

Prevalence of Coronavirus Antibody Among First Responders in Lubbock, Texas

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Abstract

Background: The ongoing coronavirus disease (COVID-19) pandemic has a major impact on first responders. Scarce personal protective equipment (PPE) has forced them to conserve and reuse some of their PPE. The efficacy of these practices in preventing transmission of COVID-19 from patients to first responders is unclear. There are limited data on the prevalence of antibodies specific for COVID-19 exposure in these front-line workers. **Aim:** Our objective was to determine the prevalence of positive immunoglobulin G antibody specific to COVID-19 among first responders in Lubbock, Texas. **Methods:** Blood samples were collected on 683 asymptomatic first responders who work in Lubbock, Texas and the surrounding area, after informed consents were signed. IgG antibody to SARS-CoV-2 was measured using Abbott's SARS-CoV-2 IgG Reagent Kit in combination with the SARS-CoV-2 IgG Calibrator Kit on the Abbott's ARCHITECT i1000SR analyzer. **Results:** The prevalence of IgG specific antibodies to COVID-19 was 0.73%, five of the 683 participants tested positive. Four of those who tested positive had no known prior SARS-CoV-2 infection or exposure without adequate PPE. **Conclusions:** The prevalence of IgG specific antibodies to COVID-19 was much lower than expected in our study population despite high sensitivity and specificity of the test reagent. The most likely explanations for this finding include limited exposure, inadequate time for a IgG response, possible clearance of COVID-19 infection locally by the respiratory tract IgA defense system without eliciting a systemic IgG response, and short persistence of IgG antibodies in mild or asymptomatic cases.

Keywords

community health, disease management, global health, impact evaluation, program evaluation

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Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a single stranded positive-sense RNA genome virus that causes the widely known coronavirus disease (COVID-19).¹ Its route of transmission is primarily via respiratory droplets, although airborne transmission, especially during medical procedure, has been suggested.² When SARS-CoV-2 enters the respiratory system, it interacts with the angiotensin-converting enzyme 2 in the respiratory epithelium where the host serine protease TMPRSS2 cleaves the viral spike protein, allowing for fusion of the viral particle and the host membrane.^{1,3} Commonly reported COVID-19 symptoms include fever, shortness of breath, cough, loss of taste or smell, and muscle pain.

SARS-CoV-2 has an incubation period of 2 to 14 days and approximately 80% of those that are infected will show mild or no symptoms.^{4,5} Diagnosis of SARS-CoV-2 relies mostly on viral RNA detection by reverse transcription polymerase chain reaction (RT-PCR) using nasopharyngeal swabs.⁶

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Antibody test results are important for detection of previous SARS-CoV-2 infection that triggered some immune response with or without symptoms. Currently, it is unclear how many survivors of COVID-19 develop antibodies, how long the antibodies last, and whether the presence of antibodies protects against reinfection.⁷ There is limited information about the rate of SARS-CoV-2 infection among first responders.

While the country and most of the world population had to stay home due to the SARS-CoV-2 outbreak, emergency medical services, firefighters, and the law enforcement professions were at the front line working around the clock to ensure health and safety of the communities they serve. With nationwide shortage of personal protective equipment (PPE), most first responders must now conserve, and in most cases reuse some of their PPE. The Center for Disease Control updated their guideline for first responders who participate in care of persons with confirmed or possible SARS-CoV-2 infection.⁸ Information on the rate of infection among first responders is scarce and underreported. New York City (first epicenter of SARS-CoV-2 infection in United States) first responders appear to have lower rate of the coronavirus infection than the general population.⁹

The first case of SARS-CoV-2 infection was documented at University Medical Center (UMC) in Lubbock on 3/17/2020. Stay at home policies were implemented in line with the statewide policies of Texas on 4/2/2020. At the time of this study, the prevalence of SARS-CoV-2 exposure in the general population of Lubbock, TX was unknown. The effectiveness of PPE policies at UMC was unknown. To help understand how common coronavirus infections are among first responders in our city, the county leadership designed a hospital-based project looking at the prevalence of coronavirus immunoglobulin G (IgG) antibody in 683 volunteered asymptomatic first responders in Lubbock county and surrounding areas. This cross-sectional study will help understand the prevalence of antibodies among the first responders who are asymptomatic and may have no known prior history of SARS-CoV-2 infection.

