Community Serum Antibody Testing For Past COVID-19 Infection.

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Here, the first community serum testing for SARS-CoV-2 exposure in the USA is reported. Serum samples were collected April 2nd to April 4th, 2020 from 40 people in Oregon, then tested for SARS-CoV-2 Spike S1 IgG antibodies with an ELISA. Participants represent a semi random sample of individuals who have not been diagnosed or tested for SARS-CoV-2 infection.

Within the testing cohort of 40 people, many report a severe cold or flu since January 1, 2020. The sample pool is composed of men and women with an age range of 24 to 73 years old. Of the 40 samples, 6 were collected from homeless individuals living on the streets of Portland, OR.

Results

Locations

Samples were collected from 8 Oregon cities, with the majority coming from the Portland metro area (figure 1).

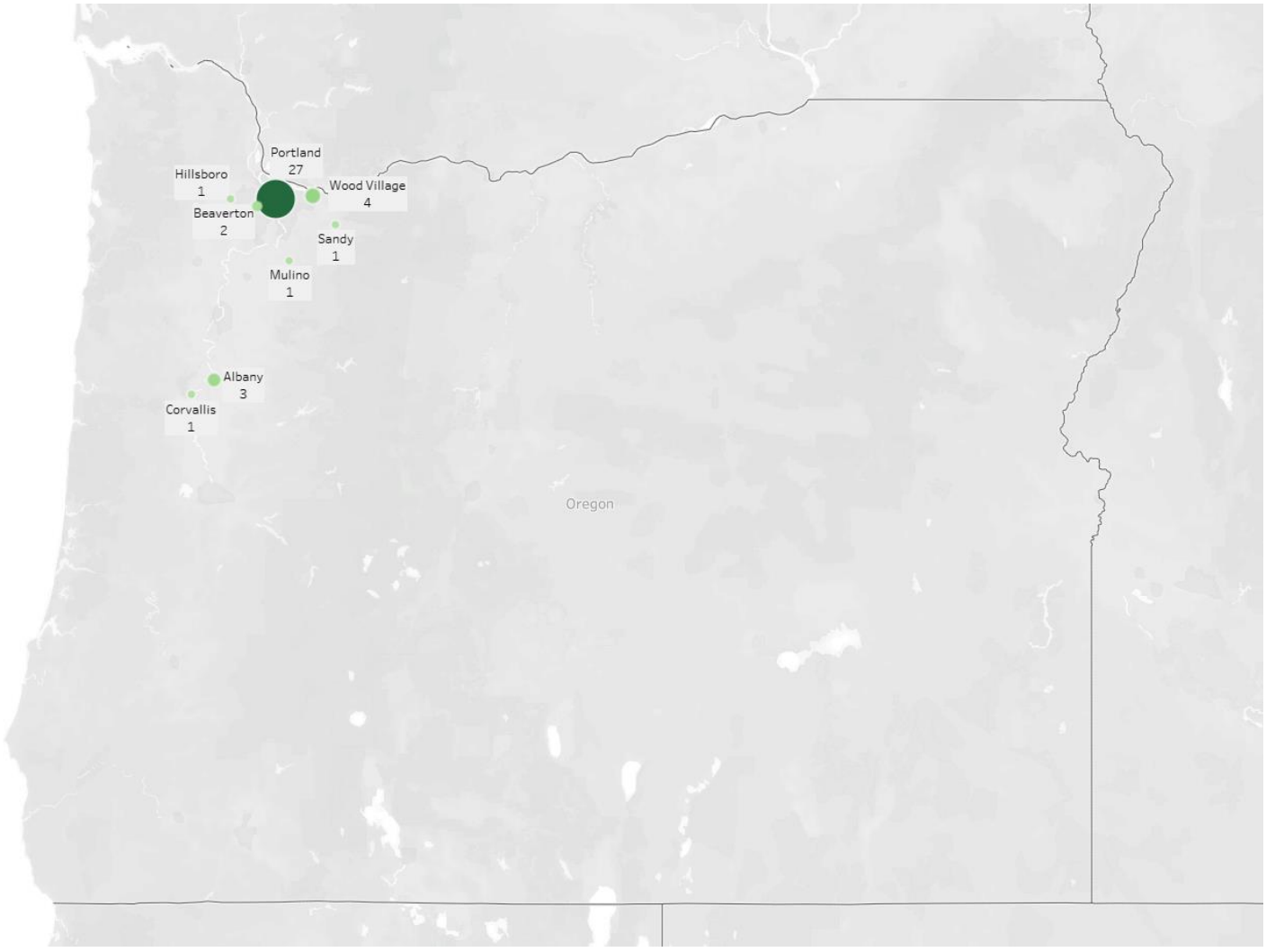

Figure 1. Cities and number of samples collected.

