



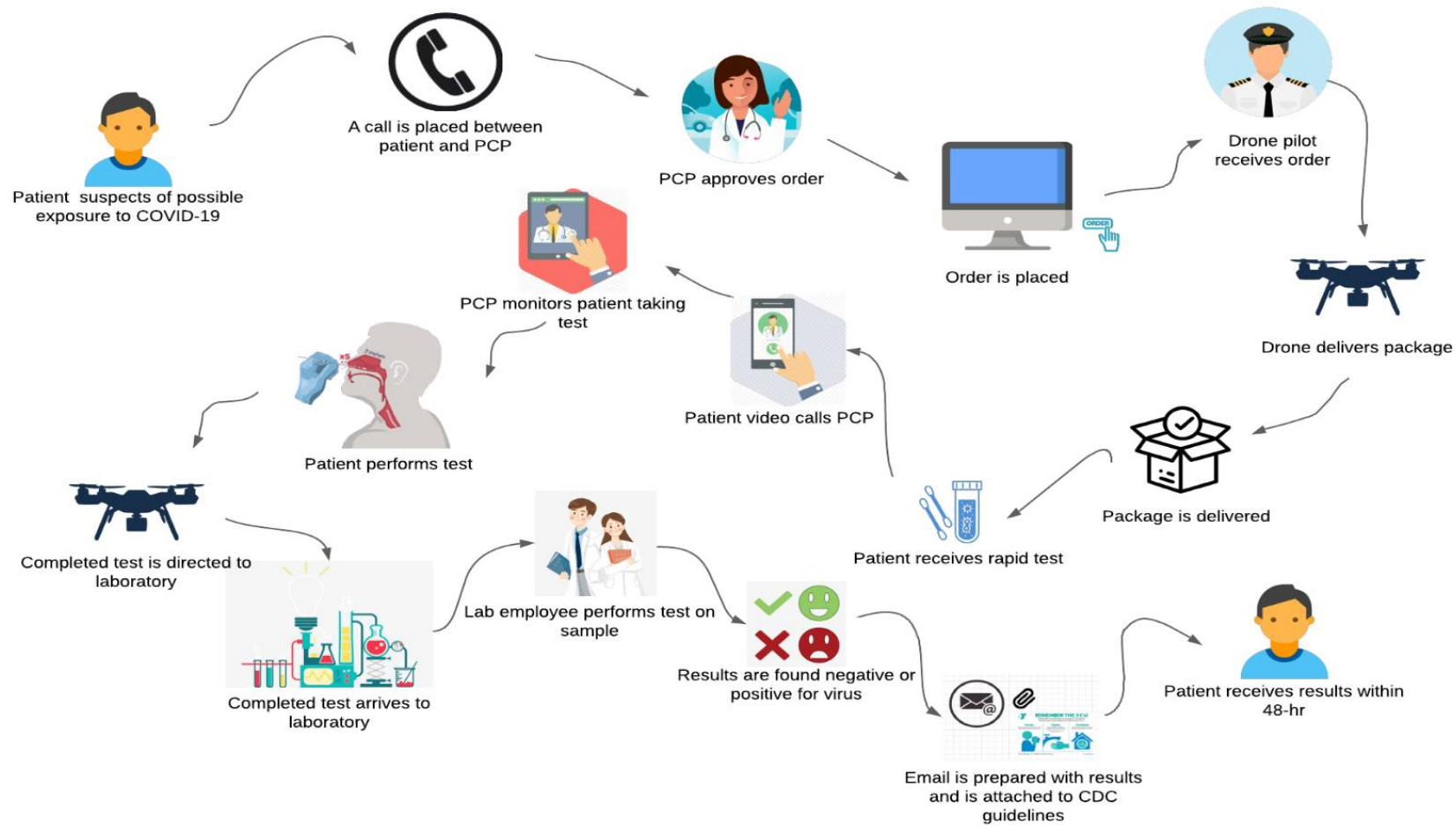
Implementation of Unmanned Aerial Vehicles for contactless COVID-19 test delivery

