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COVID19 Prevalence and Antibody Seroprevalence Among Individuals with Intellectual Disability

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ABSTRACT

Approximately 20% of the residential census at a population healthcare facility tested positive for COVID19 during the period from March 2020 through early June 2020. Individuals residing within the facility had intellectual disability, autism, and/or brain injury. Fifteen were hospitalized, but all subsequently were discharged. Two hospitalized clients died as a result of factors unrelated to COVID-19, and a third was pronounced dead upon arrival at the Emergency room, again as a result of factors unrelated to COVID-19. individuals died as a result of factors unrelated to COVID-19. Approximately ¾ of the infected clients developed antibodies within 28 days of initial diagnosis. The development of antibodies could not be predicted from readily available demographic or medical variables.

INTRODUCTION

Coronavirus Disease (COVID-19) has become a global pandemic. As of August 17, 2020, 776,157 people from over 200 countries have died from issues related to the virus (Johns Hopkins, 2020). In the United States, the death count stands at 170,067 as of August 17 (Johns Hopkins, 2020). Over 5.4 million Americans have been infected by the virus (Johns Hopkins, 2020), a current incidence rate of approximately 1.6%.

Organizations providing care for people with disabilities in larger settings have been significantly affected. Forbes (2020) reports that 42% of all COVID-19 related deaths in the United States have occurred in nursing homes and assisted living facilities. In Pennsylvania, the percentage of all COVID-19 related deaths occurring in nursing homes was 68% (Pennsylvania Department of Health, 2020). It is clear that substantial risk is associated with congregate care. Individuals who have intellectual disability are particularly at risk. Lytle (2020) reported that persons with intellectual and developmental disabilities receiving supports and services have proven to be 5.34 times more likely than the general population to develop COVID-19 and 4.86 times more likely to die from it. Landes, Stevens, & Turk (2020) have reported that while the incidence of COVID-19 infection is comparable between individuals who have intellectual disability and the general population, individuals who have intellectual disability have greater

death rates associated with the infection. Similar outcomes were reported in the 2017-2018 influenza epidemic in The Netherlands (Cuypers, Schalk, Koks-Leensen, Nagele, Bakker-Van Gijssel, Haaldenberg, & Leusink, 2020). The authors suggested that proximity of living conditions and the existence of secondary disorders were likely contributory factors. It is clear that a substantial risk is associated with some forms of congregate care, a risk that is likely magnified by a variety of health conditions. The risk is further magnified by the rotating shifts of staff who work in these facilities and maintain lives elsewhere.

It has been anticipated that a second wave of COVID-19 infections may occur in the Fall of 2020 (Xu & Li, 2020). For this reason, the development of antibodies among those infected during the first wave becomes an issue of importance. Antibodies are disease specific proteins that fight off infection and can convey immunity (CDC, 2020). Antibodies are first expressed by receptors on B lymphocytes that recognize foreign antigens, and secrete in plasma cells. There are primary and secondary responses to the antigen, and activated B cells then produce a low affinity antibody (IgM) that serve as stopgap measure to limit the proliferation of the microbe. Those B cells then proliferate into memory B cells, and differentiate which allows for more long lived and faster response to the antigen with the production of longer lasting antibodies (IgG).

Although the development of antibodies is usually protective, the development of antibodies to COVID-19 and their potential impact are currently being studied worldwide, and its long-term presence or protective effect is still unknown at this time. Long, Liu, Deng, et al. (2020) reported that 100% of infected patients tested positive for antiviral immunoglobulin-G. Given the apparent disparity of lethal outcomes associated with COVID-19 infection between people with intellectual disability and the general population, it is essential to ascertain the extent to which people with intellectual disability develop antibodies to SARS CoV-2, the virus that causes COVID-19. A second wave of COVID-19 infections may occur in the Fall of 2020 (Xu & Li, 2020). This makes the development of antibodies an issue of importance, especially among a medically fragile population.

The purpose of this report is to provide an interim report on the status of COVID-19 infection in a Southeastern Pennsylvania population health care facility for people who have intellectual disability, autism, and/or brain injury. Both incidence data and data regarding the development of antibodies will be presented. The latter data will be used in a subsequent report if there is a second wave of COVID-19 infections. All data were collected from existing records with appropriate protection of identities.

METHODS

Facility

All data were collected at a population healthcare facility in Bucks County, Pennsylvania. This program supports approximately 600 individuals in three discrete residential programs and employs almost 2000 staff. Program One (MW) serves/supports individuals of all ages who have intellectual disability. Age range is about 12 to 90 years. Homes in this program varied from community based group homes to larger campus based homes capable of housing over 40 people. Program Two (WCCB) is a treatment oriented program, supporting mostly teenagers who have intellectual disability and/or autism, concomitant with significant behavioral challenges. The goal of Program Two is to teach new behaviors so that individuals might return to community settings. The typical residence within Program 2 houses 8-10 individuals.

