PEDIATRIC HOUSEHOLD TRANSMISSION OF SEVERE ACUTE RESPIRATORY CORONAVIRUS-2 INFECTION—LOS ANGELES COUNTY, DECEMBER 2020 TO FEBRUARY 2021

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Abstract: This brief report presents transmission rates from a prospective study of 15 households with pediatric index cases of severe acute respiratory coronavirus-2 in Los Angeles County from December 2020 to February 2021. Our findings support ongoing evidence that transmission from pediatric index cases to household contacts is frequent but can be mitigated with practicing well-documented control measures at home, including isolation, masking and good hand hygiene.

Key Words: coronavirus disease 2019, household transmission, children

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Household transmission of severe acute respiratory coronavirus-2 (SARS-CoV-2) contributes significantly to disease propagation.[1] Previous household transmission studies have largely focused on adult index case populations, noting significant differences in secondary attack rates (SARs) based on household size, relationships between household members and age of index case and close contacts.[1]

Some studies have suggested that children are less likely to transmit and acquire coronavirus disease 2019 (COVID-19) infection.[2] However, dynamics of household transmission from pediatric index cases is mixed and an area of increased interest as schools reopen, and a pediatric vaccine is not yet widely available for all those under the age of 18 years.[3,4] Reported SARs have ranged from 5.8% in a retrospective cohort study in Wuhan to 53% in a prospective study in Wisconsin and Tennessee.[4,5] Both describe similar rates of transmission between pediatric and adult index cases within their samples.

We present results from a prospective case-ascertained transmission study to better understand the risk of SARS-CoV-2 transmission from a pediatric primary index case to household contacts living in Los Angeles County.

METHODS

We conducted a prospective case-ascertained transmission study of SARS-CoV-2 infection among household contacts of laboratory-confirmed SARS-CoV-2 pediatric index cases (<18 years old) in Los Angeles County diagnosed between December 2020 and February 2021. Recruitment for the study was terminated prematurely because of declining case rates in Los Angeles County. For the purposes of this study, we defined an index cases as the first individual in the household with known laboratory-confirmed SARS-CoV-2, with the day that test was performed as Day 0. Household contacts were broadly defined as any individual residing with the index case during the infectious period.

Households met eligibility criteria if the index case was less than 18 years of age, reported a positive SARS-CoV-2 test, was the first member of their household with known laboratory-confirmed COVID-19 infection in the last 14 days and resided in Los Angeles County, CA. Household contacts were considered susceptible if they did not report symptoms at the time or preceding the index case's illness onset and had not been diagnosed with COVID-19 within the last 90 days.

After being consented, members of the household obtained self-collected nasal midturbinate swab specimens on the day of enrollment and every 3 days for 14 days after index positivity. Each member of the household was observed over video to ensure proper self-collection technique and to offer technical assistance for the first collected swab. Self-collected swabs were couriered within 72 hours to the Swab Seq Lab at University of California, Los Angeles, where specimen positivity for SARS-CoV-2 was determined by the Swab Seq protocol, a high-throughput reverse transcription polymerase chain reaction approach which has been described previously.[6] Household contacts completed Qualtrics surveys at enrollment and Day 14 capturing demographics, medical history, household characteristics (including number of rooms, bedrooms, caregiver status) and control measures during the study period (including increased hand washing and hand sanitizer use, index case isolation, index case masking), in addition to daily symptom surveys.

SARs were calculated as the proportion of susceptible household contacts with positive reverse transcription polymerase chain reaction results. Persons-per-room (nonbedroom) was calculated as a measure of housing density.[7] Differences in SAR by characteristic were compared with χ^2 test of proportions. All analyses were performed in R version 4.0.1 (R Core Team, 2020). The study protocol was reviewed and approved by the University of California, Los Angeles Institutional Review Board and funded by Pfizer Global Medical Grants and National Institute of Allergy and Infectious Diseases.

RESULTS

A total of 15 laboratory-confirmed pediatric SARS-CoV-2 index cases and 50 household contacts were enrolled and completed 14-day follow-up. Median index patient age was 2 years [interquartile range (IQR) = 1–10] with 10 individuals ≤5 years and 5 were 6–17 years of age. Among index patients, 47% were White/Caucasian, and 20% were Hispanic/Latinx. Eighty percent (12/15) of index cases were symptomatic at the time of testing. Household contacts were young and healthy, with a median age of 36 years (IQR= 8–42) and only 14% with reported underlying comorbidities. No household contacts reported symptoms preceding the onset of the index case symptoms. No household contacts were vaccinated during the study period. Households had a median of 0.5 persons-per-room (IQR = 0.4–0.7).

