Background

The remarkable olfactory abilities of canines have long been recognized and made use of by humans. They are frequently utilized to search for drugs, explosives, toxic waste, and more. Scent dogs have been trained to alert for seizures and hypoglycemia, locate cadavers, and screen for viruses, bacterial infections, and numerous cancers. These capable dogs warrant a more significant role in public health protection. The purpose of this preliminary study was to determine whether dogs could be trained to accurately identify coronavirus disease 2019 (COVID-19) infections in humans. In previously published studies, dogs were trained to identify the scent of COVID-19 in inert samples with high sensitivity and specificity. In this study, 2 dogs were trained to identify the scent in live individuals (vs inert samples, as used in previous studies), a faster and more efficient screening method. These dogs tested out at 94% to 96% positive and negative agreement compared to PCR testing. These results recommend the use of scent dogs for public health applications and warrant investigation for other applications beyond COVID-19. This study is included as part of the Currents in One Health series. A partner article by Pellin et al, AJVR, January 2024, describes and evaluates the current research on the utilization of trained scent-detection dogs for the detection of disease within human and veterinary patients.

Keywords: sniffer dogs, scent dogs, SARS-CoV-2, COVID-19, public health dogs
in other canines. Current understanding is that these disease scents arise from VOCs, which are low-molecular weight compounds of cellular origin produced by the affected individual’s immune response and are unique to each illness. Dogs traditionally have been trained in identification of explosives and drugs and more recently in the detection of currency, electronics, and potentially destructive invasive plants. Given this rich history and their unique ability, the utilization of dogs for the olfactory identification of COVID-19 should be feasible and practical.

**Current Research**

In the past 2 years, several news articles and proof-of-concept studies have been published concerning canines being used to screen people for COVID-19 at airports, commercial events (e.g., professional basketball games), and entry screening at hospitals. The first half of 2020, several reports appeared describing sniffer dogs being successfully trained to identify the presence of the SARS-CoV-2 virus in inert sweat or breath samples obtained from infected individuals, including work by the CDC and Center for Infectious Disease Research and Policy.

The goal of the present study was to demonstrate that dogs could be used to effectively and efficiently identify the virus from infected, live individuals versus from inert scent samples. If successful, this could lead to larger studies establishing that dogs could prove useful and efficient as an effective public health screening tool on a larger scale. This could prove helpful in many public health protection applications, including the identification and management of future viral pandemics.

**Process**

Two dogs without previous scent training were obtained for this preliminary project to evaluate the effectiveness of sniffer dogs to assess COVID-19 infection in individuals (vs sniffing inert samples). Dog 1, a 2-year-old female spayed Labrador, was in training as a possible guide dog, had a very good drive to work, and was very food driven, but because of increased squirrel prey drive was not ideal for work as a guide dog. Dog 2, a 2-year-old male neutered Springer Spaniel, had a strong drive to work and was very food motivated. He was obtained from an experienced scent trainer but had not yet begun his scent training.

These dogs were chosen for their drive to work and keen interest in food. For the dogs, scent detection work is a game of hide-and-seek, with a food reward as a prize. In this study, as the dogs would have direct contact with the public (including children and adults), they also needed to have very friendly temperaments.

Initial Alpha variant scent samples were obtained via ambient transfer of scent from samples of frozen saliva from COVID-19-positive hospitalized patients. A scent-trapping tube (Getxent; https://getxent.com/) was placed adjacent to a tube of frozen saliva in a vented bag overnight. Scent capture was validated on the impregnated tubes by previously trained COVID-19 sniffer dogs. Additional Alpha, Delta, and Omicron scent samples were obtained by asking known COVID-19–positive individuals (based on PCR testing) to gather scent utilizing a specially designed scent-trapping tube, using protocols as established by the manufacturer. The dogs’ initial training was guided by 2 accomplished scent trainers (Laska Parrow; All Ears Training; and Stephanie Taunton; Bow Wow Productions), and during training the dogs were always handled by the same handler.