Program Three (BW) serves/supports individuals who have acquired brain injuries. About half of this program lives on a campus in 8 person homes, while the other half lives in community group homes. All programs offer services/supports to individuals who live elsewhere, but these individuals are not included in the study. Staffing level across these programs ranges from 1:1 to 1:4, depending on clinically determined need.

In addition to the habilitative instruction and behavioral healthcare provided by the facility, the facility operates a Health Services Center, staffed with physicians, Nurse Practitioners, and a full complement of nurses. Nurses are present in all residential homes on a daily basis.

Study Participants

Approximately 600 individuals live on or near the population healthcare facility's campus. This group of individuals is approximately 73% male and 27% female. Median age is 25, with a range from 8 to 95. Approximately 75% of the population has some degree of intellectual disability, 48% have autism/Pervasive Developmental Disorder, and about 17% have acquired brain injuries. Note that multiple diagnoses are possible.

Biological Tests

COVID-19 diagnosis was accomplished using the PCR nasal swab test. Specimens collected at the facility were analyzed by an outside laboratory.

Antibody testing used the Premier Biotech finger stick test. Independent evaluation of this test indicated that it correctly identified IgG antibodies 93% of the time and IgM antibodies 100% of the time (FDA, 2020; Carlson, 2020). These values were judged adequate for seroprevalence studies. While reliability was not assessed in this report, it must be recognized that reliability is a precondition for validity; the acceptable validity indices suggest acceptable levels of reliability.

Comparing pairs of temporally contiguous tests, a percent agreement reliability of 78.3% was determined. This value is acceptable for research purposes (Nunnally, 1967) but low for clinical purposes.

Precautions Taken by the Facility

The facility was proactive in establishing emergency preparedness procedures through which they operated during the pandemic. The implementation of these procedures began late February 2020. The facility attacked COVID-19 on three fronts: prevention, preparedness and response. Onsite nursing staff began taking client temperatures and vitals several times daily starting late February. Off campus trips and non-employee visitors were prohibited very early on. Family contact was supported via Skype and related electronic means. Employee travel was restricted by early March, with heavy sanctions to those who chose to vacation, including a mandatory 14-day quarantine upon return. By March 9th, the facility began daily temperatures checks at all our entrances. Any staff with a temperature of 100 or higher was directly sent to the facility's on-campus Medical Center. The Medical Center staff would confirm the present of fever through a second temperature and render a clinical decision to send employees home if necessary. Visitors with elevated temperatures were not permitted on campus. Woods also required the use of facial coverings early in March. Staff training was also provided early on. Information and literature about the COVID Virus were made available on our payroll portal and our onsite training teams began educating staff on the virus, the importance of handwashing, social distancing and facial masks early on. Non-essential staff were directed to work from their

homes. Three school buildings on campus were closed, with instruction and services provided electronically to their homes.

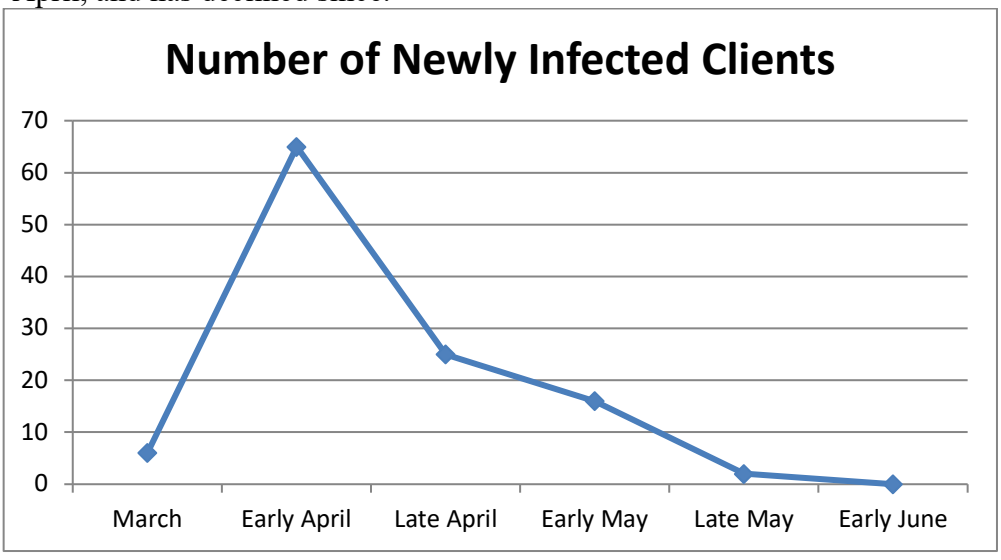
An isolation protocol was established that limited the possibility of cross-contamination. Certain homes and buildings were emptied to serve as isolation locations for infected clients. Staff received additional compensation for working with infected individuals and for volunteering to stay on facility's Campus in an isolation home. For the most medically fragile group of clients (who lived in a single building), volunteer staff literally moved into the building, remaining in that building without returning home for up to 12 weeks. In a sense, staff volunteered to entirely self-quarantine. They maintained a zero infection rate during this time.