Overall SAR was 34% (95% CI: 22%–48%) (Table 1). We additionally calculated a conservative estimate of SAR of 16% (95% CI: 8%–31%), considering only those household contacts with a negative baseline nasal swab, excluding potential asymptomatic coprimary cases. Thirty-five percent (6/17) of positive

TABLE 1. Rates of Secondary Laboratory-Confirmed SARS-CoV-2 Infection Among Household Contacts (n = 50), Overall and by Characteristic—Los Angeles County, December 2020 to February 2021

Characteristic	Laboratory-Confirmed SARS-CoV-2 Infections/ Household Members at Risk, n/N	SAR % (95% CI)	*P*
All household contacts	17/50	34 (22–48)	
Negative baseline PCR‡	6/37	16 (8–31)	
Index case age group, yr			0.42
≤5	13/33	39 (25–56)	
6–17	4/17	24 (10–47)	
Index case sex			0.16
Female	6/26	23 (11–42)	
Male	11/24	46 (28–65)	
Household member age group, yr			0.04*
≤17	2/18	11 (3–33)	
18–64	15/32	47 (31–64)	
Household member sex			0.55
Female	10/25	40 (23–59)	
Male	7/25	28 (14–48)	
Household member is caregiver?			0.23
Yes	12/28	43 (27–61)	
No	5/22	23 (10–43)	
Home type			0.41
Apartment	5/10	50 (24–76)	
House	12/40	30 (18–45)	
Number of bedrooms			0.03*
<3	13/26	50 (32–68)	
4+	4/24	17 (7–36)	
Persons-per-room			0.23
≤0.5	6/25	24 (11–43)	
>0.5	11/25	44 (27–63)	
Index symptomatic at time of testing?			0.16
Yes	16/40	40 (26–55)	
No	1/10	10 (2–40)	
Index isolated at home?			0.11
Yes	4/21	19 (8–40)	
No	13/29	45 (28–62)	
Index masked at home?			0.04*
Yes	4/23	17 (7–37)	
No	13/27	48 (31–66)	
Increased hand washing or hand sanitizer use?			0.01†
Yes	6/31	19 (9–36)	

*$P \leq 0.05$.
†$P \leq 0.01$.
‡Median time of 3 d from index case positivity to baseline household contact test.

household contacts were symptomatic at the time of testing positive. Seventy percent (12/17) of infected household members became symptomatic during the 14 days from index case positivity. No individuals required hospitalization or were deceased by 14 days after index positivity.

SAR among pediatric household contacts was significantly lower than among adult household contacts ($P = 0.04$), at 11% (95% CI: 3%–33%) and 47% (95% CI: 31%–64%), respectively (Table 1). Transmission was significantly lower in households with 4+ bedrooms compared with those with 3 or fewer [17% (95% CI: 7%–36%) vs. 47% (95% CI: 32%–68%), $P = 0.03$], for contacts where the index case was masked compared with those unmasked [17% (7%–37%) vs. 48% (31%–66%), $P = 0.02$] and with increased hand washing or use of hand sanitizer compared with those who did not report increased use [19% (9%–36%) vs. 58% (36%–77%), $P = 0.01$]. No significant difference in SAR was detected by index age (comparing ≤5 years old with 6–17 years old), index or household contact sex, caregiver status, index isolation or persons-per-room.

DISCUSSION

In this study, the estimated SAR from pediatric index cases was high (34%), similar to other published pediatric household transmission studies.[1,3,4] In our study, transmission was significantly lower for pediatric household contacts if the index case used a mask, in households with 4+ bedrooms, or with increased hand hygiene practices. These results corroborate ongoing findings from prospective studies that transmission of SARS-CoV-2 within households from pediatric index cases is high but can be mitigated with practicing well-documented control measures at home including masking and hand hygiene.

Our findings are similar to a prospective cohort study conducted in Tennessee and Wisconsin, which estimated a SAR of 53% for pediatric index cases under the age of 12 and 38% for pediatric cases 12–17 years old.[4] Moreover, our finding that transmission to pediatric household contacts was lower than that of adults supports present evidence that children may be at lower risk of acquiring infection than adults.[1,3,4,8] We note that the majority of positive household contacts in our study were relatively young, and with few medical comorbidities, many of whom were asymptomatic. This highlights the importance of continued efforts to test exposed individuals and vaccination of eligible household members to reduce and interrupt the chain of COVID transmission, particularly for younger caregivers who may be less susceptible to disease yet remain significant vectors of spread within and outside of a household.

Isolation in the household is an infection prevention technique that our study results seem to support, with more rooms in a house being a proxy for ability to isolate from other members of the household. Moreover, we find that mask use by pediatric index cases, where possible, and increased hand hygiene were associated with a significantly decreased household transmission risk, supporting evidence that even simple infection control measures at home can effectively prevent spread.[9] As more schools reopen for in-person instruction and children begin to re-engage in extracurricular group activities while vaccination efforts are still ongoing, it is important that households remain vigilant and practice evidence-based infection prevention and control measures to reduce incidence of COVID-19.[4,9]

The findings in this report are subject to a least 4 limitations. First, while pediatric index cases were symptomatic and tested positive before others in the household, there is a possibility of misattribution. No household contact reported symptoms before the onset of index case symptoms; however, it is possible households contained asymptomatic index cases or coprimary cases with delayed symptom onset. Our conservative estimate excluding asymptomatic household members testing positive at baseline may serve as a lower bound of transmission risk. Second, it is possible that parental collection of samples in children could have led to underascertainment of secondary infections in children. However, evidence suggests that unsupervised parent-collected nasal swab collection for SARS-CoV-2 testing is similarly effective to tests performed by healthcare workers.[10] Third, the households in this study—which tended to be younger, majority White and with few underlying medical conditions—are not representative of Los Angeles County as a whole and may affect the generalizability of our findings. Fourth, significant logistical challenges to recruitment existed for this prospective cohort study, limiting our sample size and ability to perform multivariate analyses. Moreover, while several household factors included in this study such as caregiver

status and index symptom status may affect transmission rates, our study may be underpowered to detect significant differences.

