

# Increasing Access to Healthcare During Disasters Utilizing Drone Technology

25<sup>th</sup> Annual Kentucky Rural Health Association Conference  
November 16, 2023 | Bowling Green, KY

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# Background

The use of drones during disasters has emerged as a method of disaster relief and management.

Recent Appalachia Kentucky disasters: COVID-19, historic flooding and ice storms.

Community health workers at Kentucky Homeplace:

- Have expanded roles in community research
- Are essential to research recruitment in hard-to-reach populations
- Completed visual observer training for drone technology to participate in disaster research



*Kentucky Homeplace CHWs Chyna Smith (Knott County) and Carole Frazier (Perry County) at the USA Drone Port.*

# How It all Began

## The Jericho Story

## The Partners

- UK Center of Excellence in Rural Health
- USA Drone Port
- Kentucky Homeplace



*CHWs help deliver personal protective equipment during the COVID-19 pandemic in a 2020 research study in Perry County, KY.*

# How It all Began

## The Projects

- *Access to Personal Protective Equipment for a High-Risk Appalachia Population using Aerial Drones and Community Health Workers (2021-22)*
- *Increasing Disaster Response Capacity in a Rural Appalachian Community Utilizing Telehealth Communication Device Delivery by Drone (TCD3) (2021-23)*

## The Funding

- UK Center for Appalachian Research in Environmental Sciences (UK-CARES)



*CHWs help deliver personal protective equipment during the COVID-19 pandemic in a 2020 research study in Perry County, KY.*

# TCD3

## (Increasing Disaster Response Capacity in a Rural Appalachian Community Utilizing Telehealth Communication Device Delivery by Drone)



- Confluence, KY is a small, remote community in Leslie County.
- Vulnerable to repeated flooding due to its geographic location at the junction of the Middle Fork of the Kentucky River and Buckhorn Lake.
- Residents are often stranded for extended periods of time and rely on boats as the only means of travel for obtaining food, medical care and other essential supplies.



# Project Goal

Identify opportunities in Confluence, KY that increase community capacity to prepare and respond to natural disasters, particularly flooding, through the utilization of aerial drone technology, including test and simulation of deliveries of telecommunication devices.



*Photo credit: WYMT News*

# Project Partners

Community Members, Leaders  
and First Responders



# Confluence Project Team



# Project Activities

- Survey community members, first responders and local government leaders of Confluence, KY to gain insight into their essential needs during natural disasters
- Complete field work to include mapping and surveillance of the Confluence, KY land area to identify safe launch, landing and delivery sites for drones
- Provide visual observer training to community members to increase community capacity for disaster response
- Test and simulate deliveries of telecommunication devices
- Evaluation of the project to document findings, outcomes and lessons learned
- Report-back to the Confluence community, funder and public

# Project Evaluation Components

Data from pre/post surveys designed to gain insight into the essential needs and barriers experienced by community members during disasters, particularly flooding

Establishment of primary and alternate delivery sites, selected by the USA Drone Port based on surveys conducted, as well as safe aerial flight routes that have been tested, will lay essential groundwork for improving community capacity for disaster preparedness.

Train a grassroots network of visual observers to increase community capacity for disaster preparedness by those who complete the required visual observer training provided by the USA Drone Port.

Feedback will be obtained from surveys taken by visual observers regarding their perceptions of the training and test deliveries conducted during the project.