Nurses were present daily in every home to monitor the welfare of both staff and clients. Any evidence of symptoms was reported to the Medical Center. Examinations and testing were completed with early symptom onset. As soon as someone presented with an elevated temperature, the individual was tested and isolated to a single room to reduce chance of spread. The facility strategically selected a lab that was able to provide results within 36 hours, allowing the facility to relocate infected clients very early on.

RESULTS

As of the date of this writing, 121 clients have been infected by the COVID-19 virus. This is approximately 20% of the population of the facility. Fifteen individuals were hospitalized. The average age of hospitalized clients was 53 years, with an interquartile range from 45 to 70 years. Two individuals were placed on ventilators while hospitalized. To date, there have been no deaths directly attributable to COVID19, although three individuals died from other causes after having tested positive for COVID-19. Hospitalized clients, with the exception of three deaths from unrelated causes, have returned to the facility. Those three individuals were, of course, not included in the antibody study.

The figure below depicts the onset of the covid19 infections at the facility. The peak was in early April, and has declined since.



This infected sample appears to be generally representative of the facility population. Males constitute 73.5% of the infected sample, and they are 73.3% of the population.

The interquartile range for the infected sample goes from 21 to 49 years. For the general population, the interquartile range goes from 20 to 47. The median age of the infected individuals was 29 years (the mean was 35.9, a value affected by several older individuals), while the median age for the facility was 25. Infected individuals included 80 Caucasians, 31 African Americans, 5 Hispanics, and 1 Asian. These counts are consistent with the residential census population of 73.3% Caucasian and 26.6% African American. Analysis of these parameters suggests that the infected sample is adequately representative of the general population at the facility, with no overemphasis of older individuals. We found no evidence of systematic bias with regard to age, gender, ethnicity, or level of disability. Overall, it appears that the infected sample was largely consistent with the residential population of the program.

The single most frequently cited symptom among the infected group was an elevated temperature. 65 of the 118 infected individuals 55.1%) were reported to experience temperatures in excess of normal. The mean recorded temperature for these individuals was 101.2. Other frequently cited symptoms were cough (42.4%), malaise (39.8%), headache (7.6%), congestion (5.9%), fatigue (3.4%), and nausea, vomiting, and/or diarrhea (8.5% combined). Four infected individuals were judged to be asymptomatic. The general presentation of symptoms was relatively mild. This is not to suggest that all cases were mild. As noted above, 15 individuals were hospitalized (12 were discharged back to the facility, and three died due to causes other than COVID19).

A systematic study of antibody development was initiated. Clients who had tested positive for COVID-19 were scheduled for antibody testing at 14, 28, and 42 days post their COVID-19 diagnosis. Some early infected individuals could not participate in the 14 and 28 day antibody testing because they had already passed that timeframe when antibody testing began. The figure below presents the number of individuals who developed antibodies at each of the testing times.

	14 day N=22	28 day N=68	42 day N=110
Negative	13	16	29
IGG Only	3	33	49
IGM Only	3	3	2
IGG & IGM	2	14	26
Refused	1	2	4

These data suggest that about 38.1% of clients had developed antibodies within 14 days, 75.8% had developed antibodies within 28 days, and 72.6% had developed antibodies by 42 days. Note that not all clients were tested at each time frame; hence, the values will fluctuate as a function of sampling. It appears reasonable to suggest that about ¾ of the participants developed antibodies within about 28 days.

In an effort to address the impact of missing cases, a second analysis limited the sample to just those individuals who contributed data at both the 28 and 42 day intervals. Fifty individuals contributed data to this longitudinal analysis. The figure below presents the seroprevalence estimates for the two time intervals.

	28 day N=50	42 day N=50
Negative	10	18
IgG only	27	19
IgM	3	0
IgG & IgM	10	13

These data suggest that approximately 80.0% of this longitudinal sample evidenced antibody development at 28 days, but this value declined to 64.0% at 42 days.