Methods

Study Design

We prospectively identified and contacted first responders working in Lubbock county and surrounding cities who were currently asymptomatic from SARS-CoV-2 infection. On May 12th and 13th, 2020, blood samples were collected from 683 volunteered asymptomatic first responders in Lubbock, Texas area. The participants were from Abernathy police department, Idalou EMS, Lubbock Fire Rescue, Lubbock Police Department, Lubbock County Sheriff's Office, New Deal Volunteer Fire Department, Shallowater EMS, Slaton Volunteer Fire Department, Slaton Volunteer Fire Department, Slaton Police Department, Ransom

Canyon Fire Department and EMS, West Carlisle Volunteer Fire Department, Wolfforth Fire & EMS, and Woodrow Volunteer Fire Department.

The study participants were between 18 and 76 years of age.

Sampling Technique

After informed consent were signed, 10mL of blood were collected using vacutainer from the volunteers for measurement of SARS-CoV-2 immunoglobulin G. The blood samples were transported and tested for presence of SARS-CoV-2 IgG in a certified commercial laboratory within 4 hours of collection.

Data Collection Techniques and Analysis

The following information about the participants were obtained and recorded on an Excel data file: age, gender, pertinent medical history, work description, and exposure history. This information was later used to interpret the antibody testing results.

Inclusion Criteria

1. Age range: 18 to 89 years old
2. First responders in Lubbock county and surrounding areas who are currently asymptomatic from SARS-CoV-2 infection.

Exclusion Criteria

1. Pregnant or breastfeeding females
2. Inability to give consent by subject
3. Acute respiratory infection (cough, fever, malaise, shortness of breath)

Justification for sample size. The prevalence of positive serology tests against SARS-CoV-2 in asymptomatic first responders is largely unknown. Reasonable estimates would include 0 out of 150 (0%, 95% confidence interval: 0%-2.4%), 3 out of 150 (2%: 95% CI = 0.4%-5.7%), and 15 out of 150 (10%, 95% CI = 5.7%-16.0%). Based on this estimate, we designed our study to recruit between 150 and 750 participants.

Site of Study

University Medical Center Hospital, Lubbock, Texas.

Antibody Detection

IgG antibody to SARS-CoV-2 was measured using Abbott's SARS-CoV-2 IgG Reagent Kit in combination with the

