no viable virus after 10 days in mild/moderate disease
  - Few later studies have some viable virus for a few days more in some
  - Shorter in vaccinated individuals
  - Ongoing PCR positivity despite no viable virus
- Small percentage of people with severe disease had viable virus for longer period, but not beyond 20 days
- Case reports of viable virus beyond that, usually in immune compromised patients
  - One over 200 days

# More COVID Epi information

- Incubation period
  - Alpha/beta mean 5 days
  - Delta mean 4.3 days
  - Omicron median 3-4 days
- Viability on surfaces
  - Up to 72 hours on plastics and stainless steel
  - No evidence for fomites playing a major role in transmission
- Mostly droplet transmission
  - Some evidence for airborne transmission in certain situations (esp aerosol generating procedures)
    - Not like measles airborne

# COVID vaccine: 7/17/23 update

- CDC recommends vaccination for everyone  $\geq 6$  months of age unless contraindicated
- Pfizer
  - 6m-4y: 3 dose series, at least 1 updated vaccine dose
  - $\geq 5$ y: 1 dose updated vaccine
- Moderna
  - 6m-5y: 2 dose series, at least 1 updated dose
  - $\geq 6$ y: 1 dose updated vaccine
- Additional dosing recommendations for immune compromised patients



# COVID vaccine

- Percent who got 1<sup>st</sup>, 2<sup>nd</sup>, and booster doses
  - <2 years: 8.9%, 4.7%, 0.6%
  - 2-4y: 10.9%, 6.1%, 0.6%
  - 5-11y: 40%, 32.9%, 4.8%
  - 12-17y: 72.2%, 61.8%, 7.8%
- AZ<20 y/o 1 or more doses: 38.7%

<https://www.azdhs.gov/covid19/data/index.php#vaccination-coverage-byage>

<https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends>

# How well do the vaccines work?

- Moving target
  - Effectiveness tends to wane over time and with newer variants
    - Still a high degree of protection
- Omicron and children
  - Preventing infection: 17-71% depending on age and time from last dose
  - ED/Urgent Care visits: 38-86%
  - Hospitalization: 38-68%
  - Critical illness: 79%
- MIS-C: 78-90%
- Maternal vaccination decreased rates of infant hospitalization in the 1<sup>st</sup> 6 months of life
  - Also see this with influenza and pertussis vaccination

# How robust is immunity from prior infection?

- Hard to say depending on what was measured
  - Many assessed antibody response
- Multiple studies, most before Omicron
  - Most suggest antibody production that lasts at least months
  - Many suggest decreased response from infection compared to vaccination, but some suggest the opposite
  - One Omicron era study suggested infection alone conferred 38% protection against reinfection
    - Protection waned with time from last infection
- Infection plus vaccination usually was better than infection alone

# When is it safe for HCW to return to work?

- CDC HCW return to work recommendations (latest update Sept 2022): depends on the situation
- Mild to moderate dz, not immune compromised
  - Return after 7 days (and wear a mask)
    - Negative test within 48 hours
    - 24 hours since last fever without antipyretics
    - Symptoms have improved
    - Otherwise return after 10 days
- Different criteria/lengths for severe/critical disease, moderate/severe immune compromise
- Day 0 onset of symptoms or positive test if asymptomatic

# How risky is returning to work: Korea study

- Omicron was circulating and lots of ill HCW
  - 5 HCW out per week per hospital unit in 2700 bed hospital
- Fully vaccinated HCW could return to work at 5d if they wore a tight-fitting mask
  - Similar to CDC recs at the time
- 248 HCW developed infection within 5 days of returned colleague
  - Only 18 had close contact suspicious for transmission at work
    - 9 had other close contact exposure (household, etc)
    - 1 ate meal in same close area with masks off (which was against policy)
      - 3 others developed symptoms very early in the typical incubation period suggesting possible alternative source of infection
- Median time to negative viable culture: 4 days
  - One lasted 7 days

# How well do masks work?

- 2023 Cochrane review: randomized controlled trials
  - Moderate certainty evidence suggests that wearing masks made little to no difference in outcomes
    - Ding dong the mask is dead?
- What about other data?