Spring 2021

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IE 4466 SENIOR DESIGN

Concept of Operations



Decomposition of Concept of Operations



Figure 1

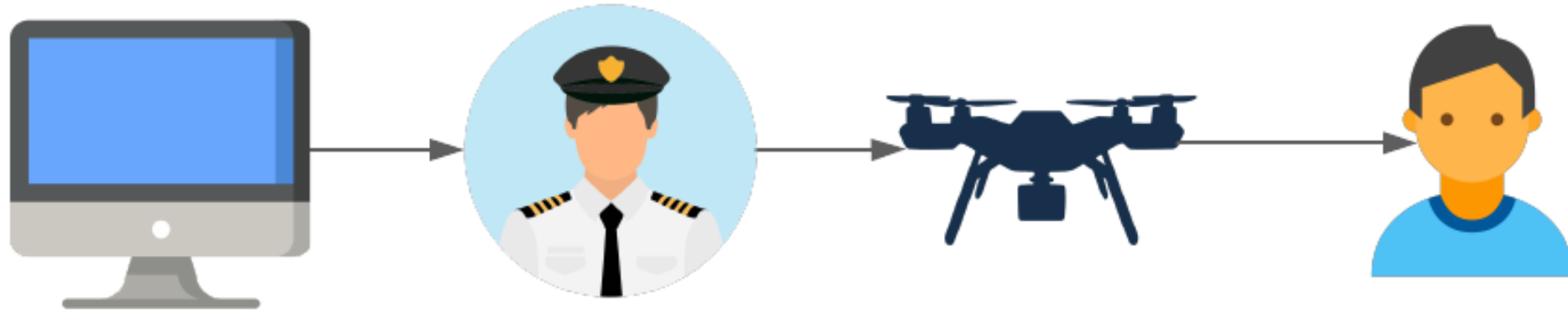


Figure 2

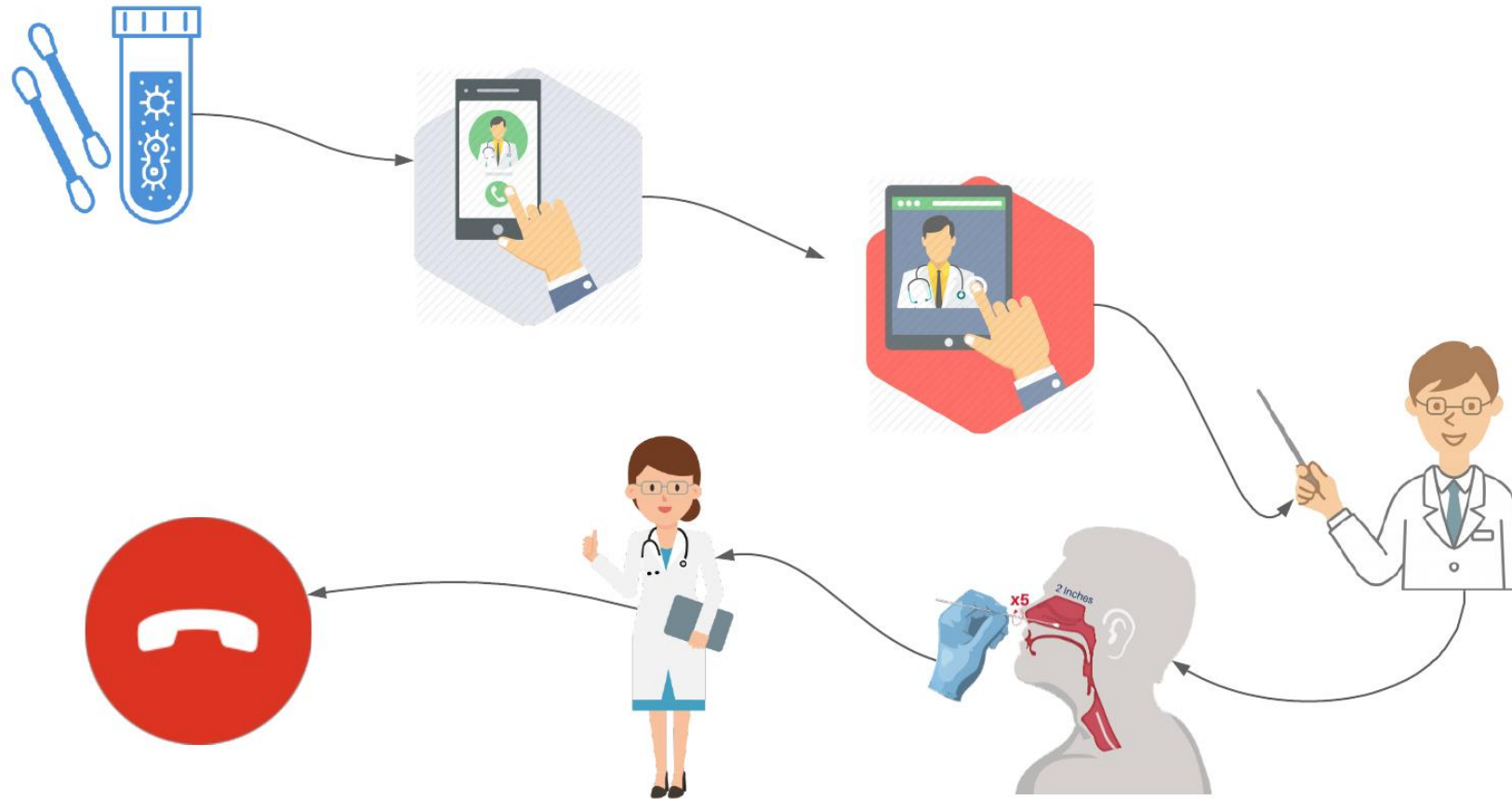


Figure 3

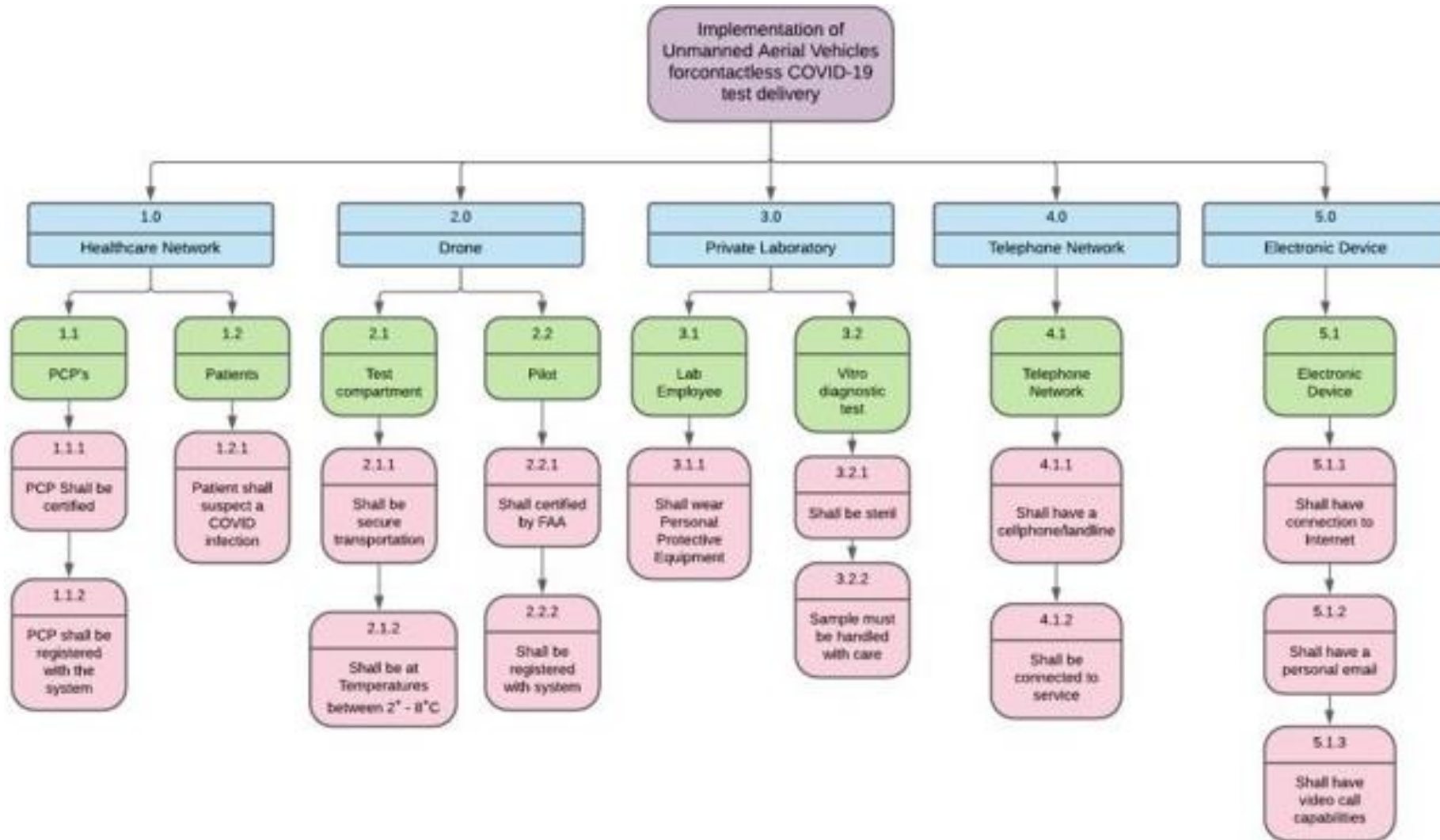


Figure 4



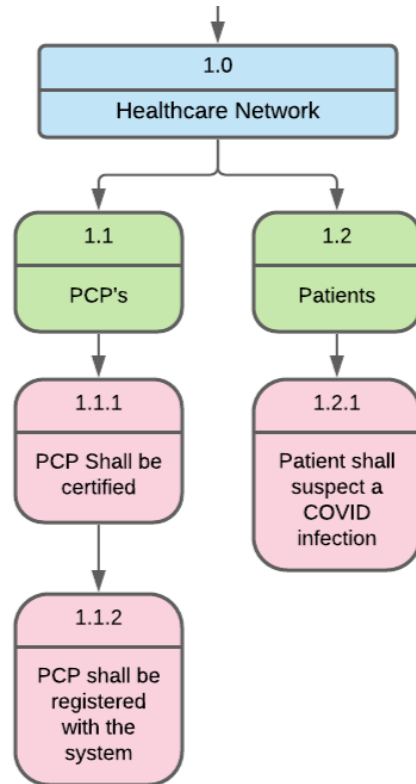
Figure 5

System Decomposition and Requirements



Subsystem and Part Design

Healthcare Network



1.1 PCP

1.1.1 PCP shall be certified

A background investigation shall be conducted on behalf of the employer to verify educational history.

THIRD PARTY

1.1.2 PCP shall be registered with the system.

The PCP should fill out an application to enroll themselves in the system and send directly to headquarters.

Enrollment Application

1.2 Patient

1.2.1 Patient shall suspect a COVID infection

The patient should observe COVID – 19 symptoms.

The patient should conduct a self-assessment to determine whether it is necessary to take a COVID – 19 test.

Self – Assessment Form

Enrollment Application

UAV Contactless Delivery Program Enrollment Application

Primary Care Provider Information

Name:

Phone Number:

Healthcare Center Information

Address:

City:

State:

Zip Code:

Phone Number

Submit Application

Self- Assessment Form

COVID-19 SELF ASSESTMENT QUESTIONNAIRE

Are you experiencing any of the following symptoms? (CIRCLE ANSWER)

FEVER	YES	NO
COUGH	YES	NO
SHORTNESS OF BREATH	YES	NO
SORE THROAT	YES	NO
RUNNY NOSE	YES	NO
FEELINGS OF UNWELLNESS	YES	NO

HAVE YOU BEEN IN CONTACT WITH ANYONE WHO HAS TESTED POSITIVE FOR COVID 19? (CIRCLE ONE)

