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TITLE PAGE

The impact of COVID-19 and masking practices on pertussis cases at a large academic medical center (2019-2021)

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HIGHLIGHTS

- Masking reduces cases of pertussis among patients and health care workers
- masking reduces respiratory disease transmission outside of COVID-19
- waning immunity could be contributing factor to acquiring pertussis
- The majority of patients with known exposure to pertussis occurred at school
- The majority of patients who acquired pertussis were symptomatic when tested

NARRATIVE ABSTRACT

We reviewed cases of *Bordetella pertussis* (*B. pertussis*) cases in ambulatory clinics at a large academic healthcare institution in Los Angeles from 2019-2021. Public health prevention measures during the Coronavirus disease 19 (COVID-19) pandemic impacted the number of pertussis cases identified.

NARRATIVE ABSTRACT

We reviewed cases of *Bordetella pertussis* (*B. pertussis*) cases in ambulatory clinics at a large academic healthcare institution in Los Angeles, California from 2019-2021. Public health prevention measures during the Coronavirus disease 19 (COVID-19) pandemic impacted the number of pertussis cases identified.

BACKGROUND

Pertussis, is a respiratory disease caused by the bacterium, *Bordetella pertussis*. Spread rapidly through droplet transmission, it can affect individuals of all ages.^{1,2} When patients seek care, the risk of transmission ($R_0 = 12-15$)² to other patients and healthcare workers (HCW) can be high.^{1,2} This risk results in increased costs to health care facilities due to investigation, antimicrobial prophylaxis, and post exposure treatment and care.^{1,3}

Vaccination is the best way to prevent pertussis infection. In California, vaccination against pertussis is required to attend public schools including colleges and universities.⁴ Pertussis vaccines, however, have waning immunity, with maximum protection occurring in the 2 years after vaccination.⁵ As the Coronavirus disease 19 (COVID-19) pandemic emerged, universal masking, requiring adherence to masking in public, was utilized to reduce the spread of illness. COVID-19 also led to children staying home from school, and impacted primary care visits where routine vaccines are given.⁶ We sought to evaluate the impact of COVID-19 mitigation

measures on the number of primary pertussis cases in patients and secondary cases in staff members at ambulatory clinics at our institution before and after the COVID-19 pandemic.

METHODS

This study is a retrospective analysis of *B. pertussis* cases collected from January 1, 2019 to December 31, 2021 in the ambulatory setting comprising of over 200 clinics in a large academic health care system in Los Angeles (LA), California. The study population was classified as all patients who presented to a clinic and had *B. pertussis* detected through polymerase chain reaction (PCR) via nasopharyngeal specimen.

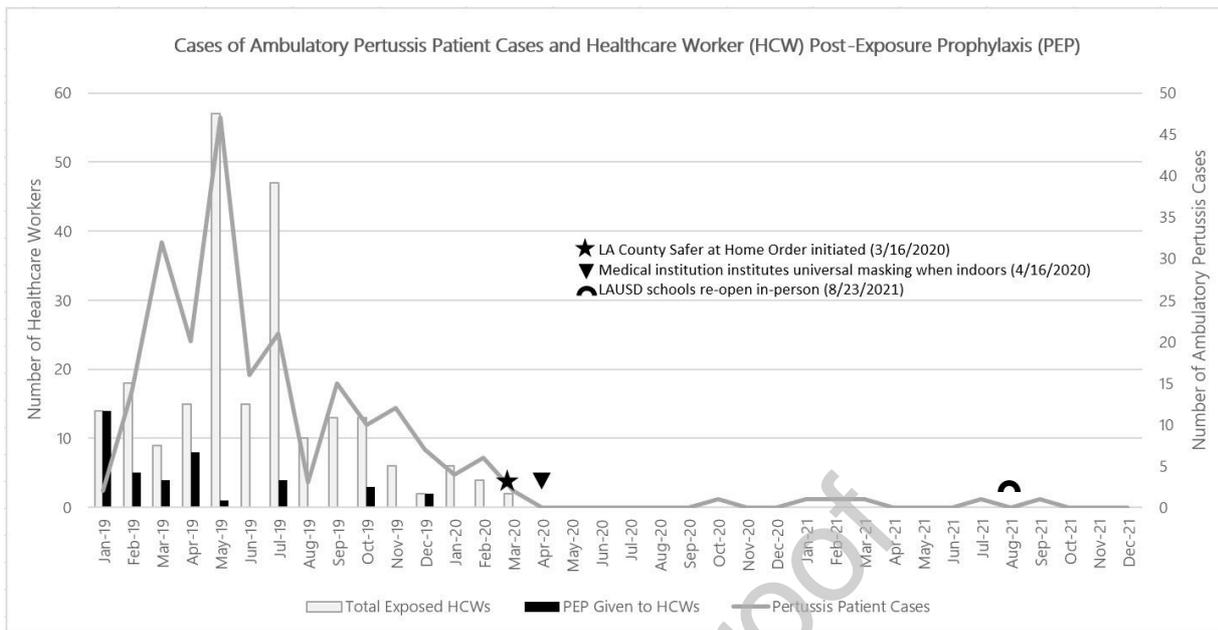
Positive cases were identified from daily reports of abnormal PCR pertussis results.

Demographic characteristics were collected via chart review. When a *B. pertussis* case was identified, the Clinical Epidemiology and Infection Prevention department contacted the clinic to identify patients and/or HCWs who were exposed to the index case. Exposure was identified by contacting clinics for presence of masking. As visits were limited to general care visits, exposure was defined as not wearing a mask when within 3 feet of patient while the patient was not wearing a mask. HCWs that met the exposure definition were referred to Occupational Health for follow up.