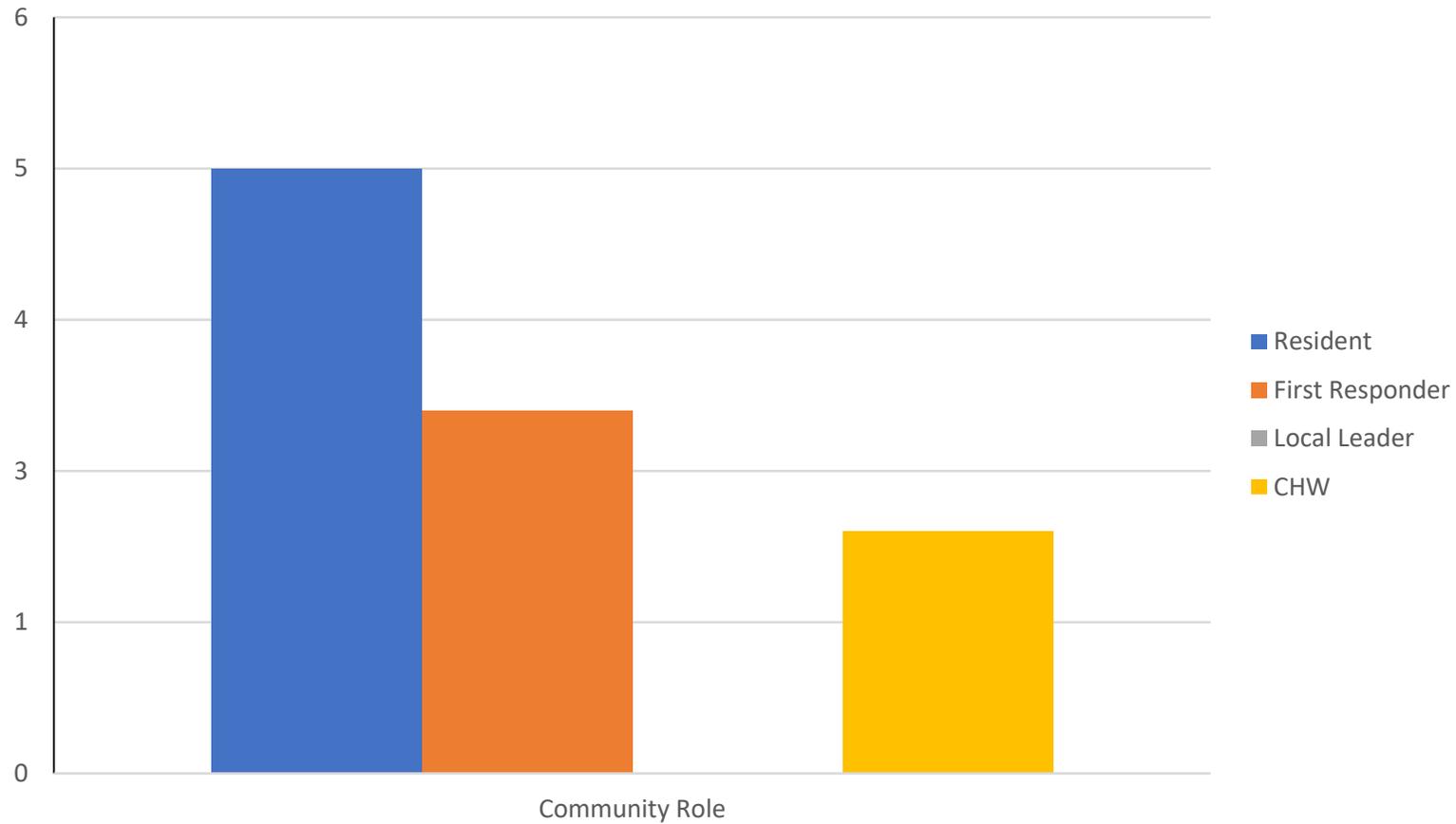
The USA Drone Port will provide lessons learned and analyze the data collected during the survey and test delivery processes.

Future plans/next steps

# Pre-Survey Findings

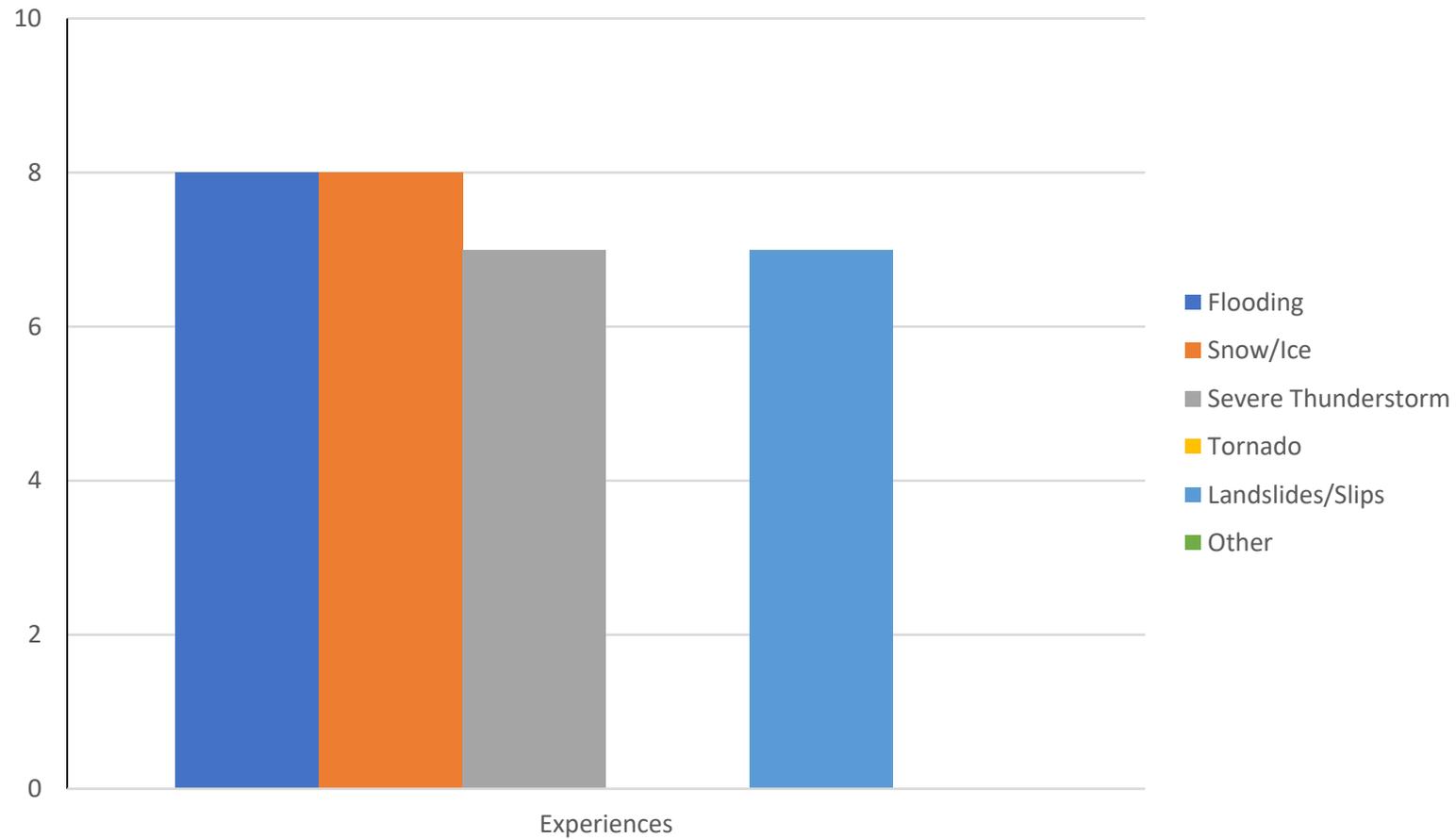
Which of the following best describes your role in the Confluence community?

