BIOTHREAT DETECTION CANINES FOR DISEASE DETECTION & PANDEMIC PREPAREDNESS

Michele N. Maughan[2], Caitlin E. Sharpes[2], Jenna D. Gadberry[3], Kelley L. Evans[1], and Patricia E. Buckley[1]

[1]U.S. Army Combat Capabilities Development Command Chemical Biological Center, Aberdeen Proving Ground, MD, [2]Excet Inc., Springfield, VA, [3]Intrinsic24 LLC Hayden, ID

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Requirement: Canines have a proven capability in detection of diseases based on sensing changes in the human volatilome. During the early stages of an outbreak, canines can be rapidly deployed while waiting for traditional detection/diagnostics to come online.

Objective: Utilize scent detection working dogs to rapidly pre- screen subclinical or early-stage suspected COVID-19 patients in order to better triage patient care, manage scarce resources (test kits, PPE) and limit personnel entry into groups or facilities. Current screening relies on thermometers (measuring fevers), but with a 5+ day incubation period, that often misses a large sector of the infected but subclinical or asymptomatic population.

Approach: Currently fielded biological threat detection technologies and FDA-approved medical diagnostics rely on detecting a pathogen's genetic material in a host or antibodies created by the host immune response; both approaches require close contact, handling of hazardous materials, technical expertise, and time. However, there is one autonomous stand-off biological detector that has a rapid, seek-and-find capability thereby reducing the risk of direct human contact with the pathogen: Dogs. Canines represent a detection platform entirely unlike any technology in existence: semi-autonomous, capable of periods of continuous operation, and truly threat-agnostic. U.S. Army DEVCOM CBC and research centers around the world have demonstrated that **scent detection dogs are able to identify COVID-19 positive individuals and disregard COVID-19 negative individuals.**

Biomedical Detection Dogs (BMDDs) for Disease Detection
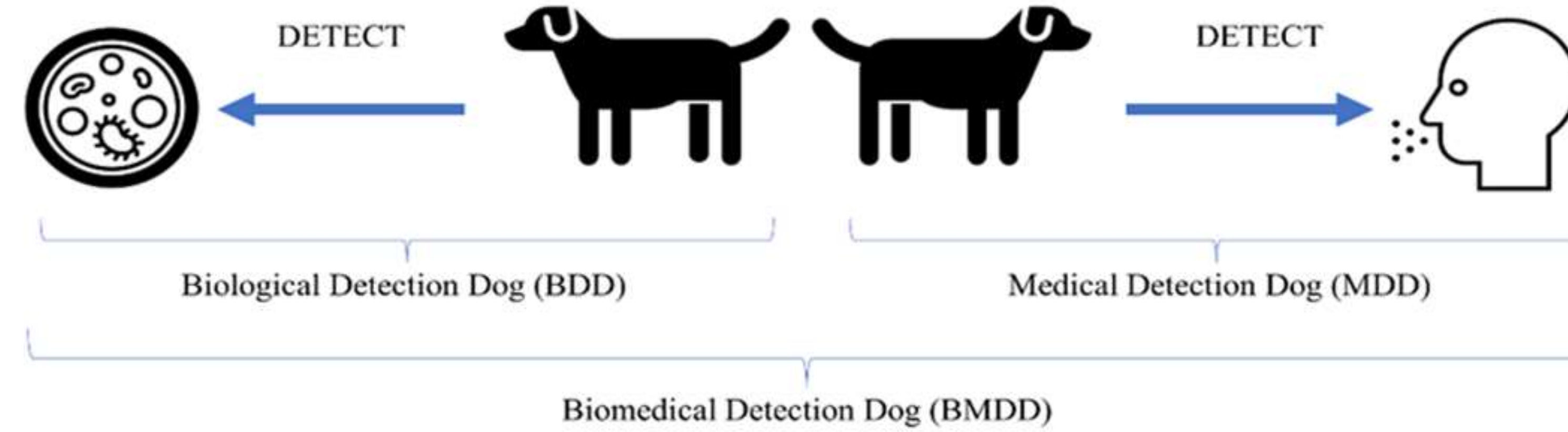
The Biological Detection Dog (BDD) detects the odor of (or odors associated with) the pathogen or etiological agent.