# 2023 Cochrane review: physical interventions to reduce the spread of respiratory viruses

- Only evaluated randomized controlled trials
  - Most from pre pandemic era looking at influenza and other respiratory viruses
  - Hospital and community based trials
  - Many had moderate to high risk of bias
- Mask vs no mask
- N95 vs surgical/simple mask
- Hand hygiene
- No trials on face shields, gowns and gloves, or screening at entry ports

# Cochrane: med/surg mask vs no mask

- 10 community based trials
  - 2 hospital trials were excluded because of variable mask usage data
  - 2 during the COVID pandemic
- Moderate certainty evidence suggests that wearing masks made little to no difference in outcomes



# Cochrane: N95/P2 Respirator vs med/surg masks

- 5 trials, all prior to the pandemic
  - HCW and community based
- No benefit of N95/P2 over med/surg mask
  - These were not infections typically spread by airborne droplet nuclei
  - Didn't include COVID

# Problems with the data/design

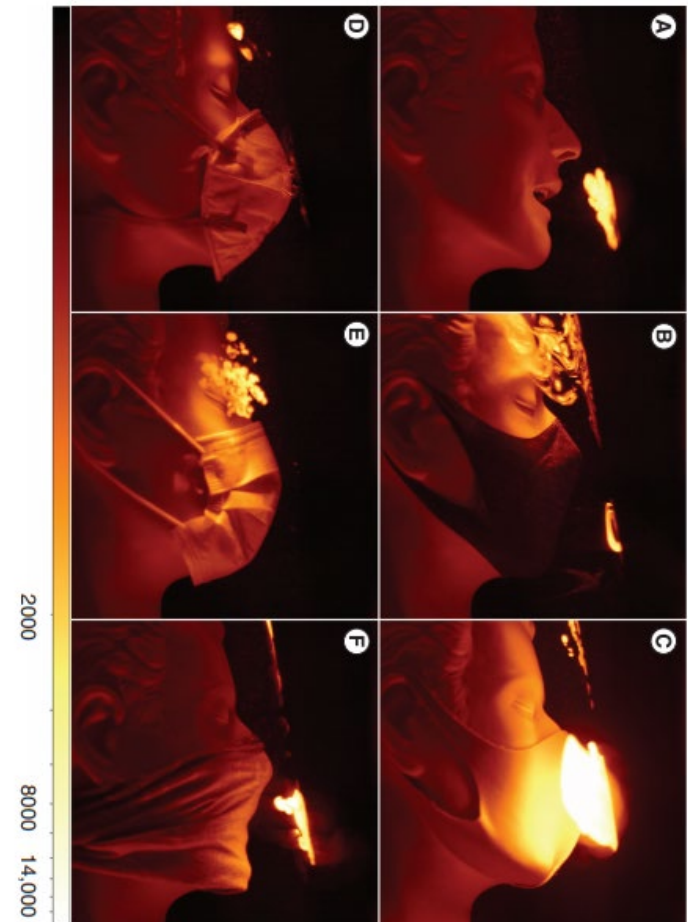
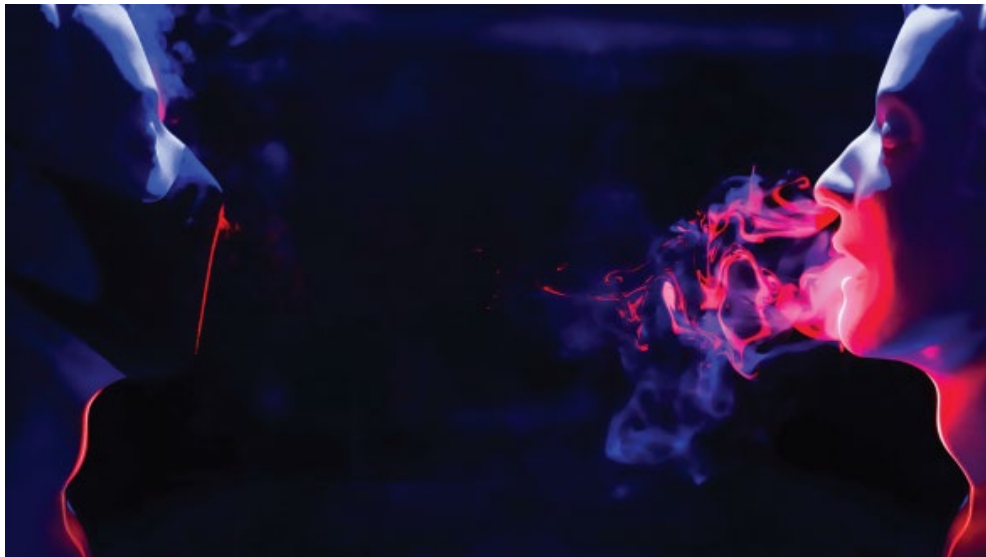
- Some authors of the studies proposed that there was a benefit seen, but high risk of bias and wide confidence intervals made that suspect
- Variable adherence to mask wearing instructions
- Short time of intervention
- Often didn't include younger family members in the intervention
- One college dorm trial included spring break during the intervention