YES	NO
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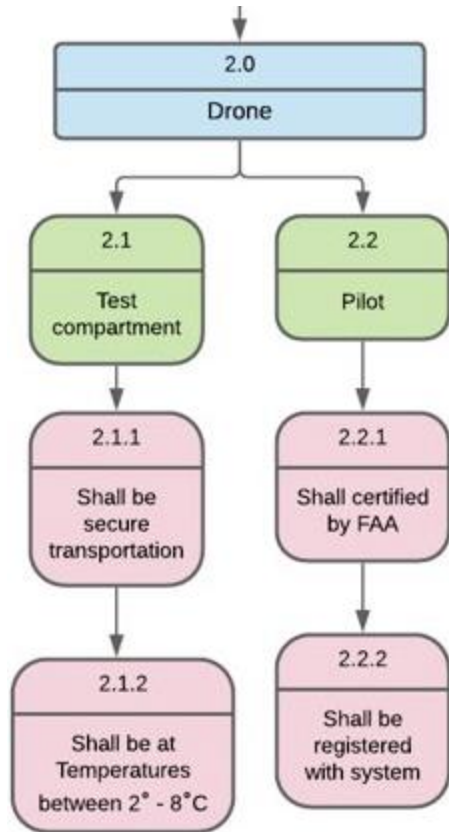
HAVE YOU TRAVELED OUT OF TOWN IN THE PAST 10 DAYS?

YES	NO
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IF YOU HAVE ANSWERED "YES" TO ANY OF THE QUESTIONS, A COVID-19 INFECTION IS POSSIBLE.

SEEK TO GET TESTED AND SELF ISOLATE

Drone System



2.1 Test Compartment

2.1.1 Shall be secure transportation

A monthly test and inspection shall be conducted in order to test the drone's delivery compartment to ensure that the compartment is secure.

2.1.2 Shall be at temperatures between 2 to 8 degrees Celsius

A monthly test and inspection shall be conducted to ensure temperature functionality.

Preventive Maintenance Inspection Form

2.2 Pilot

2.2.1 Pilot shall be certified by the FAA

A background investigation shall be conducted on behalf of the employer to verify educational history and certification.

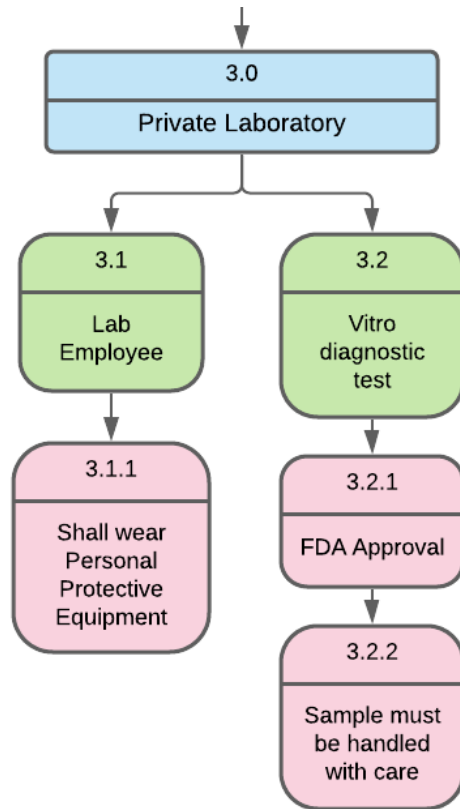
2.2.2 Pilot shall be registered with the system

The pilot's employer shall enroll pilot in the drone operating system in order to give access of flying drone to pilot.

Preventative Maintenance Inspection Form

PREVENTATIVE MAINTANENCE INSPECTION FORM	
INSPECTOR _____	DATE _____
DRONE SERIAL NUMBER _____	
	CHECK OFF
PRELIMINARY INSPECTION	
DRONE IS COMPLETELY POWERED OFF	_____
DRONE HAS AN APPROPRIATE COMPLETED CLEANING ROUTINE LOG	_____
IF NOT, SEND BACK FOR REGULAR CLEANING CYCLE	
DRONE DOES NOT HAVE ANY LOSE SCREWS	_____
PROPELLERS DO NOT EXIBIT ANY OBSTRUCTIONS	_____
TRANSPORT INSPECTION	
DRONE COMPARTMENT OPENS AND CLOSES	_____
DRONE COMPARTMENT DOES NOT OPEN DURING FLIGHT TIME	_____
DRONE COMPARTMENT COOLING UNIT	
COOLING UNIT MAINTAINS THE TEMPERATURE 2-8 DEGREES CELCIUS FOR TWO HOURS	_____
INSPECT THE EXTERIOR OF DRONE. NOTE IF THERE ARE ANY ADDITIONAL CRACKS OR ANOMALIES	
COMMENTS:	

