L'UTILISATION DE CHIENS RENIFLEURS POUR LA DÉTECTION DU SARS-COV-2

RAG sous-groupe Testing – 12 avril 2021

Note : Les recommandations actuelles sont susceptibles d'être modifiées en fonction de nouvelles informations et/ou de l'évolution de l'épidémie.

Résumé des recommandations :

- Les preuves actuellement disponibles sont encore insuffisantes pour recommander l'utilisation de chiens renifleurs. Nous recommandons donc de réaliser une étude complémentaire dans une deuxième phase, dans laquelle les aspects suivants seront approfondis :
  - Performance des chiens dans une situation réelle de dépistage de personnes asymptomatiques. Il est préférable de le faire dans un cadre où la RT-PCR est déjà systématiquement testée, comme les voyageurs revenant d'une zone rouge ou les étudiants.
  - La sensibilité dans la détection du SARS-CoV-2 par rapport à la charge virale (% de sujets avec une charge virale élevée détectée et comparaison avec d'autres tests de dépistage).
  - Détection éventuelle de cas pré symptomatiques/ pré-PCR positifs (par exemple en comparant le résultat avec le deuxième test RT-PCR chez les voyageurs de retour au jour 7).
  - Des moyens d'augmenter le nombre de dépistages par chien et par jour, et de simplifier la collecte d'échantillons, notamment en examinant si le reniflement direct des humains est une option.
  - L'impact sur les personnes vaccinées.
  - Le coût par personne dépistée.
- Il est recommandé d'élaborer un protocole pour l'étude susmentionnée et de le soumettre à l'approbation du Task Force Testing.
- Ne pas commencer à former d'autres chiens avant d'avoir obtenu des éclaircissements sur ce qui précède.

Les personnes suivantes ont participé à cet avis :

Emmanuel André (KU Leuven); Olivier Denis (CHU-UCL Namur); Herman Goossens (UAntwerpen); Marie Pierre Hayette (CHU-Liège); Yves Lafort (Sciensano); Barbara Legiest (ZG); Tinne Lernout (Sciensano); Pieter Libin (UHasselt); Elizaveta Padalko (UZGent); Olivier Vandenberg (LHUB-ULB); Ann Van den Bruel (KU Leuven); Steven Van Gucht (Sciensano); Pieter Vermeersch (KU Leuven).

CONTEXT

In October 2020, a positive advice was given to grant funding for a project by a consortium of academic institutions (UGent, ULiège) and actors on the ground (army, fire brigade, police) to train a selected number of search dogs in the detection of SARS-CoV-2. The first phase of the project has now been finalized, and a request was made for additional funding to train more dogs.

The RAG Testing was requested to evaluate the results of the first phase and provide an advice on the usefulness of this testing approach and potential settings in which it could be applied.

RECOMMENDATIONS IN THE OCTOBER 2020 ADVICE

It was recommended to grant the funding on the condition that a more detailed and clearly written-out protocol was presented. Search dogs were said to potentially be an additional tool in a diversified testing strategy, in circumstances when quick results and high-throughput are required.

The protocol had to address the following issues:

- Specify the level of viral shedding of the COVID-19 cases from which the samples were taken, to allow assessing the level of infectiousness of detected and missed cases.
- To assess interference by other (respiratory) infections like Influenza.
- To assess the usefulness in detecting COVID-19 in pre-and a-symptomatic cases.

RESULTS OF PHASE 1 AND PROPOSED NEXT STEPS

Six dogs were trained and each dog tested 300 COVID-19 positive and 100 COVID-19 negative armpit sweat samples. Positive samples were collected from different hospitals and negative samples from nursing homes and among volunteers. Sensitivity in detecting positive samples varied between dogs from 72.6% to 94.2% (average of 80.6%) and specificity from 95.0% to 100% (average of 98.3%). Sensitivity was improved by letting 2 dogs sniffing the same sample.

The faculty of Veterinary Medicine of UGent conducted an acceptability study through a questionnaire among the general population. Preliminary results show high acceptability, and the proposed contexts where to employ search dogs are mostly airports/ports/stations, festivals/events, and sport manifestations.

The consortium steering group already developed a protocol for certifying dog teams as “Medical Detection Dogs”, in which it defines that the minimum sensitivity has to be 80% and the minimum specificity 95%. Certification would be valid for a period of 6 months. The steering group argues that the currently trained dogs need further training to remain operational. The time required for training a search dogs is 3 months, and an additional 2 months to train them in detecting SARS-CoV-2.