# Looking at masks from a different angle

- Experimental cough model data that show masks decrease flow of potentially infectious material
- Masks can filter small particles the size of viruses
- Data shows decreased respiratory virus detection in aerosols from cough in children wearing mask compared to no mask

# Looking at masks from a different angle

- Depends on the type of material, fit and length of use



# Other Mask Studies Suggest

- Meta analyses and other data suggest benefit
- 2021 MMWR study from Maricopa and Pima Counties that showed decreased outbreaks in schools that required masks
- 2021 MMWR study that showed decreased rate of COVID in masked students during an outbreak at a St. Louis University
- 2021 PLoS one study showed lower COVID rates in communities with higher mask usage

# Cover Your Cough

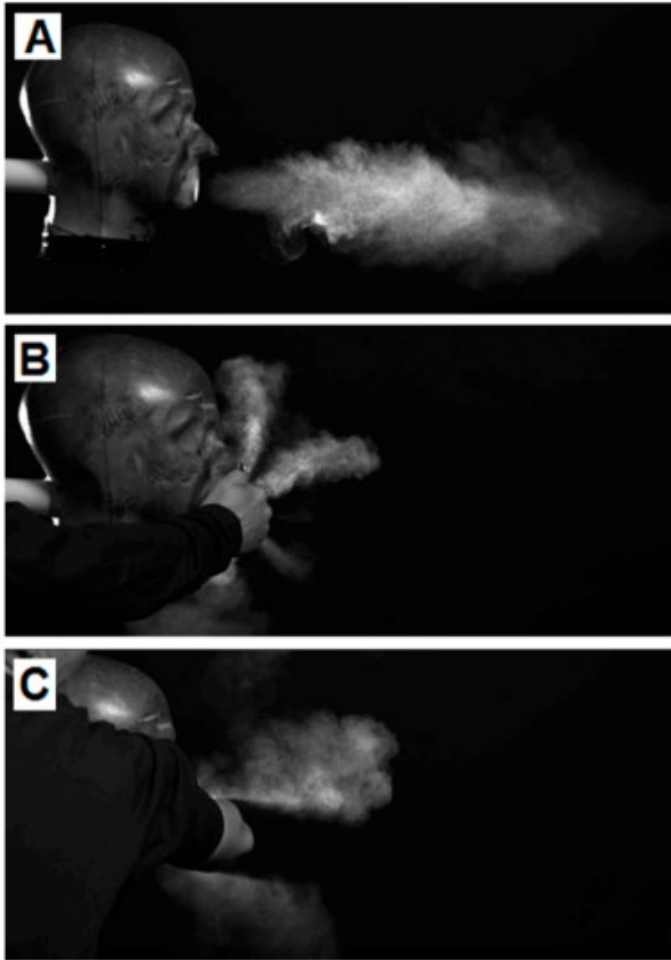


Figure 7. High-speed backlit photographs of test (A) the cough with no intervention, test (B) the cough with the hand over the mouth, test (C) the cough with a bare elbow.

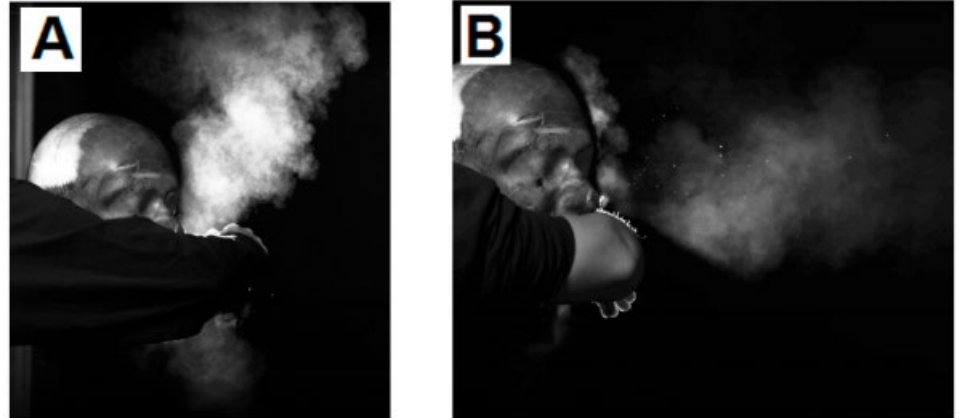


Figure 9. High-speed backlit photographs of the cough with (A) a sleeved elbow and (B) the elbow touching the mouth.