(n=10)



# Pre-Survey Findings

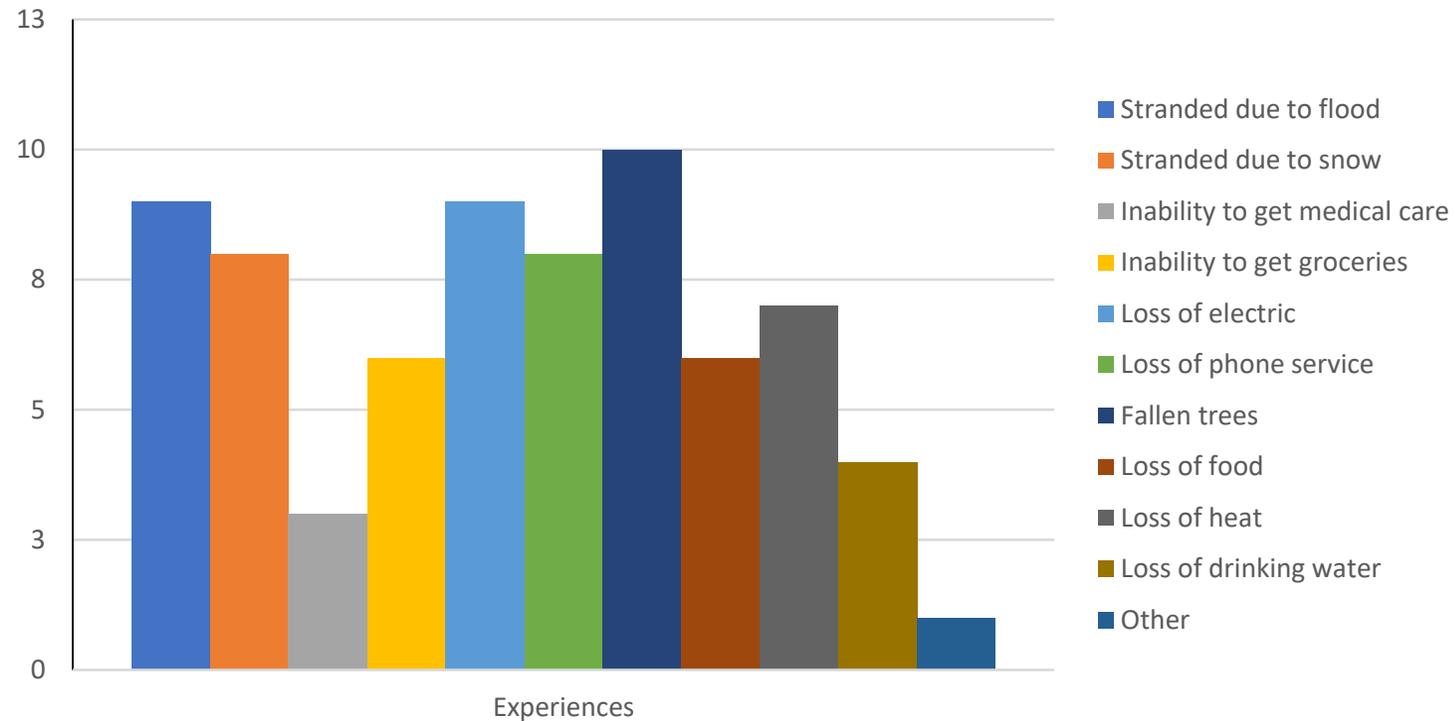
While living or working in the Confluence community, have you experienced any of the following? Check all that apply.