Serum IgG Antibody Test

Serum was tested for the presence of IgG antibodies in order to measure past infection rates. IgM was not tested.

Of the 40 people tested, one individual was positive for IgG antibodies against SARS-CoV-2 Spike S1. Weak positive signals were also qualitatively detected in study participants 6, 13 and 35 (figure 3).

The study participant with strongest IgG signal was subject number 32 and they reported significant illness in December of 2019.

Study participant 32 and 35 are friends and had contact with each other. Study member 35 reported a significant flu like illness in January of 2020. Of the four individuals with a positive result, only these two had contact with each other.

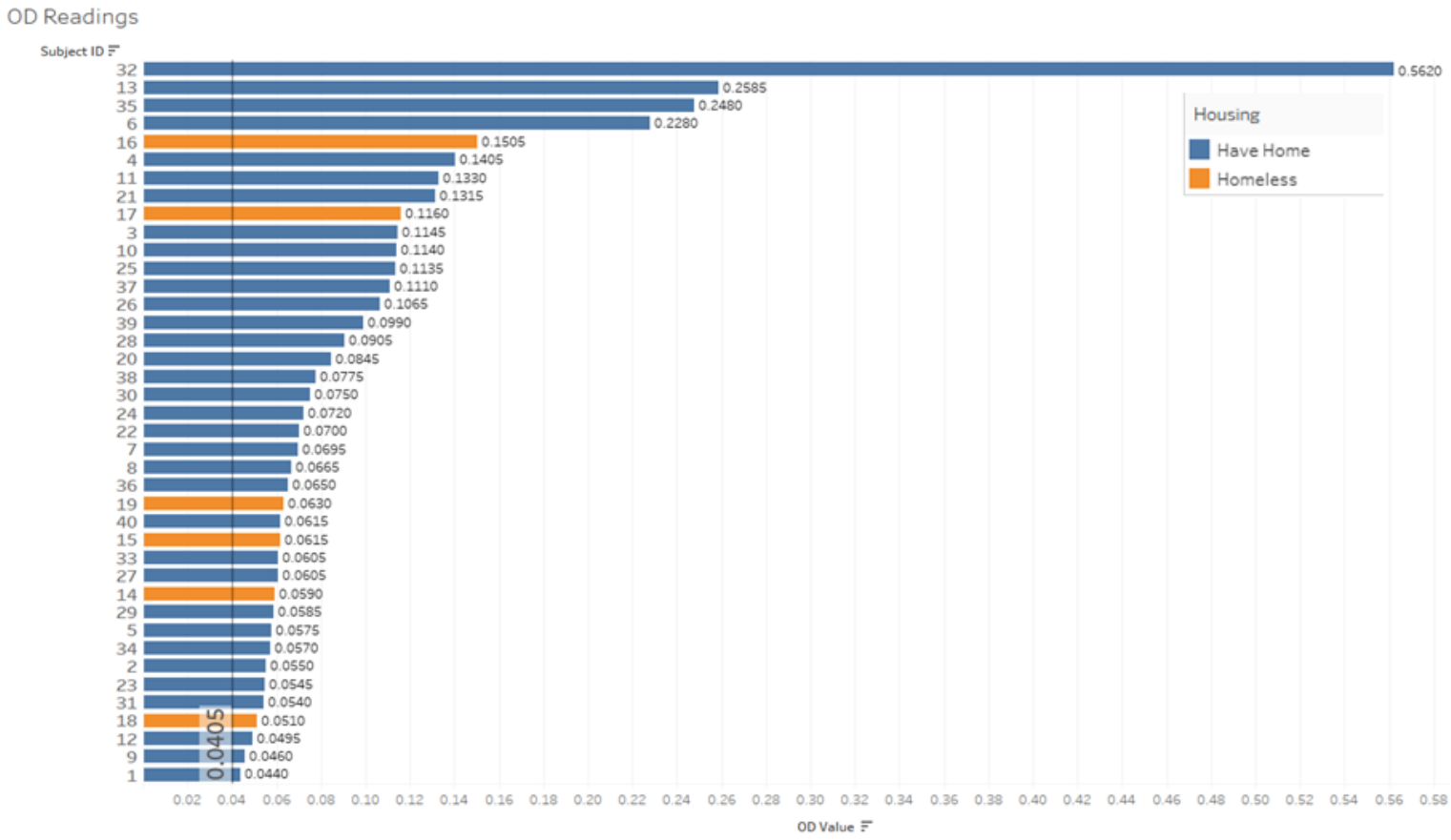

Figure 2. OD readings from SARS-CoV-2 Spike S1 ELISA. The reference band at 0.0405 represents the negative control OD Value.