The maximum capacity of a test team (comprising 2 dogs and 5 people) per day is 192 samples, corresponding with about 4000 tests per month. There are plans to raise this number to 300/day.

DISCUSSION

- Several studies assessing the effectiveness of search dogs in detecting SARS-CoV-2 have been conducted with overall positive results (reasonably high sensitivity and specificity), although with an important limitation. The positive SARS-CoV-2 samples used were all from symptomatic people at hospitals, and Ct values were not documented. It is therefore not exactly known what the performance is in low-risk asymptomatic people and to what extent the detected and missed cases are infectious. The Belgian pilot study was expected to address these issues, but did not.
- While real-life experiences all claim good results, none has scientifically assessed the effectiveness of the screening. The Finish Ministry of Social Affairs and Health has halted the expansion of employing search dogs on the ground that there is not sufficient evidence of its effectiveness.
- There appears to be agreement that the employment of search dogs is a useful addition to a test strategy, but can never replace diagnostic tests.
- The only current use is in pilot projects screening arriving passengers at international airports. Other possible uses mentioned are at other international entry points (harbors, train stations) hospitals, senior care facilities, schools, universities, and large public gatherings for sporting events and concerts.
- Performance varies substantially between dogs, and can vary over time in the same dog because of fatigue, boredom, external distractions, etc.
- Sensitivity can be increased by having the same sample sniffed by more than one dog.
- The sample used varies between studies, and between current real-time implementations. Most commonly used are armpit sweat (France, Lebanon, UAE) and skin wipes (Finland, Chile). Some studies used respiratory secretions.
- No international agency is yet providing advice on the use of search dogs for SARS-CoV-2 detection, and no national guidelines were identified.
- The current capacity (6 dogs) allows screening approximately 500-600 people/day, possibly 900/day in the future. This capacity appears insufficient for systematically screening all arriving passengers at airports, or for screening large crowds (more than hundred) before mass gathering events.
- The time required to train additional dogs is 5 months.
- There are no data on what the effect of vaccination is on the dogs' performance. Theoretically vaccination could produce volatile organic components that have a similar effect as of a SARS-CoV-2 infection.

CONCLUSION

There are still a number of questions that need to be answered, before concluding that employing search dogs is a useful strategy:

- More clarity is needed on the performance of the dogs with regards to the level of infectiousness. It is currently not known what the viral load is of detected and missed cases, or how the dogs compare to other screening tests, such as rapid or automated Ag tests.
- Available data are currently all from study settings evaluating performance on samples from hospitalized patients, and there is a lack of data on performance in real-life screening of asymptomatic people.
- The number of screenings performed per dog team is currently too low to be useful in settings where a large number of people need to be screened. Alternative sampling methods need to be further explored. Ideally dogs should be able to sniff infected people without having to collect a sample.
- The cost appears high (employing 5 persons to screen only 200 samples/ a day) and there is a need for a more precise cost estimate per person screened.

RECOMMENDATIONS

- To conduct a next phase with the currently six trained dogs, evaluating the following issues:
  - Identify a real-life screening setting in which the performance of the search dogs can be compared to the results of an RT-PCR test. This is best a setting in which an RT-PCR test is already systematically performed, such as among resident travelers returning from a red zone (for example at an airport) or among students who are already screened for other reasons (for example at ULiège or KU Leuven).
  - Calculate the sensitivity in function of the viral load (sensitivity in people with viral load >=10^5 RNA copies/mL or Ct value <25).
  - Assess possible detection of pre-symptomatic/ pre-PCR positive cases (for example by comparing the result to the second RT-PCR test among returning travelers on day 7).
  - Explore ways to improve efficiency by increasing the number of screening/dog/day. Assess performance of directly sniffing people vs. sniffing sweat samples. Assess the use of alternative samples, such as skin wipes.
  - Assess the effect on vaccinated people.
  - Estimate the cost per person screened (cost of training, salary cost of accompanying staff…).
- To elaborate a protocol for the above study and submit it for approval to the Task Force Testing.
- Not to initiate the training of additional dogs until there is more clarity on the above.

BACKGROUND

Scientific evidence

A first review of the scientific evidence of the performance of search dogs in detecting SARS-CoV-2 is available in the previous advice. Since then, some additional publications have

become available. The table below summarizes the results of the different studies. Other studies are ongoing, but have not yet published any results (1).