# Pre-Survey Findings

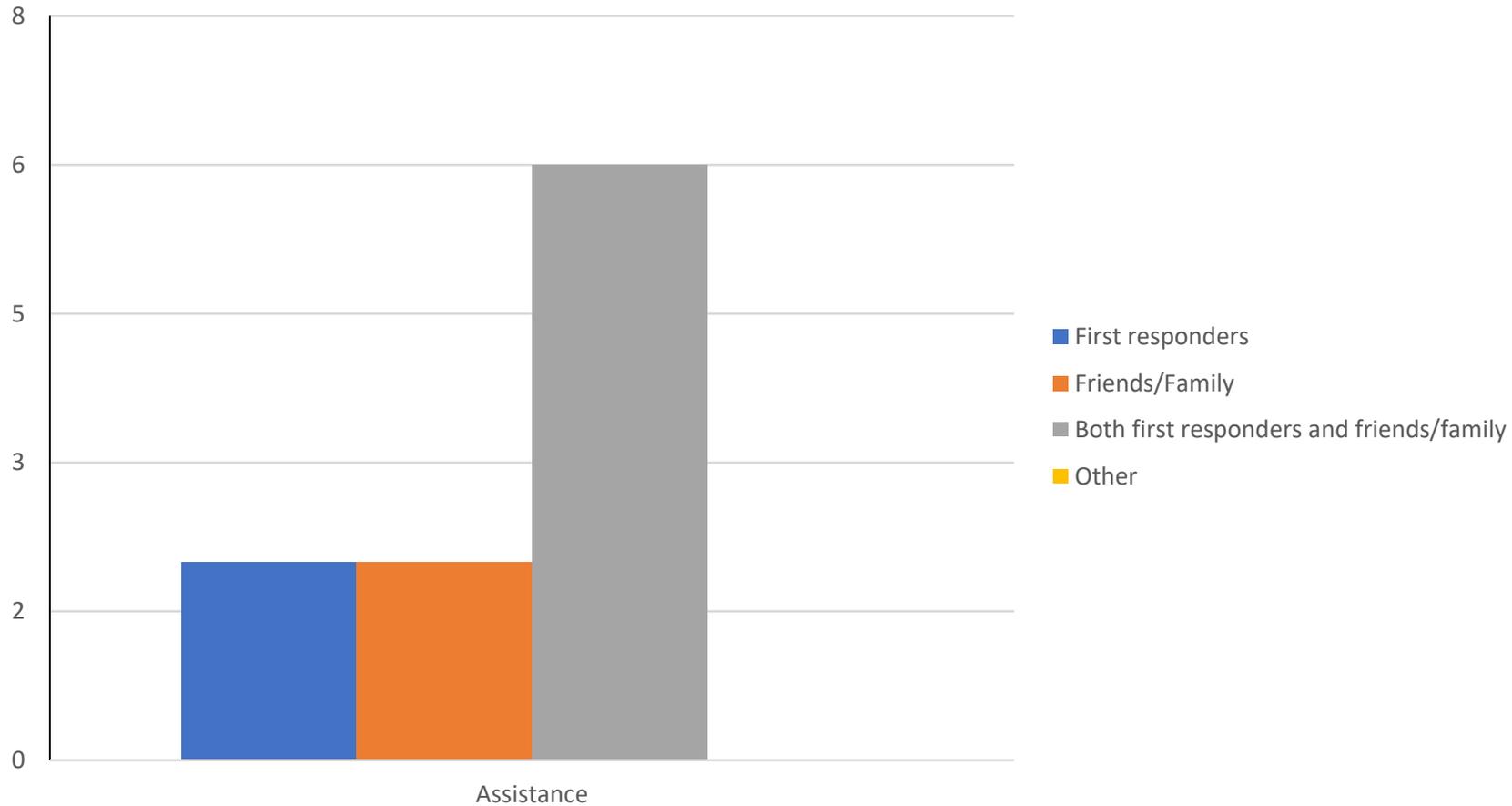
During natural disasters like flooding, ice storms or other forms of severe weather, what are your greatest challenges you face?

Check all that apply.