Private Laboratory



3.1 Lab Employee

3.1.1 Shall wear Personal Protective Equipment including; an appropriately fitted isolation gown, a NIOSH-approved N95 filtering facepiece respirator or higher level, a face shield or goggles, and a pair of disposable patient examination gloves.

- We will purchase the proper PPE from Pacific Medical Products.
- We are going to purchase the following components:
 - Protective Procedure Gown by PolyCo - \$29.99 (box of 15)
 - Gerson 1730 N95 Mask, MEDICAL Grade USA Made - \$477.95 (240 masks)
 - Safety Goggles by Graham Field- \$4.49 ea.
 - Small Nitrile Gloves - \$12.95 (100 ct.)
- All PPE components will be thoroughly disinfected upon arrival to the facility.
- We will ensure employees follow the donning and doffing procedures CDC has recommended by posting the following flyer around the facility:

https://www.cdc.gov/coronavirus/2019-ncov/downloads/A_FS_HCP_COVID19_PPE_11x17.pdf
- Managers must comply with routine checks around the facility to supervise the right use of the protective equipment.

3.2 Vitro Diagnostic Test

3.2.1 Vitro Diagnostic Test shall be approved by the FDA.

- We will purchase the Vitro Diagnostic Tests from Becton, Dickinson and Company (BD)

<https://bdveritor.bd.com/en-us/ordering-reimbursement>

- We will purchase the following FDA approved products:



BD Veritor™ Plus Analyzer

DISTRIBUTOR PRODUCT NUMBERS:
Medline: 800256066
McKesson: 1029527 / 25662409
TwinMed: 005-105449
Concordance Healthcare Solutions: 262317
Fisher: 8256066
Henry Schein: 126-5527
BD Product number: 256066
Quantity: 1 Analyzer



BD Veritor™ System for Rapid Detection of SARS-CoV-2* kit

Includes: BD Veritor™ System SARS-CoV-2 tests, sample collection swabs, BD Veritor™ System SARS-CoV-2 Extraction Reagent, tube top, BD Veritor™ System SARS-CoV-2 positive (-) and negative (+) control swabs

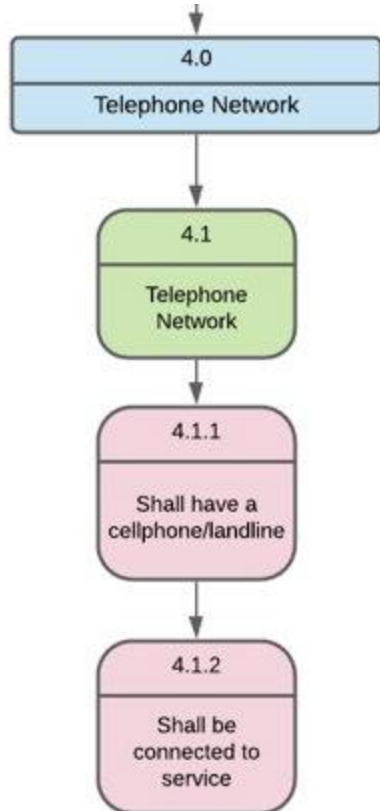
DISTRIBUTOR PRODUCT NUMBERS:
Medline: 800256062
McKesson: 11030187 / 25602430
TwinMed: 805-105445
Concordance Healthcare Solutions: 320088
Fisher: 8256082
Henry Schein: 138-4449
BD Product number: 256062
Quantity: 30 tests

- To start, we will be purchasing 5 Analyzers and 20 Detection Kits (30 tests ea.)