Country	Nr of dogs trained	Type of sample	Nr of samples		Sensitivity		Specificity		Accuracy	
			pos	neg	Range	Mean	Range	Mean	Range	Mean
France/ Lebanon (2)	6	axillary sweat	95	82					76-100%	90%
Columbia (3)	6	respiratory secretions	220	780	77.3-100%	95.5%	99.2-99.8%	99.6%	99.1-99.8%	99.6%
Germany (4)	8	respiratory secretions	187	825	67.9-95.2%	82.6%	92.4-98.9%	96.4%		94%
UAE (5)	21	axillary sweat	151	110	71.4-100%	92.1%			70-100%	91.6%
Iran (6)	3	pharyngeal secretion	26	54	60.0-83.3%	65.4%	85.0-92.9%	88.9%		
Belgium	6	axillary sweat	300	100	72.6-94.2%	80.6%	95.0-100%	98.3%	90.7-97.7%	94.9%

Sensitivity differs substantially between studies and, most importantly, between dogs, but is generally in the range of 70%-100%. Specificity is higher, but rarely reaching 100%. Important is to point out that none of the studies documented the viral load of the used positive samples, and that all samples were from hospitalized symptomatic COVID-19 cases, often from the ICU. It is therefore risky to extrapolate the findings to asymptomatic, low-risk people.

A few review articles were published, analyzing the results of some of the studies above. Dickey et al. reviewed the studies in France/Lebanon, Columbia and Germany and concluded that scent detection dogs can likely be effectively employed to nonintrusively screen and identify individuals infected with the COVID-19 virus in hospitals, senior care facilities, schools, universities, airports, and even large public gatherings for sporting events and concerts (7).

Sakr et al. reviewed the studies in France/Lebanon and Germany, and other information available on the internet (8). They concluded that detection of SARS-CoV-2 by dogs is potentially an easy real-time mobile diagnostic aid with low cost and good performance. However, more evidence is needed to define the best fluid to test, testing procedure, time of possible detection according to disease evolution, risks associated with the dog exposure and to translate the good results in a study setting into a real-life operational one.

In a letter to the editor, Sharun et al. reviewed the same available evidence (9). They concluded that search dogs can be used as a preliminary screening method to help in the early identification and segregation of potential asymptomatic SARS-CoV-2 infected passengers from susceptible individuals at key entry points, such as airports and sea ports, but that they cannot be considered as a replacement to highly sensitive molecular diagnostic tests. They highlight that dogs are subjected to fatigue, hunger, boredom, and other external distractions, that can affect their ability to detect positive cases.

Else raises concerns about the limited sample size in the studies in France/Lebanon and Germany, and argues that larger datasets are needed (10).

International guidelines

No international or national guidelines on the use of search dogs for the detection of SARS-CoV-2 were identified.

International experiences

In France, the study of the performance of search dogs has entered a next phase with a larger experiment among 2000 students in Paris (11). No results are yet available.

Several countries have piloted/ initiated screening of arriving international passengers for COVID-19 with search dogs.

Since September 2020, six search dogs are employed at Helsinki airport, Finland, to screen for COVID-19 on skin wipes (12). Positivity rate in October 2020 was 0.6%. According popular media, accuracy is high and the dogs can even detect COVID-19 before actual symptoms appear, although no scientific report was ever published confirming these statements. On the other hand, plans to expand the employment of search dogs to screen travelers passing through other border checkpoints was halted by the Ministry of Social Affairs and Health on grounds that there is not sufficient evidence of the ability of dogs to detect COVID-19 (13).

In a pilot project at Beirut airport, Lebanon, search dogs screened 1,680 arriving passengers and found 158 Covid-19 cases (9.4%) that were confirmed by later RT-PCR tests. According popular media, specificity was 100% and sensitivity 92% (14). Travelers arriving at Dubai airport, UAE, are screened by six search dogs for CoVID-19 on armpit sweat samples since August 2020 (15). Saudi Arabia followed this example soon after (16). In Santiago de Chile's international airport search dog screen arriving passengers on sweat swipes (17). Thailand and India are also considering or planning the use of search dogs.