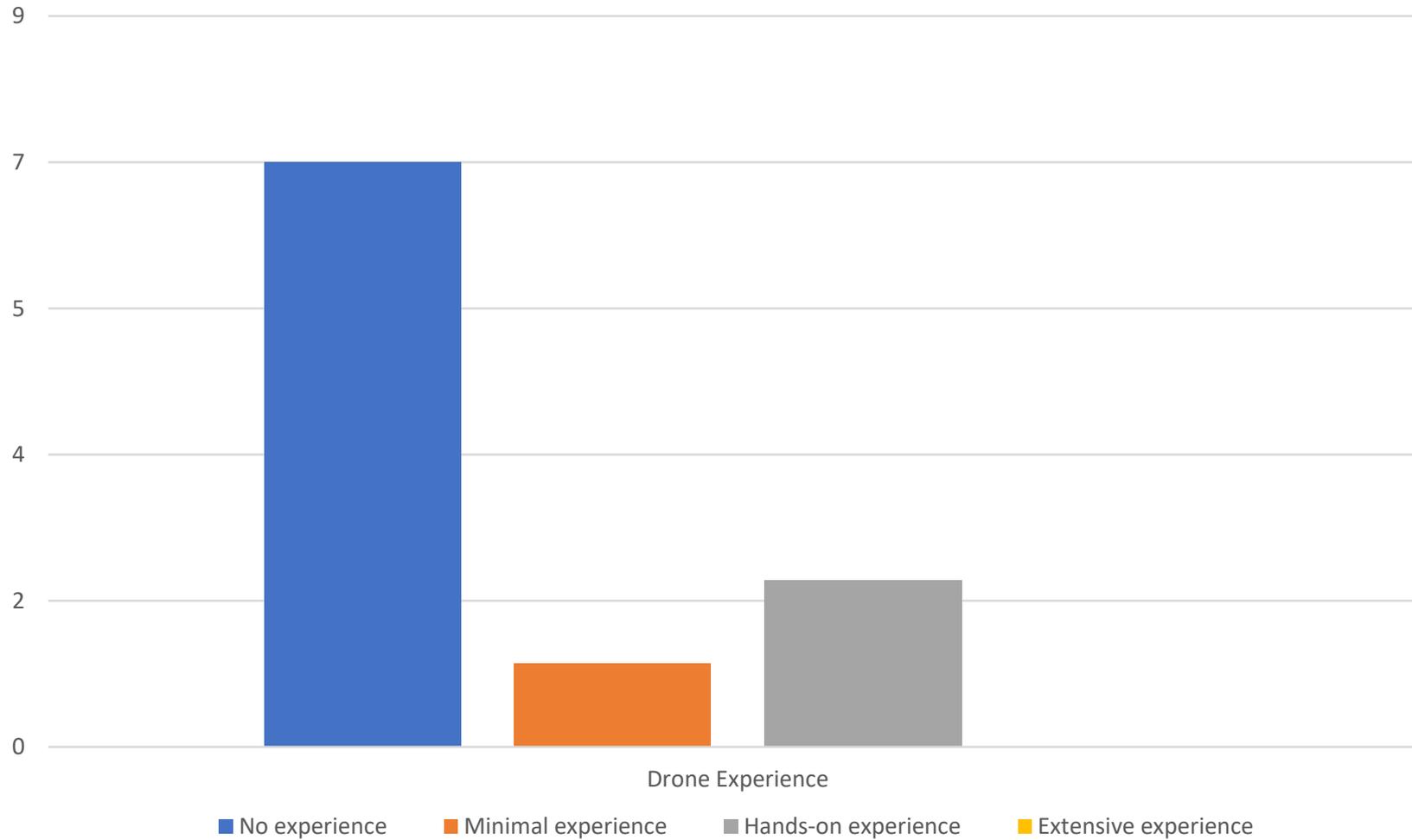
# Pre-Survey Findings

When experiencing challenges related to disasters, who do you call on if you need assistance?



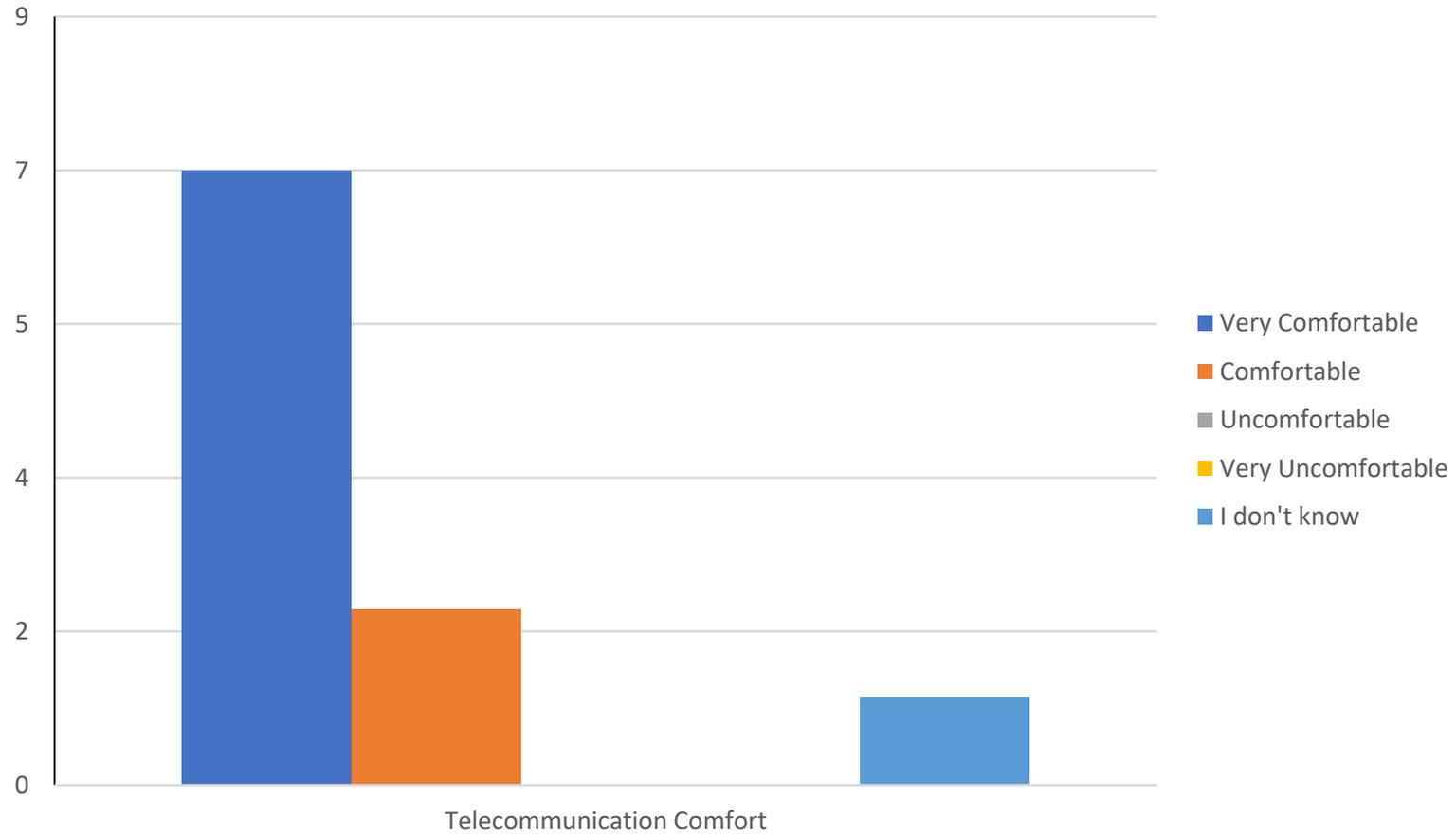
# Pre-Survey Findings

How much experience do you have with drones?