3.2.2 Vitro diagnostic Test shall be handled with care: lab employee must not spill sample, nor contaminate it.

- Inspectors qualified to evaluate the methodologies used by the laboratories in performing laboratory examinations and other procedures will be hired to make sure there is in effect a certificate issued by the Secretary for our Laboratories.
- Without proper procedures, inspection would not be approved therefore no certificate would ever be issued.
- FDA will oversee and regulate these inspectors.
- Facilities will be regulated frequently. (No less than twice a year).

Telephone Network



4.1 Telephone Network

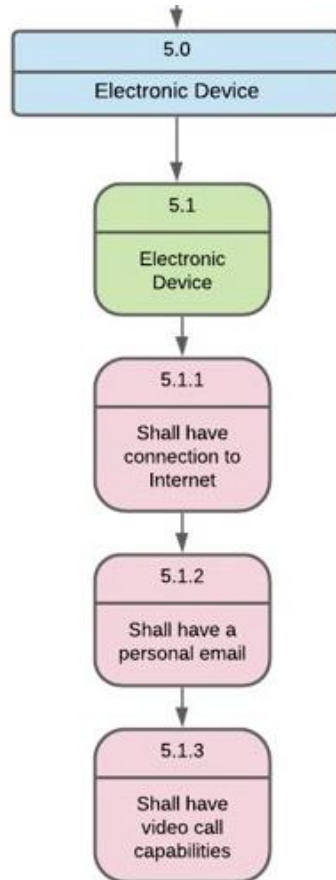
4.1.1 The telephone network shall have a cellphone/landline.

- We will make sure that the PCP has a cellphone (iPhone or other cellphones), this will allow them to contact the patient virtually.
- There will be an investigation conducted, we will test that both parties have access to a telephone landline from where they are located.
- To ensure that both parties have access, the patient must call the PCP first to make sure that their call went through.

4.1.1 The telephone network shall be connected to service.

- Once we investigate the PCP's internet connectivity, we will confirm the PCP to contact the patient.
- We will investigate that both parties will have internet connection in order to avoid any glitches or system interruptions, this will make the call stable and the patient could perform the test correctly and appropriately.
- We will inspect the PCP's internet connectivity while they are giving the patient instructions to make sure that there are no system interruptions.
- Another investigation must be conducted on the patient to make sure that their internet connection is strong enough in order for them to receive the COVID-19 Rapid test results.

Electronic Device



5.1 Electronic Device

5.1.1 The electronic device shall have connection to the internet.

- We'll make sure the patient has access to an internet connection during the registration process by verbally asking the patient for confirmation of internet access.
- (As an extra measure for confirmation of internet access, a confirmation email will be sent to the patient when confirming email access, confirming internet access as a byproduct.)

5.1.2 Shall have a personal email

- We'll confirm the patient has access to a personal email by sending a confirmation email to the patient during registration. We'll verbally confirm this email was received by the patient during registration call.

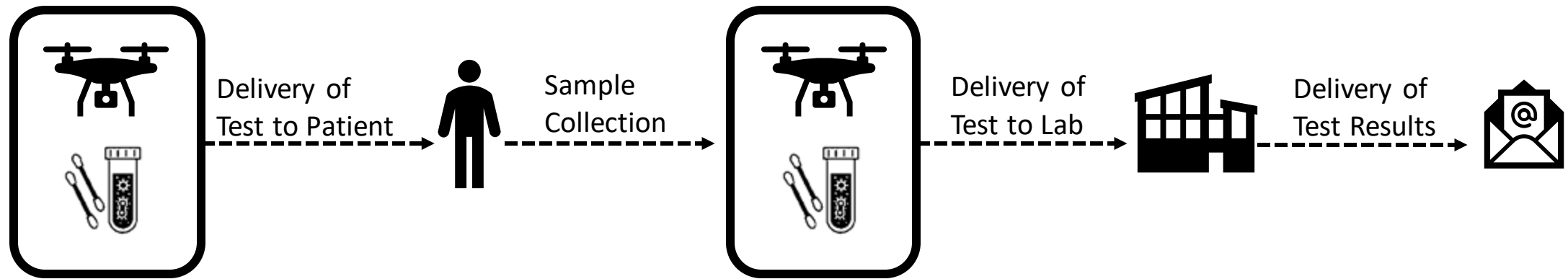
5.1.3 Shall have video call capabilities

- To ensure the patient has video call capabilities, a test call will be conducted during registration. A video call has been established between the two parties will serve as a confirmation of video call capabilities.
- Video call will be done through third-party service at the preference of the customer.