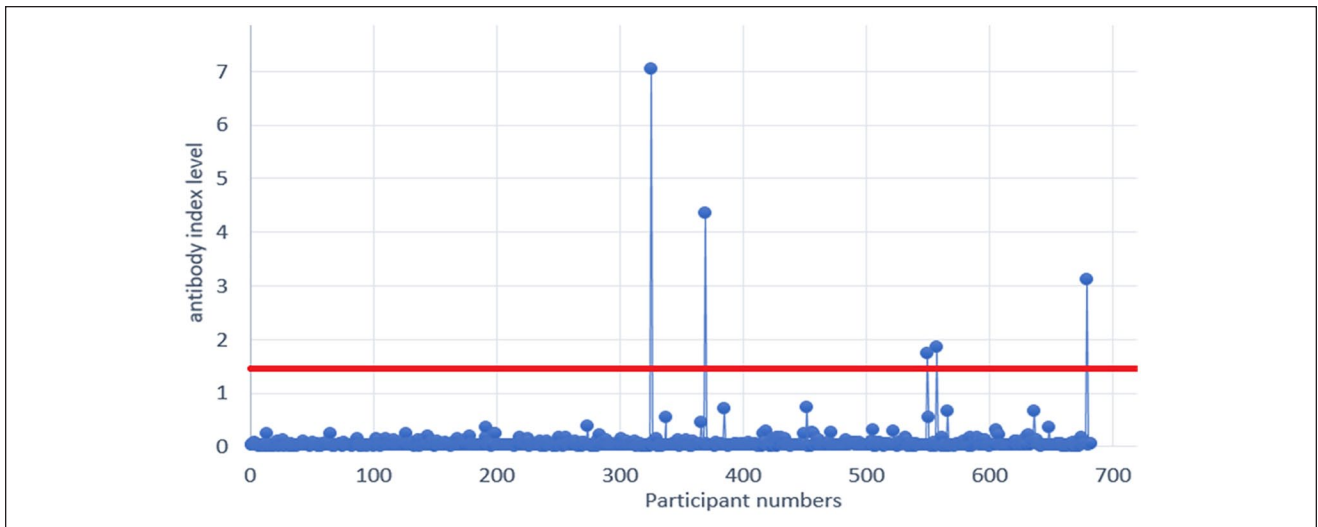


Figure 1. SARS-CoV-2 antibody levels among first responders (vertical axis - participant numbers. Horizontal axis - SARS-CoV-2 antibody level measured in index. Positive threshold is 1.4 index and above).

SARS-CoV-2 IgG Calibrator Kit on the Abbott's ARCHITECT *i*1000SR analyzer. This test kit has been distributed to hospitals and laboratories across the country under Emergency Use Authorization (EUA) that was approved by FDA on April 26th, 2020.¹⁰ This test is a two-step qualitative test that uses chemiluminescent microparticle immunoassay technology for the detection of IgG antibodies against SARS-CoV-2 in human serum and plasma. Results are reported by dividing the sample result by the stored calibrator result. The default result unit for the SARS-CoV-2 IgG assay is Index.¹¹ The threshold for a positive result was 1.4 Index. The sensitivity and specificity of the kits was 100% and 99.90%, respectively, for IgG at day 17 after symptom onset and day 13 after PCR positivity.¹²

Results

Five of the 683 participants who consented for the SARS-CoV-2 IgG antibody testing were positive (Figure 1). There were 2 females and 3 males, their age range was 30 to 65 years old (Table 1). The demographic distribution of the IgG positive participants includes 2 firefighters, 2 police officers, and 1 emergency medical technician. The EMT had a prior RT-PCR proven COVID-19 infection 2 months prior with mild symptoms that were managed at home. The rest of the participants had no prior infection, symptoms, or known exposures without adequate PPE. All the IgG positive participants were relatively healthy with no significant chronic medical condition that would make them high risk for severe SARS-CoV-2 infection.

Many of the participants with negative results reported respiratory symptoms (cough and shortness of breath) and subjective fever within the past 5 months. Some of them

underwent testing for COVID-19 but had negative results. More than 50% of the participants reported contacts with known COVID-19 patients but with proper PPE per their department's infection control protocol.

Discussion

This study demonstrated a prevalence of positive IgG antibody to SARS-CoV-2 of less than 1%, much less than expected. This low number alleviated concerns about the effectiveness of PPE protocols. This low number reassured the first responders in Lubbock county area about their safety in the work environment. However, this low number challenges assumptions about SARS-CoV-2. This low number is not much more than what would be predicted from the false positive rate claimed by the manufacturer. The remainder of the Discussion will explore possible explanations for this lower than expected number.

It would be reasonable to assume that the virus had already spread to the general population by the time blood samples were obtained. There is no reason to believe the prevalence of exposure to SARS-CoV-2 would be less for first responders than for the general population given the time of the study relative to the first appearance of clinical disease in Lubbock. Conclusions from the low prevalence of IgG antibody in the population of first responders include: (1) there was inadequate time from exposure to form IgG response to COVID-19, (2) a significant number of first responders successfully kill the virus with respiratory tract IgA defenses, so the virus never enters the blood, (3) IgG antibodies, once produced, do not persist for very long, (4) prevalence of SARS-CoV-2 exposure is much lower in Lubbock than in either Santa Clara,¹³ New York¹⁴

Table 1. Demographics of Those that Tested Positive for SARS-CoV-2 Antibody.