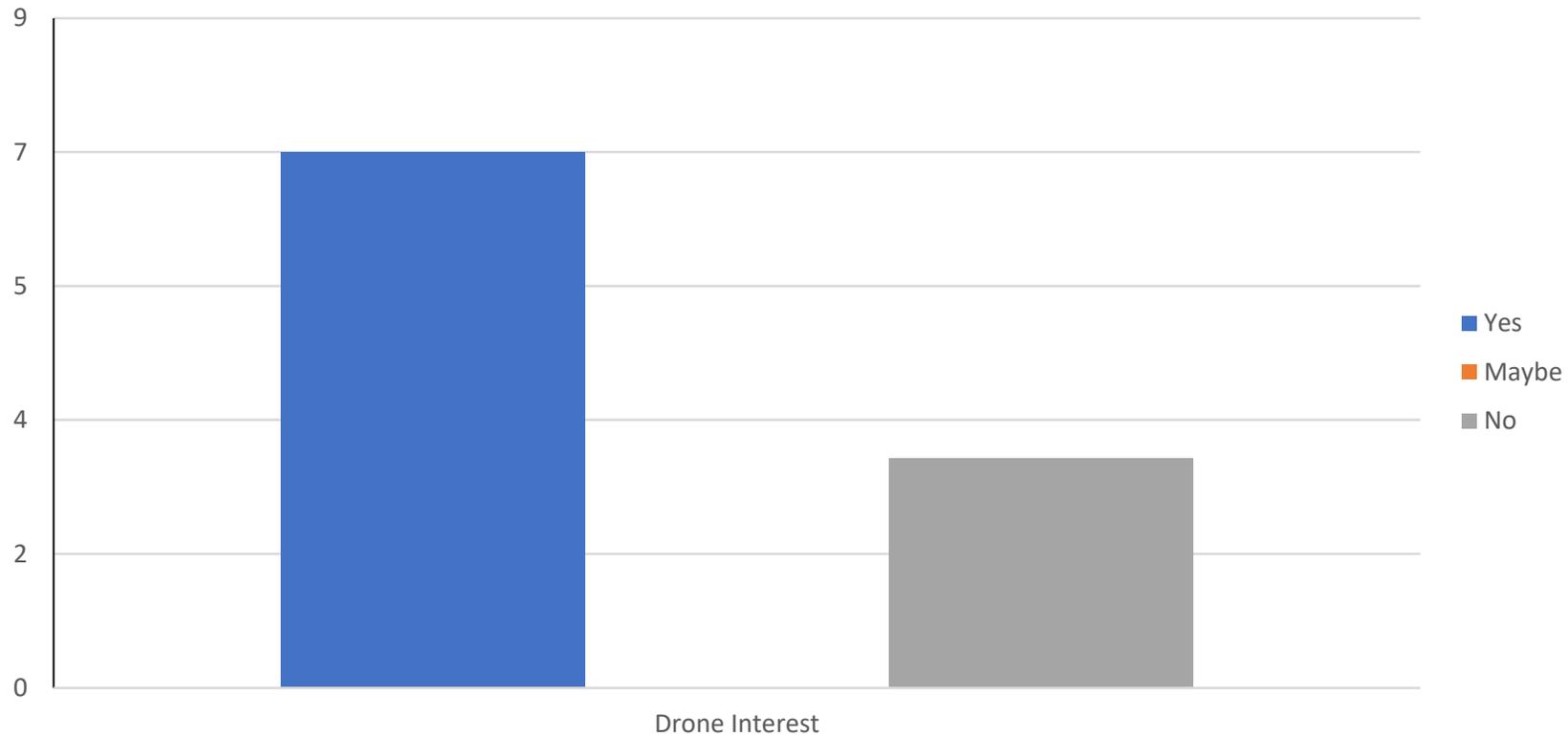
# Pre-Survey Findings

In the event of illness or injury during a disaster, how comfortable would you feel participating in a telemedicine visit via communications device such as a smart phone or tablet that could be delivered via drone?