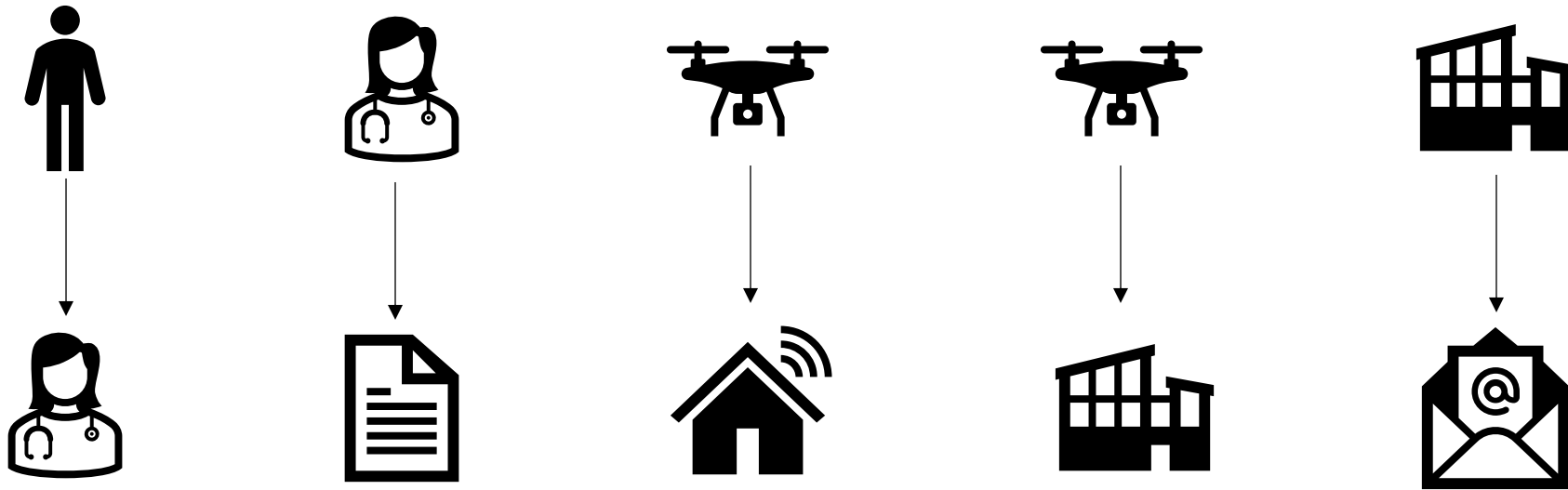
Requirements Validation and Verification Plan

Requirement	Requirement Validation	Verification Method	Verification Plan
Patient shall suspect a COVID-19 infection	The patient will suspect a COVID-19 infection. That way, they will contact their PCP to order their test immediately.	Analysis	We will analyze the patient's concerns by asking specific infection - related questions for the PCP to confirm the test delivery.
Test compartment shall transport test securely and tightly.	The test compartment will transport the test securely and tightly. The drone shall be tested before delivering the test to the patient in order to check if the drone is safe to deliver the test.	Test	We will test the drone's capability of holding the tests before delivering them to the patient.
Lab employees shall wear Personal Protective Equipment including; an appropriately fitted isolation gown, a NIOSH-approved N95 filtering facepiece respirator or higher level, a face shield or goggles, and a pair of disposable patient examination gloves.	Lab Manager will make sure employees who encounter any test samples are properly wearing their required Personal Protective Equipment as indicated by the CDC.	Inspection	Laboratory managers will ensure lab employee are complying with the appropriate use of this equipment.
Patient shall have a personal email.	Patient will have a personal email in order to receive test results and additional information . This includes on how to protect themselves and others if their results are positive.	Inspection	We will inspect that the patient shall have a private email in order to receive test results.

Recomposing Parts into Final System



Validating Overall System



Questions?