Department	Age	Gender	Known exposure	Symptomatic
Police	65	Male	No	No
Emergency medical services	30	Female	Yes	Yes
Police	35	Female	No	No
Fire	39	Male	No	No
Fire	49	Male	No	No

or other parts of the country, and (5) effectiveness of PPE measures.

Inadequate Time for IgG Response

This is a plausible explanation. This explanation leads to a problem of establishing a time threshold before testing for IgG antibody. Repeat testing of subjects might answer this question.

COVID-19 is Successfully Defeated by Respiratory Tract IgA Defenses and Never Enters the Blood

There is evidence for a role of IgA antibody in defense against COVID-19. The IgA appears earlier than the IgG response.¹⁵ In mild cases, there may be an IgA response without IgG response.

Short Persistence for IgG Antibody Response

There is recent evidence that antibody response may be short lived. Some patients with mild disease show a decline of antibody to baseline levels within 2 months.¹⁶ The window to detect antibody may be very narrow in mild or asymptomatic cases.

Low Prevalence of COVID-19 in Lubbock

Prevalence for positive IgG antibody to SARS-CoV-2 was less than 1% in our first responder subjects. Prevalence for positive antibodies in Santa Clara was 2.8%.¹³ Prevalence for positive antibodies in New York was up to 25%.¹⁴ There is evidence that IgG response is associated with more severe disease than IgA response without IgG response.¹⁵ Deaths per 1 million population (mortality rate rather than case fatality rate) are 429 for the U.S., 1672 for New York State, 193 for California, and 136 for Texas.¹⁷ As of 07/16/2020, Lubbock County has 64 deaths attributed to SARS-CoV-2 with a population of 310 569¹⁸ (as of 07/01/2019). The Lubbock County mortality rate from SARS-CoV-2 is 209 deaths per million population, so the prevalence of SARS-CoV-2 infection would not be expected to be less than average for the state of Texas.

Differences in mortality rates for different locations may be due to population density, demographics, use of mass transit, standard of living, and other factors. It is plausible that severity of disease is different in different localities, so different prevalence of IgG antibody in different localities is not surprising. Furthermore, subsequent data on COVID-19 cases and mortality have shown this problem to be very dynamic. As of October 11, 2020, the mortality rate in Texas has increased to 588 deaths per million population.¹⁷ This compares to 663 for the USA, 419 for California, and 1716 for New York.¹⁷ Conditions at the time of this study no longer reflect current conditions.

Effectiveness of PPE Measures

Whatever hypothesis or hypotheses explain the low prevalence of positive IgG antibody in Lubbock first responders, this low prevalence gives some reassurance that current PPE measures are adequate given the environment at the time of the study. Adherence to the recommended PPE protocol by the institution's infection control is important to help maintain the currently low infection prevalence among our first responders. Further testing, as outlined in conclusions, may be necessary before protective measures can be relaxed.

Conclusion

Prevalence for positive IgG antibody to SARS-CoV-2 was less than 1% of first responders. This number was lower than expected given the suspected prevalence of exposure to SARS-CoV-2 within the general population of Lubbock. This number was not much higher than what would be expected from the false positive rate of the test. Subsequent events have shown the number of COVID-19 cases to be very dynamic. As the situation evolves over time, repeat testing will be necessary to ascertain the present state of first responders in Lubbock, TX.

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Declaration of Conflicting Interests

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Ethical Approval

This study was reviewed and approved by the institutional board review (IRB #: L20-177) of Texas Tech University Health Sciences Center, Lubbock Texas.

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