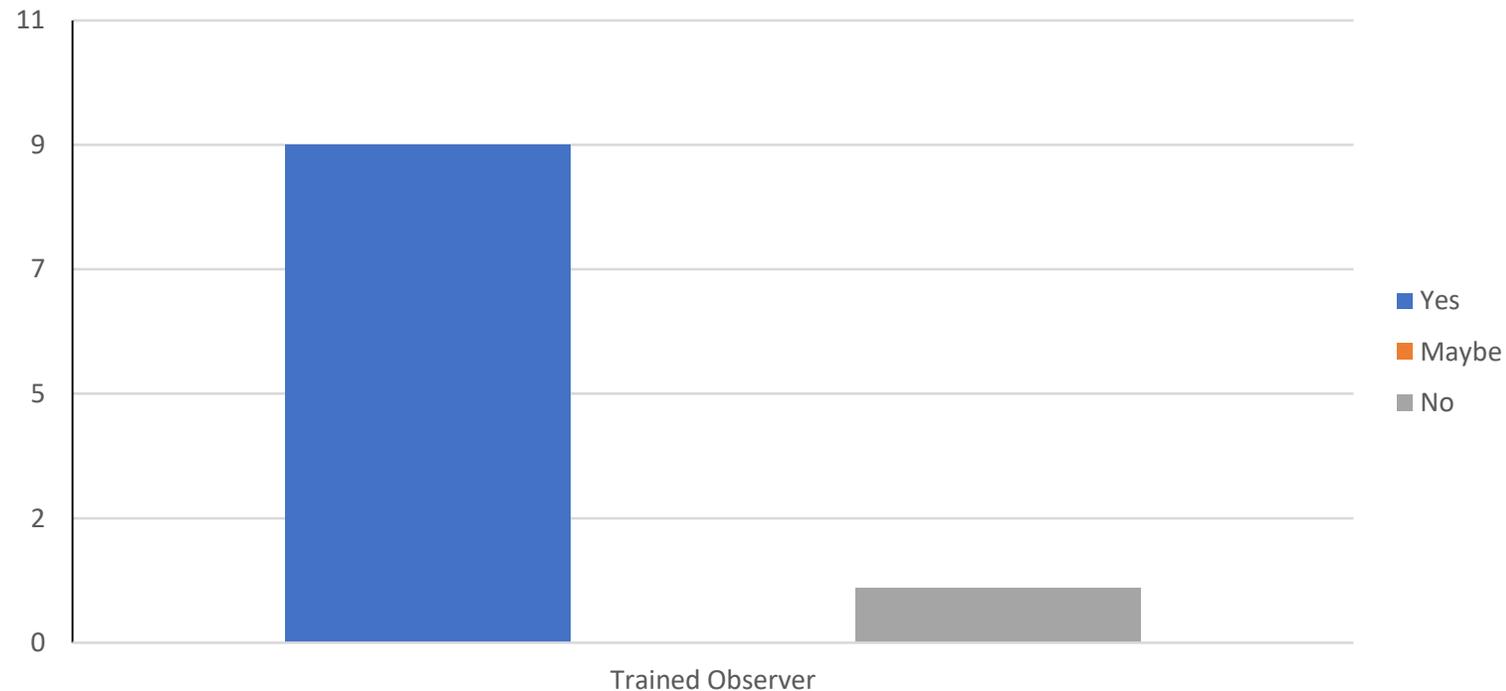
# Pre-Survey Findings

Would you be interested in helping to improve the Confluence community's capacity for disaster preparedness by participating with researchers at the UK CERH to test drone delivery of telecommunications devices to simulate telemedicine visits?



