Short Communication

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Taking Clinical Laboratory Testing To New Heights: Reference Laboratory's Proof-Of-Concept Drone Logistics Flight for Diagnostic Specimens

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Logistics, Drones, Laboratory Testing, Clinical, Specimens.

Drone History and Applications
Unmanned aircraft vehicles (UAV), also known as drones, are aircrafts without an onboard human pilot. On December 1st of 2013 Amazon.com introduced delivery civilian drones. Driven by low-cost sensors, UAVs had military uses, but since 2013 civil applications were reported, namely, industrial surveillance, business parcel delivery, and imaging. Recently, health applications have included search and rescue, drug and vaccine delivery, the provision of care technology in emergencies, and organ transport. Transportation of clinical laboratory specimens is an attractive potential UAS application.

Logistic Challenges of Clinical Laboratory Specimens
The transportation of clinical specimens occurs daily in both urban and rural environments by planes or cars. Generally, specimens are collected in physician offices or clinics, with small laboratories with limited testing capabilities, and must be transported to larger, moderate or high complexity laboratories to perform the testing to help in the clinical care process. To demonstrate the logistic challenge in the United States there are approximately 244,000 laboratories, physician offices and other small non-hospital clinical laboratories that account for ~75% of these laboratories, which only do 13% of testing. In addition, 63% of that testing volume was in a point-of-care format; thus, offering a limited testing menu.

At Interpath Laboratory (IPL) the decentralization laboratory model is a logistical challenge. IPL with more than 90 locations, across three states, namely, Oregon, Washington and Idaho. IPL currently has its own quality courier system that covers 15,000 miles/day and faces transportation challenges such as traffic delays due to accidents, traffic, or weather.

Interpath Laboratory Rises to the Challenge and Plans to Integrate a Drone Logistic System
UAS have advantages for the transportation of clinical specimens such as no traffic delays, low overhead costs, and ability to travel to unreachable places. Currently, Interpath Laboratory has flown, via a Wingcopter 198, the first successful 15 mile round trip proof-of-concept transportation of specimens from the Yellowhawk Tribal Health Center to Interpath's main medical laboratory location in Pendleton, OR (Figure 1). The significant potential impact of UAS transportation on laboratory testing is to reduce the turnaround time, improve patient satisfaction and timely healthcare provider follow-up. We have begun the validation experiments on the stability of UAS transportation on the most common tests performed at Interpath laboratory [1]. In addition, we are in the midst of assessing the acceptability quality criteria for UAV-transported specimens. They are mainly measures of accuracy. We will be evaluating our results in three ways: 1) the establishment of performance acceptability criteria; 2) examination of changes in reference range-based clinical classification; and 3) assessment of differences between laboratory-derived (analytic) CV's and that from our paired vehicle-transported samples. If successful, UAS transportation will dramatically change the way health care systems use diagnostic testing.

Author Contributions
All authors confirmed they have contributed to the intellectual content of this paper and have met the following 4 requirements: (a) significant contributions to the conception and design, acquisition of data, or analysis and interpretation of data; (b) drafting or revising the article for intellectual content; (c) final approval of

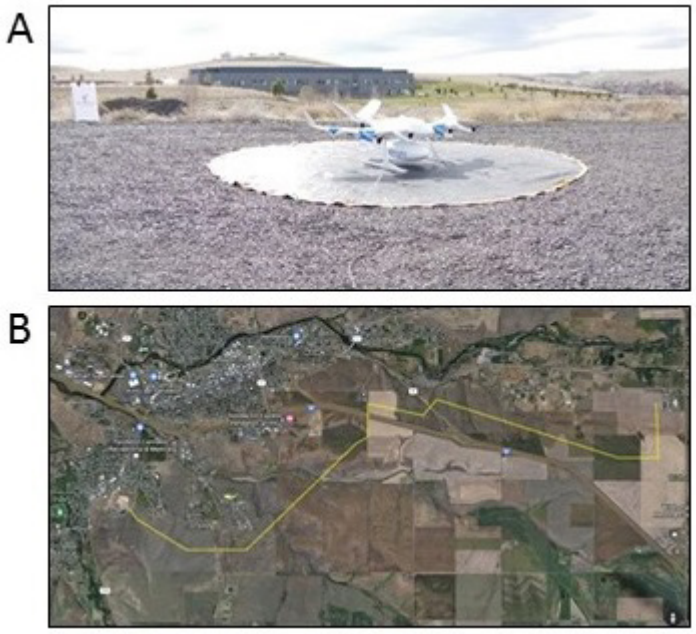

Figure 1: UAV proof-of-concept 15-mile flight. A) UAV model and B) Flight path from Yellowhawk Tribal Health Center to Interpath's Laboratory in Pendleton, OR.

the published article; and (d) agreement to be accountable for all aspects of the article thus ensuring that questions related to the accuracy or integrity of any part of the article are appropriately investigated and resolved.

C Alexander Valencia drafted and finalized published article.

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