We sought to predict who would develop antibodies. An individual was considered to have developed antibodies if his/her final antibody test was positive for IgG, IgM, or IgG and IgM. No variable was found to be significantly correlated to the development of antibodies. Analyzed variables included: Number of listed diagnoses, presence of seizures, diagnosis of Prader Willi Syndrome, Axis I diagnosis, Brain Injury, Autism, Intellectual Disability, gender, ethnicity, NSAID use, hypertension, fever, malaise, headache, coughing, nausea, diarrhea, or congestion. In our cohort, there was no correlation between antibody production and the presence of these chronic diseases

The CDC and the WHO have suggested that certain comorbidities are more likely to result in infection or death**.** Examples included hypertension, diabetes, COPD, and obesity. Study participants were reviewed for the presence of these comorbidities. Presence or absence of these key comorbidities was examined relative to the production of antibodies via Chi-square tests. None of these tests yielded statistically significant results.

DISCUSSION

Data from COVID tracker (covidtracking, 2020) suggests that the infection rate in both New Jersey and New York was calculated to be about 1.9% (confirmed cases divided by state population). Brightspring, a residential provider of intellectual disability services based in Kentucky reported an incidence rate of about 0.6% (Mills, Sender, Lichtefeld, Romano, Reynolds, Price, Phipps, White, Howard, Poltavski, & Barnes, 2020). The 20% figure reported for this healthcare facility is likely to have been increased by the combination of congregate living and revolving staff most of whom maintain contact with the outside world. Its location in the Northeastern part of the United States was also a significant contributing factor. Of course, it should be recognized that testing was more readily available within a healthcare setting, and this may have impacted the results as well. Nevertheless, the differences appear large.

It should be noted that a number of individuals who tested positive for COVID19 were described as asymptomatic. This raises the possibility that prevalence of infection might actually be higher than reported, with some unknown number of asymptomatic individuals being positive for COVID19. Routine antibody testing has been incorporated into annual wellness check, and these data will enable us to estimate the percentage of hidden COVID19.

Despite the relatively high incidence rate of infection, there is perhaps reason to be encouraged. With appropriate supportive care, individuals returned to their homes. Most of the associated symptoms were relatively mild. Outcomes to date appear largely satisfactory. It is noteworthy that the 15 hospitalized individuals were older than both the remainder of the infected group and the facility population as a whole. Whether this is a function of

overabundant caution on the part of medical staff or whether this suggests that older individuals experience a more significant impact from COVID19 infection is not known at this time.

The data suggest that approximately ¾ of those individuals with intellectual disability who were infected with the COVID-19 SARS CoV2 virus developed antibodies within about one month of initial diagnosis. While this finding is encouraging, it must be recognized that whether the development of antibodies will protect against future infection remains an unknown. It is anticipated that the predicted second wave of the virus will afford an opportunity to ascertain the protective value of the developed antibodies. One must recognize that the successful development of a vaccine will hinge on the ability of these antibodies to defend against the infection.

Antibody studies thus far in the pandemic have shown various rates for antibody production. In Italy and New York City, different areas have demonstrated different rates of antibody productions, which could be as high as 68% or as low as 17%. Causes for this discrepant finding are still under investigation by the scientific community. Potential reasons include false positive results, variations in disease penetrance, genetic variations in B-cell antibody response, and immune status. Further studies are needed.

It is concerning that in the longitudinal part of the study, the percentage of participants who tested positive for antibody development actually declined from the 28 day data to the 42 day data. It was reported that 80% of the participants evidenced some antibody response; only 64% of those same individuals had antibody development as of the 42 day data collection. At question is whether this decline reflects measurement error or simply illustrates the impermanence of the antibodies. Given the high validity reported in the independent report referenced earlier (FDA, 2020; Carlson, 2020), it seems unlikely that test reliability is a factor. Reliability is a mathematical precondition for the establishment of validity. This suggests that the development of antibodies may not be as enduring as might be hoped.

Long, et al (2020) reported a reduction of IgG and neutralizing antibody levels in the early convalescent stage. This phenomenon is not unusual. Nunez (2020) noted that most corona viruses have a limited durability of immunity, typically lasting three to six months. It should be understood, however, that dwindling antibody levels do not necessarily translate to dwindling protection. T-cells do contain a memory component that generally enables a rapid response to a new infection, thus affording immunity.

The development of antibodies in this population may provide information on the protective nature of antibodies, and support the work to develop vaccines. Note that roughly three-quarters of the infected individuals evidenced development of some antibodies after about 28 days. The information we have gained will assist in protection of this most vulnerable population. Nevertheless, the question regarding antibodies remains empirical, and will perhaps be answered if there is a second wave of COVID-19 this fall.

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