These findings build on present evidence that transmission of SARS-CoV-2 within households from pediatric index cases is high but can be mitigated with practicing well-documented control measures. Continued practice of testing, self-isolation, quarantine, masking and hand hygiene will be important to reduce the likelihood of transmission alongside ongoing efforts to vaccinate our communities.

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ONE AFFECTIONATE PUPPY: A CASE OF SEPTIC ARTHRITIS DUE TO *STAPHYLOCOCCUS PSEUDINTERMEDIUS*

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Abstract: We describe a case of septic arthritis caused by *Staphylococcus pseudintermedius*, a common colonizer of dogs that has emerged as a rare human pathogen. Our patient presented with ankle pain and swelling and was treated adequately with cefazolin/cephalexin and arthrotomy. *S. pseudintermedius* is often misidentified as other coagulase-positive staphylococcal species and has high rates of methicillin and nonpenicillin antibiotic resistance.

Key Words: septic arthritis, *Staphylococcus pseudintermedius*, zoonotic infection, dogs

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Staphylococcus pseudintermedius is a commensal organism and frequent pathogen of dogs that has been increasingly recognized as a zoonotic pathogen of humans. The first documented human case involved an adult with an implanted cardioverter-defibrillator pocket infection in 2006.[1] Since then, *S. pseudintermedius* has most frequently been described as a cause of skin and soft-tissue infections (SSTIs) among veterinary workers, dog owners, and individuals bitten by dogs. Infections can lead to significant morbidity in humans and have been associated with tissue necrosis.[2] Treatment may be complicated by frequent antibiotic resistance.[3]

In this report, we describe an otherwise healthy child with septic arthritis due to *S. pseudintermedius*. We are unaware of any prior cases of *S. pseudintermedius* native joint septic arthritis or infection in an otherwise healthy child. The patient and her parents provided assent/consent for case publication.

CASE REPORT

A previously healthy 7-year-old female presented to the emergency department with a complaint of right ankle pain starting approximately 48 hours prior. She denied recent trauma, fevers, skin breaks, puncture wounds, or animal bites. She lived at home with her parents, healthy sister, and a recently acquired puppy. The family's home is in a heavily wooded area endemic to Lyme disease. She was afebrile and hemodynamically stable at presentation. Examination demonstrated a right ankle effusion with warmth, diffuse tenderness to palpation, and limited mobility of the ankle joint secondary to pain.

Laboratory serum analysis demonstrated a white blood cell count of 11.6 K/μL (reference: 6.0–11.0 K/μL), erythrocyte sedimentation rate (ESR) of 5 mm/h (reference: 0–20 mm/h), and C-reactive protein (CRP) of 0.9 mg/dL (reference: 0.0–0.5 mg/dL). Radiographs of the right ankle were normal. Needle aspiration of the ankle synovial fluid yielded 8-mL of cloudy fluid consisting of 37,330 white blood cells/μL with 89% neutrophils. No organisms were seen on Gram stain. Magnetic resonance imaging of the ankle showed synovial thickening, moderate joint effusion, and synovitis of the peroneal tendons, with no evidence of osteomyelitis (Fig. 1). She was admitted to the hospital and started on intravenous cefazolin while synovial fluid culture and Lyme disease serology were pending.

While admitted she remained afebrile, though her symptoms were unchanged despite antibiotics. On hospital day 2, Lyme disease serology returned negative. On hospital day 3, her inflammatory markers trended upward (ESR of 69 mm/h and CRP of 1.7 mg/dL) and the synovial fluid aspirate culture grew rare Gram-positive cocci in clusters. The organism was beta-hemolytic on blood agar, catalase positive, and pyrrolidonyl arylamidase (PYR) positive. Slide coagulase testing was weak/borderline positive. Following 4 hours incubation at 37 °C, a tube coagulase test was negative at 4 hours but positive at 24 hours. The organism was then identified as *S. pseudintermedius* by VITEK 2 ("excellent" confidence level by GP ID card, software version 9.01, bionumber 070412075723231; bioMérieux, Inc., Hazelwood, MO). Antimicrobial resistance testing showed susceptibility to all antibiotics tested, including oxacillin, vancomycin, tetracycline, macrolides, levofloxacin, trimethoprim-sulfamethoxazole, and linezolid. Upon further discussion, the patient reported having frequent close contact with the puppy, including licking of the patient's mouth and feet.