Data was collected from Occupation Health for HCW exposure and antibiotic prophylaxis (azithromycin). HCWs who received post-exposure prophylaxis (PEP) were exposed and accepted or requested PEP.

RESULTS

Figure 1. Cases of ambulatory *B. pertussis* and HCW who received PEP



From January 2019 to December 2021, 215 cases of *B. pertussis* were identified at our health system (Table 1). Most were male (55.3%) and patients ranged in age from 2 months to 71 years. Cough with upper respiratory symptoms were the most common symptom presentation (46.0%), followed by cough alone (39.5%). Patients with a known school exposure source decreased from 38.3% in 2019 to 16.7% and 0% in 2020 and 2021, respectively. The majority of positive cases in 2019 had been vaccinated against pertussis (89.4%), and all positive cases in 2020 and 2021 were vaccinated.

From the 215 cases of *B. pertussis*, 272 HCWs were exposed (Table 2). Through follow-up with the clinic, no additional exposed patients were identified as secondary cases. HCW exposures peaked in May and July of 2019 which correlated with increased patient cases. 41 HCW (15.1%) were given azithromycin as PEP. There were no reported HCW exposures to *B. pertussis* after March 2020. In the three years, no secondary HCW exposures were identified.

There was a statistically significant difference in cases from 2019 compared to 2020 and 2021 (each p-value <0.01). The decrease in cases coincided with the onset of the COVID-19 pandemic along with California State and LA County local stay at home orders activated March 16th 2020 and lifted June 15th 2021.^{5, 7, 8}

DISCUSSION

We found that the number of *B. pertussis* patients significantly decreased after the onset of the COVID-19 pandemic. Variables which accounted for this decrease include the California Stay-at-Home Order (including school closures) and masking requirements in public and healthcare settings.⁷ At the system where this study occurred, permissive, or allowance of masking began on March 26th, 2020, and universal masking began on April 16th, 2020 which correlated with the drop in pertussis cases. *B. pertussis* cases dropped both nationally and statewide.⁹ *B. pertussis* cases for 2019, 2020, and 2021 in the LA jurisdiction were 1008, 87, and 0 respectively.⁹ This suggests the prevention strategies employed during the COVID-19 pandemic were beneficial to the reduction of *B. pertussis* cases.

As many positive cases were fully vaccinated against pertussis, this data suggests waning immunity is a contributing factor to acquiring pertussis.⁶

Limitations to this study include that the number of *B. pertussis* patients could be higher due to decreased physician appointments during the pandemic. This was reflected in the reduced number of pertussis tests ordered in 2021 and 2022. Drops in annual physician visits during the pandemic could have decreased vaccination rates against *B. pertussis*, therefore future spikes in rates remains unknown.⁶ Reliance of vaccination status was based on immunization information

present in a patient's chart which could have been incomplete. Additionally, positive cases observed are from a single system, however, the trend does follow that of LA County.⁹

Our findings demonstrate that masking can impact respiratory disease transmission outside of COVID-19. These results are of clinical importance in healthcare as they show how wearing a mask with symptomatic respiratory patients can be beneficial in reducing exposure and PEP need.

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Table 1. Patient characteristics of positive *B. pertussis* PCR result collected in the ambulatory setting from a large academic health care system in LA, CA

Year	2019	2020	2021	Overall
Cases positive for pertussis	198	12	5	215
Total pertussis tests ordered	2302	339	235	2876
Percent positivity (%)	8.60	3.54	2.13	7.47
Sex <i>n</i> (%)				
Female	92 (45.5)	3 (25)	1 (20)	96 (44.7)
Male	106 (53.5)	9 (75)	4 (80)	119 (55.3)
Age				
mean (years)	16 y	16 years	4 years	16 years
min, max	2 months, 71	4 months, 56	5 months, 6	2 months, 71

	years	years	years	years
Symptoms <i>n</i> (%)				
Cough with URI sx	90 (45.4)	5 (41.7)	4 (80)	99 (46.0)
Cough	83 (41.9)	1 (8.3)	1 (20)	85 (39.5)
Cough w/ post-tussive emesis	7 (3.5)	3 (25)	0 (0)	10 (4.7)
Congestion	3 (1.5)	0 (0)	0 (0)	3 (1.4)
Cough w/ paroxysmal episodes	3 (1.5)	0 (0)	0 (0)	3 (1.4)
Cough w/ URI Sx post-tussive emesis	3 (1.5)	0 (0)	0 (0)	3 (1.4)
Cough with whoop	1 (0.5)	3 (25)	0 (0)	4 (1.9)
No symptoms/unknown	8 (4.0)	0 (0)	0 (0)	8 (3.7)
Duration of symptoms (days)				
Mean	10	19	20	11
min, max	0, 56	2, 52	7, 30	0, 56
Known exposure <i>n</i> (%)				
No known exposure	77 (38.9)	9 (75)	4 (80)	90 (41.9)
School	76 (38.4)	2 (16.7)	0 (0)	78 (36.3)
Family	19 (9.6)	1 (8.3)	1 (20)	21 (9.8)
Y, Location unspecified	11 (5.6)	0 (0)	0 (0)	11 (5.1)
Friend	8 (4.0)	0 (0)	0 (0)	8 (3.7)
Extracurricular	4 (2.0)	0 (0)	0 (0)	4 (1.9)
Camp	2 (1.0)	0 (0)	0 (0)	2 (0.9)
Work	1 (0.5)	0 (0)	0 (0)	1 (0.4)

Vaccinated <i>n</i> (%)				
Yes	177 (89.4)	12 (100)	5 (100)	194 (90.2)
No/unknown	21 (10.6)	0	0	21 (9.8)

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