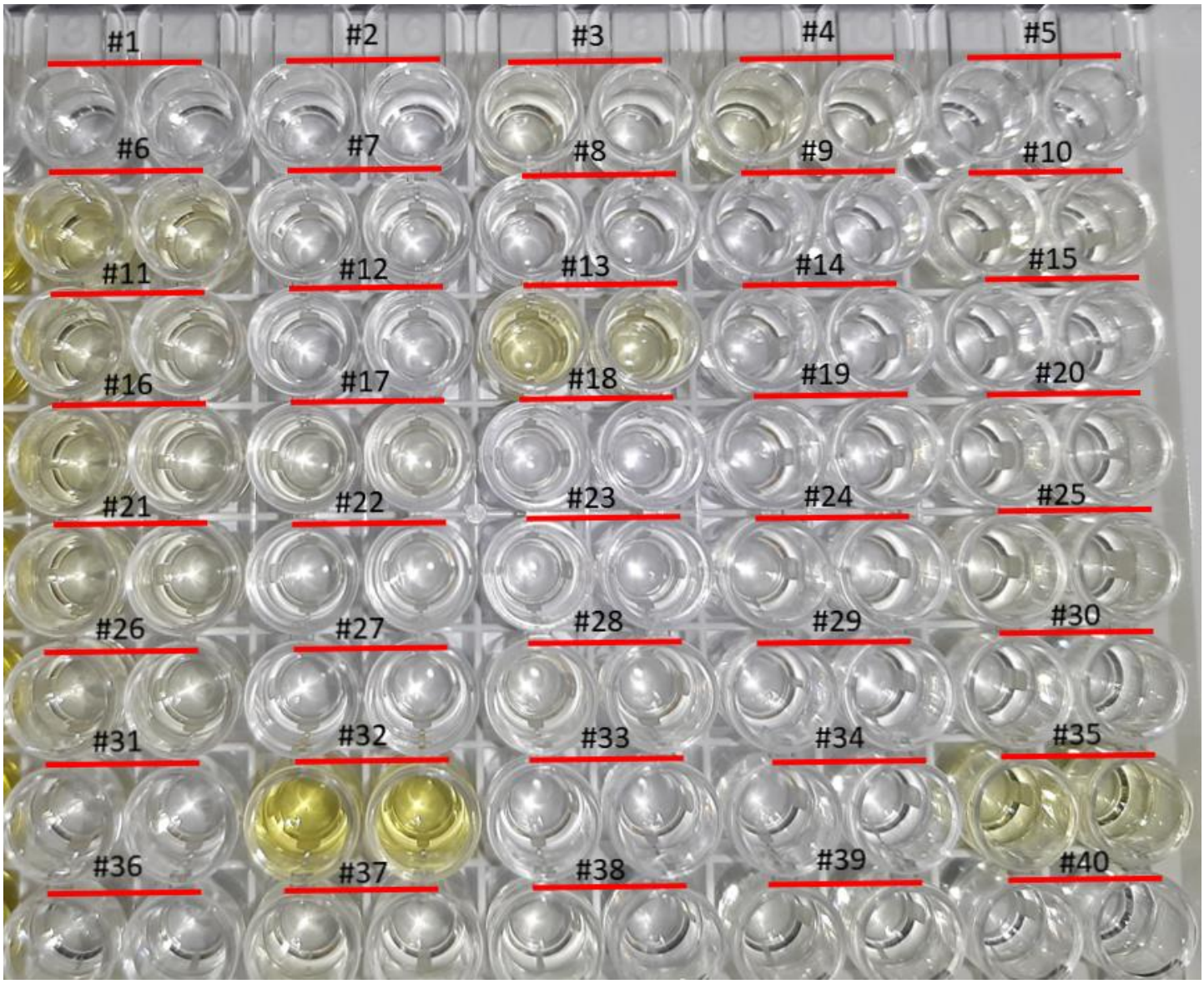

Figure 3. Image of developed ELISA plate. Study IDs are listed above their samples, which were run in duplicate. Serum was diluted 1:100. Sample #32 was deemed to be positive and samples #6, #13 and #35 were considered weakly positive.

Questionnaire Results

There were 16/40 (40%) individuals who thought they have had COVID-19 and 21/40 (52.5%) said they did not think they have had the virus. Three individuals did not answer.

Of the 40 study participants there were 31 (77.5%) who reported having a cold or flu sometime since January 1, 2020. There were 7 (17.5%) who had not had a cold or flu since January 1.

All four with positive signals were men. Of those four, two thought that they had the COVID-19 coronavirus (study participants 32 and 35).

The study cohort had 11 women (27.5%), 29 men (72.5%) and an average age of 44 years old.

Protocol

Study participants were informed that the test was for research purposes and not a clinical diagnosis. They were also made aware of the risks associated with a blood draw. Once informed consent was obtained, blood was collected by venipuncture into a marble top SST tube.