Figure 8. High-speed backlit photographs of the cough with balled fist.

# Hand Hygiene: Cochrane 2023

- Modest improvement in risk of viral infection in hand hygiene trials
- 3 trials added masks to hand hygiene
  - Pre pandemic
  - Didn't show added benefit compared to hand hygiene alone
    - Had wide confidence intervals so benefit is possible
- Didn't assess bacterial transmission risk

# Fomites in the waiting room

- New Zealand 2001 study: levels of coliform bacteria
  - 6 practices, 4 of which didn't regularly clean their toys
    - 90% of Soft toys had moderate to high contamination rates
      - Laundering or autoclaving didn't make much difference
      - Got recontaminated quickly
    - 27% of Hard toys moderate to high rates
      - Regularly cleaned ones showed no evidence of coliforms
      - Slow rate of recontamination
- Other clinic and hospital studies show high rates of bacterial contamination on toys
  - Soft worse than hard toys
- Hospital pseudomonas outbreak associated with contaminated bath toys with retained water



# Fomites in the waiting room

- Viral RNA study Virginia 2010
  - Measured RNA from influenza, rhino/enterovirus and RSV
  - 3 separate dates in respiratory season in a single office
  - 21% had viral RNA present
    - Including toys from the well child waiting area
    - Higher rates from the sick area
  - Viral RNA not found on fingers of the adult who handled the toys
  - After disinfecting with wipes: lower rates but still present
  - Unknown if viral RNA=infectious viable virus

# Recommendations to decrease transmission: AAP policy statement

- Ideally clean between use
- Daily cleaning acceptable
- Remove toys contaminated with body fluids so they can be cleaned
- Avoid soft toys because they are hard to clean effectively

Separate waiting rooms?

# 1985 Suburban Private Practice Study

- 70 patients/day
- Winter months
- Compared illness rates of children who went to the office to a cohort that did not go to the office
- Single waiting room
  - But did try to schedule well child visits in blocks to decrease exposure to ill children
- Shared toys

# 1985 Study

- Excluded children with underlying medical conditions, ill at presentation or had been to the office in the prior 2 weeks
- Collected data on number of children/adults in household, household illnesses, number of children that slept in the same room and day care attendance
- 127 office/home child pairs

# 1985 Study

- Found no difference in GI and Respiratory illness rates
  - Didn't evaluate for chickenpox or measles
- Few parents attributed illness to office visit
- Months after the study was done opened a separate sick waiting area that had been already planned
  - Improved parental satisfaction

# Separate waiting areas?

- Case reports of infection acquired in the waiting room
- 2011 Montreal Study
  - 304 children visited peds ED in respiratory season
    - Common waiting area
  - No increased risk of subsequent respiratory infection
- 2014 Iowa study
  - Retrospective chart analysis of 84,595 families over 13 year period
  - Found 3% increase of influenza like illness visits by a family member 1-2 weeks after a well child visit

# Other good infection prevention practices

- Pay attention to expiration dates, package integrity, storage temps, etc
- Regularly clean high touch areas
- Follow disinfection/sterilization practice recommendations
  - Pay attention to contact/drying time
- Avoid carpet
- Use nonporous furniture



# Consequences of the pandemic

- Increased CLABSI and other HAIs
  - Burn out
  - Frank break down of infection prevention principles
    - Lack of PPE
    - Nurse to patient ratios
    - Severity of disease, increased interventions
    - Lack of support teams
      - IP staff
      - Line placement/maintenance teams
      - Daily rounding
      - Lack of resources to implement new initiatives

# Infection Prevention Resources

- AAP Policy Statement: Infection Prevention and Control in Pediatric Ambulatory Settings
  - Published in Pediatrics 2017
- AAP Red Book
  - Inpatient and outpatient chapters
- CDC Healthcare Infection Control Advisory Committee (HICPAC)
  - <https://www.cdc.gov/infectioncontrol/guidelines/index.html>
- Your local infection preventionist if available

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