Commonly accepted positive reinforcement training techniques were employed. The focus was on repetition, praise, and reward with treats. Both dogs were trained using approximately 60 different positive scent samples, from approximately 60 different individuals, male and female, ages 4 to 82 years of age, with a random assortment of underlying comorbidities and presumably medications. None of these individuals had been hospitalized. The only common factor in the samples was current infection with COVID-19. After basic training was completed, approximately 30 tubes from 30 negative individuals (collected with the same technique as the positive patients, per tube manufacturer instructions) were included as negative controls in the training array. This was done to ensure that the dogs were alerting on disease-related scent on the tubes, rather than a false alert triggered by any scent innately on the tubes or as a result of tube handling.

Training of the dogs was considered effective when they were able to consistently find hidden scent samples with ≥97% accuracy. This occurred after approximately 60 days of training. They then were graduated to “live sniff tests” conducted on community members known to be positive (from 1 to 10 days following positive test, typically 4 to 14 days after onset of symptoms) via current PCR test. Sniff lineups included negative individuals as well, typically at a ratio of 4 to 5 negative to 1 to 2 positive. All tests were run outside, all individuals were double masked, social distancing was respected, and the handler was blinded to infection status of the participants. Dogs were on 20-foot leads to allow the handler to maintain a safe distance and not influence the reactions of the dogs. Each dog was slowly walked up and down the line from a distance of approximately 4 to 6 feet from the individuals. Dogs had no direct physical contact with individuals being sniffed and were wiped down with a damp cloth after completing the sniff to minimize any possible fomite transfer.

The dogs were very efficient, typically needing 5 to 10 seconds/person to identify positive scent in an individual. The commonly available commercial tests typically require a minimum of 15 minutes and PCR typically at least 24 hours. When the dog found the scent, they alerted—sat and nodded to where they were able to consistently find hidden scent samples with 97% accuracy. This occurred after approximately 60 days of training. They then were graduated to “live sniff tests” conducted on community members known to be positive (from 1 to 10 days following positive test, typically 4 to 14 days after onset of symptoms) via current PCR test. Sniff lineups included negative individuals as well, typically at a ratio of 4 to 5 negative to 1 to 2 positive. All tests were run outside, all individuals were double masked, social distancing was respected, and the handler was blinded to infection status of the participants. Dogs were on 20-foot leads to allow the handler to maintain a safe distance and not influence the reactions of the dogs. Each dog was slowly walked up and down the line from a distance of approximately 4 to 6 feet from the individuals. Dogs had no direct physical contact with individuals being sniffed and were wiped down with a damp cloth after completing the sniff to minimize any possible fomite transfer.

The goal of the present study was to demonstrate that dogs could be used to effectively and efficiently identify the virus from infected, live individuals versus from inert scent samples. If successful, this could lead to larger studies establishing that dogs could prove useful and efficient as an effective public health screening tool on a larger scale. This could prove helpful in many public health protection applications, including the identification and management of future viral pandemics.
indicated that both dogs achieved 95% to 96% positive agreement and 94% to 96% negative agreement. Although they have not been specifically retrained to the most recent variants (Omicron subvariant VBB), they have been able to identify infected individuals with the same accuracy, suggesting that the VOC production is consistent and similar, regardless of variant.

In several situations, the dogs were able to identify infected individuals several days before they tested positive. This occurred in a household of 4, in which initially 1 individual tested positive both via PCR and positive dog sniff. All other family members were home isolated and did PCR testing every 2 days. The dogs did sequential sniff tests every 2 to 3 days for 8 days, for 4 sniffs total. The dogs alerted on an additional then asymptomatic family member, who tested PCR-positive 2 to 3 days later. Three individuals eventually tested positive and 1 stayed negative (via PCR and dogs), which concurred with the dogs’ results. The ability of the dogs to find the scent before commercially available testing would make this a useful approach for public health protection.