Study Population

The study population was composed of adults from Oregon. Most of whom reside in the Portland metro area. In order to better evaluate community spread, 6 homeless individuals were recruited.

At the time of venipuncture, only 1 individual in the entire study cohort identified as having a current illness (study participant 4). No other study participant exhibited visible signs of illness such as cough, runny nose or difficulty breathing.

Sample Collection and Testing

After collection, blood was allowed to clot for 30min-60min, then centrifuged for 10 minutes at 1600xg. The serum layer was removed and stored at -20deg C˚ until all samples had been collected. The last sample was frozen overnight and SARS-CoV-2 Spike S1 ELISA (Genscript, Catalog # L00831) was performed on all samples the next day. Prior to running the ELISA, all reagents were brought up to room temperature. Serum samples were diluted 1:100 in kit manufacturer's dilution buffer. Optical Density (OD) values were read with 450nm absorbance on a plate reader.

Background

On March 11, 2020 the World Health Organization declared 2019-nCoV acute respiratory disease to be a global pandemic. The disease originated in Wuhan, China in late 2019 and has rapidly spread around the world. As of April 5th, 2020, SARS-CoV-2 has resulted in over 1 million confirmed cases globally.

Many patients are hospitalized due to the severity of upper respiratory symptoms. The infectious nature means that society could be crippled by unrestrained COVID-19 spread.

Because of the threat of mass infection, mitigation strategies have been enacted by local, state and federal authorities. These strategies have focused on slowing the spread by closing non-essential businesses and ordering people to stay at home as much as possible.

In many places these directives appear to be working and the threat of overrun healthcare facilities and mass public infections has not been realized.

While mitigation strategies have been effective, they have come with a significant economic price. But these decisions have been made with little to no insight into the percentage of the population that has already been infected, recovered and now produce anti-COVID19 antibodies.

Serum IgG antibody testing can reveal previous exposure, recovery and antibody production specific to SARS-CoV-2 viral proteins. Testing community members would therefore help us better understand where we are in the community infection cycle. This could guide future decisions about our mitigation strategy and reopening the economy.

Serum antibody testing also helps identify candidates to donate serum for convalescent serum therapy, as described here.

To address the existing spread of COVID-19 and to identify potential convalescent serum donors, serum IgG antibody testing was performed via ELISA.

Discussion

The work here presents the first known community serum survey for COVID-19 antibodies in the USA. No participant in this study has been clinically tested or diagnosed with COVID-19 infection and therefore would not be reported in state testing data.

Despite their absence from official COVID-19 testing data, there was one individual who had a positive IgG signal for SARS-CoV-2 Spike S1. Three other individuals had weak positive tests, which brought the total sum to 4/40 individuals with positive ELISA signal.

The study subject with strongest positive signal (#32) had a significant flu like event in December 2019.

Study participant #35 had a weak positive signal but reported a significant flu like event in January of 2020. They may have contracted the illness from #32 because they are friends and were in contact. Due to very severe lower respiratory symptoms, both thought that their illness was COVID-19.

The other two individuals with weak positive ELISA did not think that they ever had COVID-19. The positive signal seen in their sample could indicate cross reactivity from other coronavirus exposure.

Other non-COVID-19 coronaviruses are prevalent in the community and there is evidence that some individuals possess antibodies that recognize multiple coronaviruses.

That means positive results in this assay could indicate past infection to a non-COVID-19 coronavirus, not past infection to COVID-19 itself. However, the positive signal does indicate preexisting antibody recognition of the SARS-CoV-2 Spike S1 protein. This would likely offer some protection against an encounter with COVID-19.

Responses to the questionnaire indicate that people generally overestimate their exposure to COVID-19. Only 4 people tested positive for antibodies to SARS-CoV-2 Spike S1 but there were 15 who thought that they had the virus in the past. Most people reported having a cold or flu sometime since January 1, 2020 and that may explain the misperception about COVID-19 exposure.

Results from the homeless cohort indicate that COVID-19 has not hit that population in Portland. This is good but the sample size was limited, so it may not be indicative of the wider population. More testing needs to be done and strategies need to be developed to protect that vulnerable population before the virus hits them.

Conclusion

This report has shown that a community serum survey can detect individuals who haven't had a COVID-19 clinical test or diagnosis but produce antibodies that recognize SARS-CoV-2 Spike S1. Therefore serum antibody assays could be used as a quick and cheap screening tool to evaluate community spread, preexisting humoral responses or potential convalescent serum donors.

It is possible that past exposure to other coronaviruses provides some humoral cross reactivity to COVID-19. This should be closely evaluated to better understand the potential for spread in Oregon and the rest of the United States.

The protocol and strategies employed in this report can and should be copied elsewhere. That will allow us to make more informed decisions as we decide the best ways to fight the 2019-nCoV acute respiratory disease.