Medical Detection Dog (MDD) detects the odor of (or odors associated with) the disease state produced by an infected host in response to the pathogen or the altered volatilome due to disease not caused by an infectious agent.
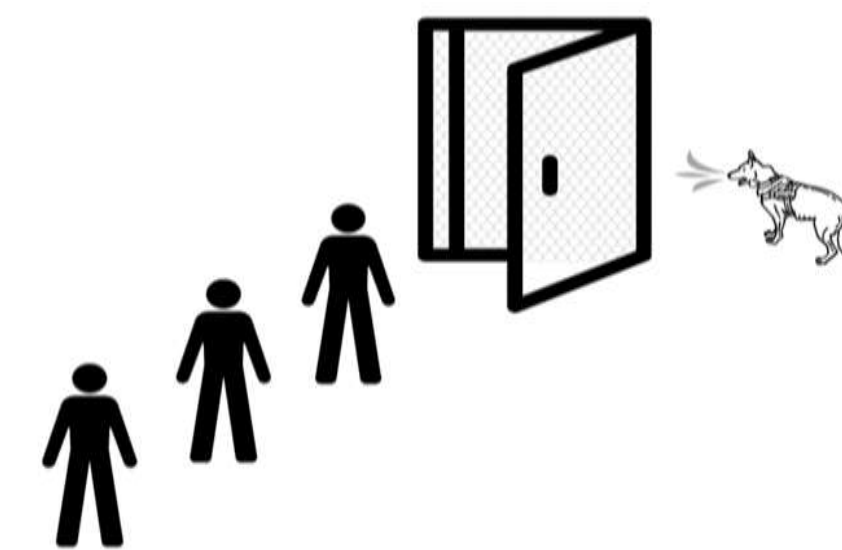
Operationalization of BMDDs
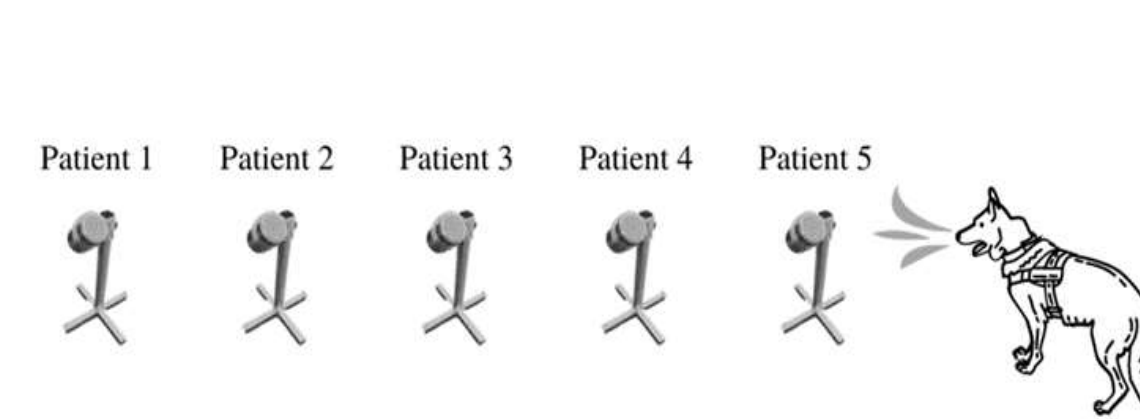
Deployment Scenario 1: Patient Line Ups

The most basic of deployment scenarios in which a BMDD screens people or environmental samples in an area separated from the disease outbreak.

Patient Sample Line Ups:
-Detention centers
-Hospitals
-Large scale exercises

Deployment Scenario 2: Controlled Portal

BMDD people screening in the disease outbreak area, yet physically separated from the population. Here, the BMDD is separated by a mesh screen or high efficiency particulate air filter if needed and can screen people through a checkpoint or individually through a lineup or room.

Personnel Portal:
-Established Entry Control Point (ECP)
   -Embassy
   -Military Bases
   -Ships
   -Congress
   -Pentagon
   -White House
   -Borders

Deployment Scenario 3: Expeditious Triage

Most complex deployment scenario in which a canine team screens people either en masse or in a lineup by being able to directly sniff each individual or group of people.

Short Notice Triage:
-Quick infil/exfil
-No established portal infrastructure
   -Outbreak at exercise
   -On board a ship
   -At a Forward Operating Base (FOB)

Real World Case Study – Patient Sample Line-Ups

The objective of this study was to train detection dogs to discriminate between SARS-CoV-2 (+) and (-) humans based on worn t-shirts. A total of 8 dogs were tested with a total of 13 novel SARS-CoV2 (+) targets and 60 novel SARS-CoV2 (-) controls.

K9	Sensitivity (%)	Specificity (%)
Argo	86.36	89.02
Blaze	79.54	92.40
Dixie	79.54	91.98
Jake	77.27	89.45
Miley	93.18	95.35
Poncho	83.72	91.56
Tikka	84.09	91.98
Tuley	88.63	93.24

For the overall evaluation, the **sensitivity was 84.0%** and the **specificity was 91.9%**. A prop test indicates there is a statistically significant difference between the detection rate and random guessing. Prop tests by K9 do not indicate a statistically significant difference between correct detection or false alert rates by K9.

In conclusion:
• BMDDs proved to be rapid, highly-selective detectors of the COVID-19 disease state in humans,
• Simple cotton t-shirts were able to capture and retain identifiable human scent for over a year, and
• The 8 BMDDs in this study demonstrated similar detection capabilities.