**Key Findings**

These dogs exhibited 95% to 96% accuracy compared to PCR testing in detecting COVID-infected individuals (positive percent agreement). They were 94% to 96% accurate in identifying negative individuals (negative percent agreement). They were able to identify the scent rapidly, typically within 5 to 10 seconds.

Depending on the age of individuals sniffed, scent was present for variable lengths of time. Scent in adults positive for Alpha, Delta, and Omicron variants typically lasted approximately 10 days from onset of symptoms. For children, the scent only lasted for 2 to 3 days. This is consistent with the usual disease pattern in children, which generally resolves faster than adults.

The dogs were able to accurately find the scent in some individuals 2 to 3 days before they were either symptomatic or tested positive, which could be particularly useful for public health safety screening.

The dogs were able to identify the scent in a dried week-old rapid test cassette, as well as in unwashed clothing that had been worn while the individual was symptomatic. This indicates that the scent can linger for an extended period of time on an inert substance.

**Conclusions**

Both dogs achieved consistently accurate results, especially on inert scent samples (scent-impregnated tubes). Their live sniff accuracy was mildly impacted by distractions, such as other animals in the area, unusual noises or movements, children, etc. Live sniffs are more time efficient than the diagnostic tests readily and currently available, especially those for rapid screening. Use of scent-trained dogs could be very useful for screening larger groups of people relatively rapidly.

The dogs’ ability to accurately identify positives of multiple C19 viral variants (without additional training for that variant) suggests there is commonality of the odor even with viral mutations. The dogs’ ability to identify the scent in presymptomatic preparative tests should make them particularly useful in group screening situations.

Once trained, the dog can be pivoted to new “scents of interest” in approximately 4 to 6 weeks. This would make them very useful for public health protection against other threats and allow them to be deployed more rapidly than conventional laboratory tests.

Most importantly, scent dogs are currently underutilized in the sphere of public health. They may be able to provide valuable screening assistance to the medical community. They could be utilized for other viral or bacterial infections, which, after what we have learned from this pandemic, we should be expecting. Dogs already have shown to be of use in the screening of certain neoplasias. They may well be of use in the detection and screening of as-yet-unknown diseases. The merit of detection dogs in this area should not be overlooked.

**Limitations**

The small sample size of 2 dogs in this pilot study was a limitation and warrants further investigation with a larger group of scent dogs. The dogs can work for about 30 minutes, then need a quick break to reset and refocus. Live sniffs include the risk for more distractions, which may decrease accuracy. This detriment is offset by the significant increase in efficiency.

In social and organizational situations, verification through comparison with existing commercial tests would be optimal. Many of these tests exhibit lower accuracy than the capability of detection dogs, which could produce discordant results. This would need to be resolved by policies established by the managing entity (government agencies, regulatory bodies, etc).

In summary, trained scent dogs could prove to be important, practical, effective, efficient, and economical contributors to public health protection. Robust clinical trials and larger peer-reviewed studies are necessary to establish and verify that role. Public education about their proven validity would be necessary to gain widespread acceptance for trained scent dogs in the detection of disease.

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**Table 1**—Results of live-person dog sniff tests with PCR-verified positive and negative individuals. Both dogs achieved 94% to 96% positive and negative agreement with PCR test results. Dog 2 had fewer tests, as he was obtained 3 months after Dog 1.

<table>
<thead>
<tr>
<th>Dog</th>
<th>No. of individuals sniffed</th>
<th>Correctly detected positive</th>
<th>Correctly detected negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dog 1</td>
<td>50</td>
<td>25/26 (96%)</td>
<td>23/24 (96%)</td>
</tr>
<tr>
<td>Dog 2</td>
<td>38</td>
<td>21/22 (95%)</td>
<td>15/16 (94%)</td>
</tr>
<tr>
<td>Total</td>
<td>88</td>
<td>46/48 (96%)</td>
<td>38/40 (95%)</td>
</tr>
</tbody>
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References