References

1. Jones RT, Guest C, Lindsay SW, Kleinschmidt I, Bradley J, Dewhirst S, et al. Could bio-detection dogs be used to limit the spread of COVID-19 by travellers? J Travel Med. 2020 Dec 23;27(8).
2. Grandjean D, Sarkis R, Lecoq-Julien C, Benard A, Roger V, Levesque E, et al. Can the detection dog alert on COVID-19 positive persons by sniffing axillary sweat samples? A proof-of-concept study. PloS One. 2020;15(12):e0243122.
3. Vesga O, Valencia AF, Mira A, Ossa F, Ocampo E, Agudelo M, et al. Dog Savior: Immediate Scent-Detection of SARS-COV-2 by Trained Dogs. bioRxiv. 2020 Jun 19;2020.06.17.158105.
4. Jendrny P, Schulz C, Twele F, Meller S, von Köckritz-Blickwede M, Osterhaus ADME, et al. Scent dog identification of samples from COVID-19 patients - a pilot study. BMC Infect Dis. 2020 Jul 23;20(1):536.
5. Grandjean D, Marzooqi DHA, Lecoq-Julien C, Muzzin Q, Hammadi HKA, Alvergnat G, et al. Use Of Canine Olfactory Detection For COVID-19 Testing Study On U.A.E. Trained Detection Dog Sensitivity. bioRxiv. 2021 Jan 20;2021.01.20.427105.
6. Eskandari E, Ahmadi Marzaleh M, Roudgari H, Hamidi Farahani R, Nezami-Asl A, Laripour R, et al. Sniffer dogs as a screening/diagnostic tool for COVID-19: a proof of concept study. BMC Infect Dis. 2021 Mar 5;21(1):243.

7. Dickey T, Junqueira H. Toward the use of medical scent detection dogs for COVID-19 screening. J Am Osteopath Assoc. 2021 Feb 1;121(2):141–8.

8. Sakr R, Ghsoub C, Rbeiz C, Lattouf V, Riachy R, Haddad C, et al. COVID-19 detection by dogs: from physiology to field application-a review article. Postgrad Med J. 2021 Feb 11;

9. Sharun K, Jose B, Tiwari R, Natesan S, Dhama K. Biodetection dogs for COVID-19: an alternative diagnostic screening strategy. Public Health. 2021 Jan 19;

10. Else H. Can dogs smell COVID? Here's what the science says. Nature. 2020 Nov 23;587(7835):530–1.

11. Les chiens plus efficaces que les tests PCR pour dépister le Covid ? Une expérimentation lancée [Internet]. LCI. [cited 2021 Mar 30]. Available from: https://www.lci.fr/sante/covid-les-chiens-plus-efficaces-que-les-tests-pcr-pour-depister-le-coronavirus-une-experimentation-lancee-2178681.html

12. Finland first in Europe to use dogs to detect Covid-19 [Internet]. United Nations Western Europe. 2020 [cited 2021 Mar 30]. Available from: https://unric.org/en/finland-first-in-europe-to-use-dogs-to-detect-covid-19/

13. Finnish Customs won't use dogs to sniff out Covid-19 despite months of preparation [Internet]. [cited 2021 Mar 30]. Available from: https://www.helsinkitimes.fi/finland/finland-news/domestic/18786-finnish-customs-won-t-use-dogs-to-sniff-out-covid-19-despite-months-of-preparation.html

14. Early studies using sniffer dogs to detect Covid-19 show some promise [Internet]. Hindustan Times. 2020 [cited 2021 Mar 30]. Available from: https://www.hindustantimes.com/science/early-studies-using-sniffer-dogs-to-detect-covid-19-shows-some-promise/story-7Shk955cJq5nmo6cP6aWLP.html

15. Coronavirus: UAE's police dogs first in the world to successfully sniff out COVID-19 [Internet]. Al Arabiya English. 2020 [cited 2021 Mar 31]. Available from: https://english.alarabiya.net/coronavirus/2020/07/31/Coronavirus-UAE-s-police-dogs-first-in-the-world-to-successfully-sniff-out-COVID-19

16. After UAE, Saudi Arabia to use dogs to sniff out COVID-19 at airports [Internet]. The Week. [cited 2021 Mar 31]. Available from: https://www.theweek.in/news/world/2020/08/05/saudi-arabia-and-uae-to-use-dogs-to-sniff-out-covid-19-at-airports.html

17. Staff R. Sit, stay, detect COVID! Chile dogs report for duty at Santiago airport. Reuters [Internet]. 2020 Dec 24 [cited 2021 Mar 30]; Available from: https://www.reuters.com/article/us-health-coronavirus-chile-dogs-idUSKBN28X2S2