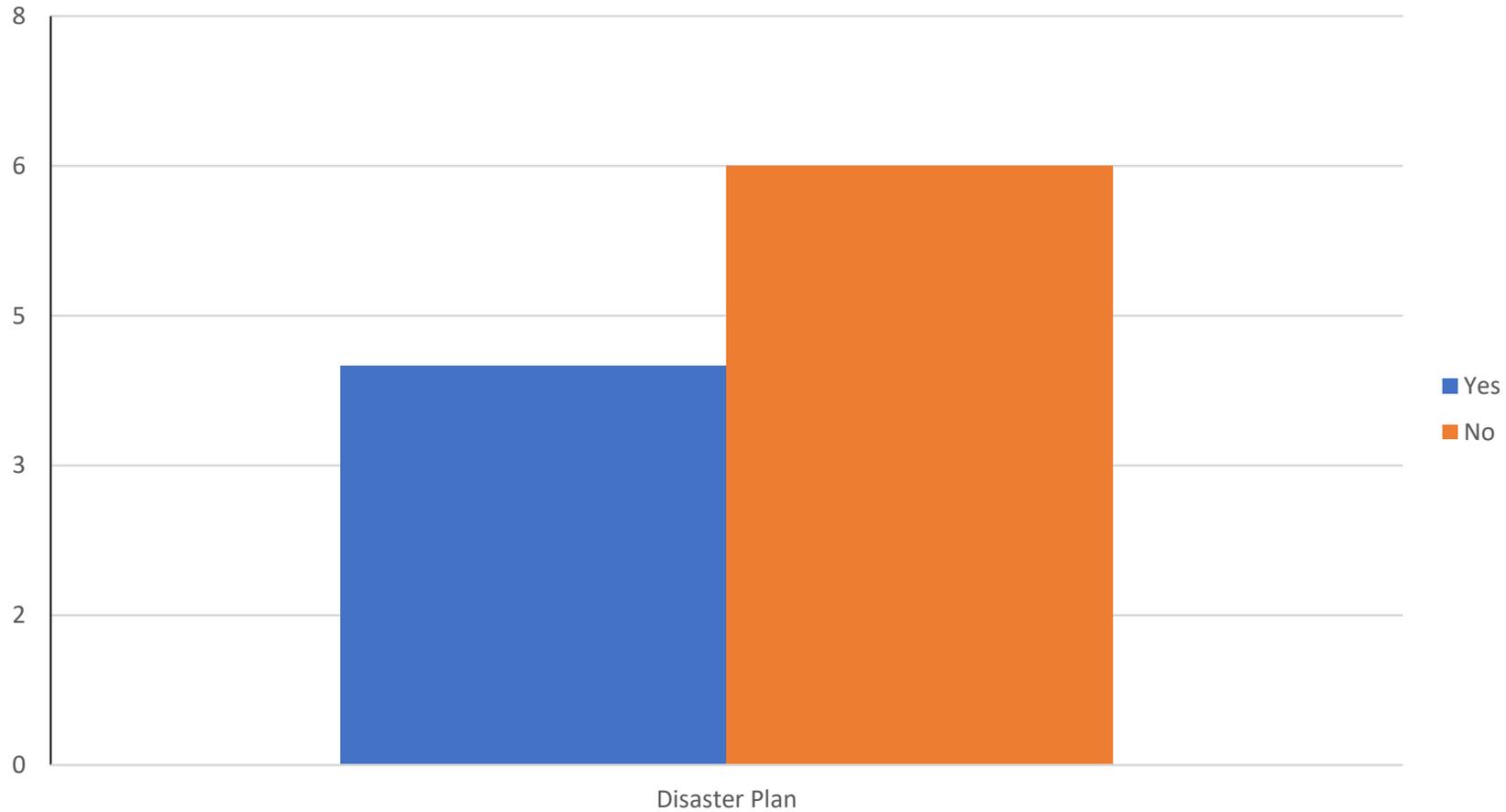
# Pre-Survey Findings

A trained visual observer communicates with drone pilots to improve the safety and accuracy of drone landings or drone delivery of small packages. Would you be interested in participating in visual observer training provided by experts at the USA Drone P



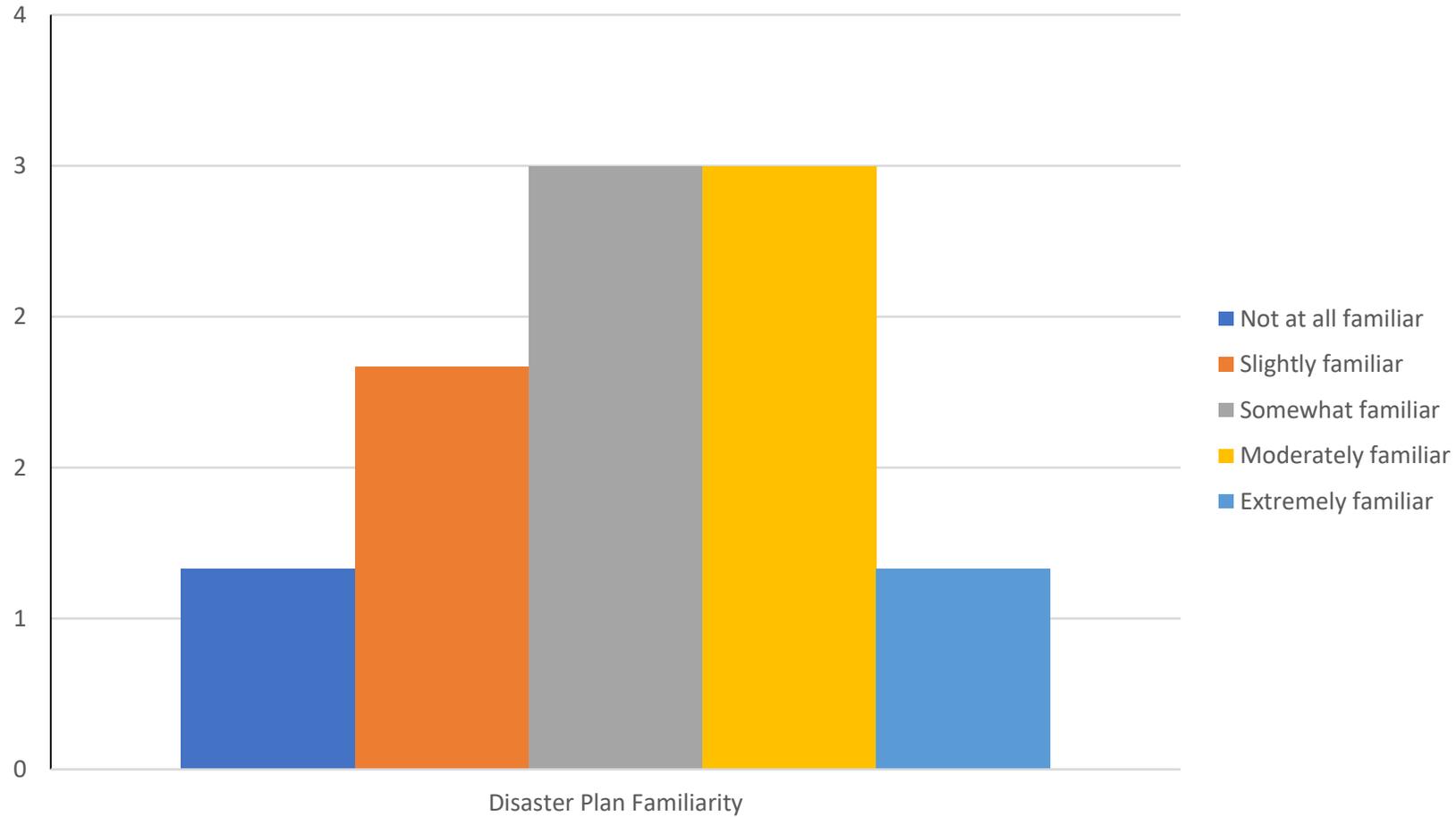
# Pre-Survey Findings

Do you have a disaster preparedness plan? (A written plan that includes a checklist and steps to take during or after a disaster).



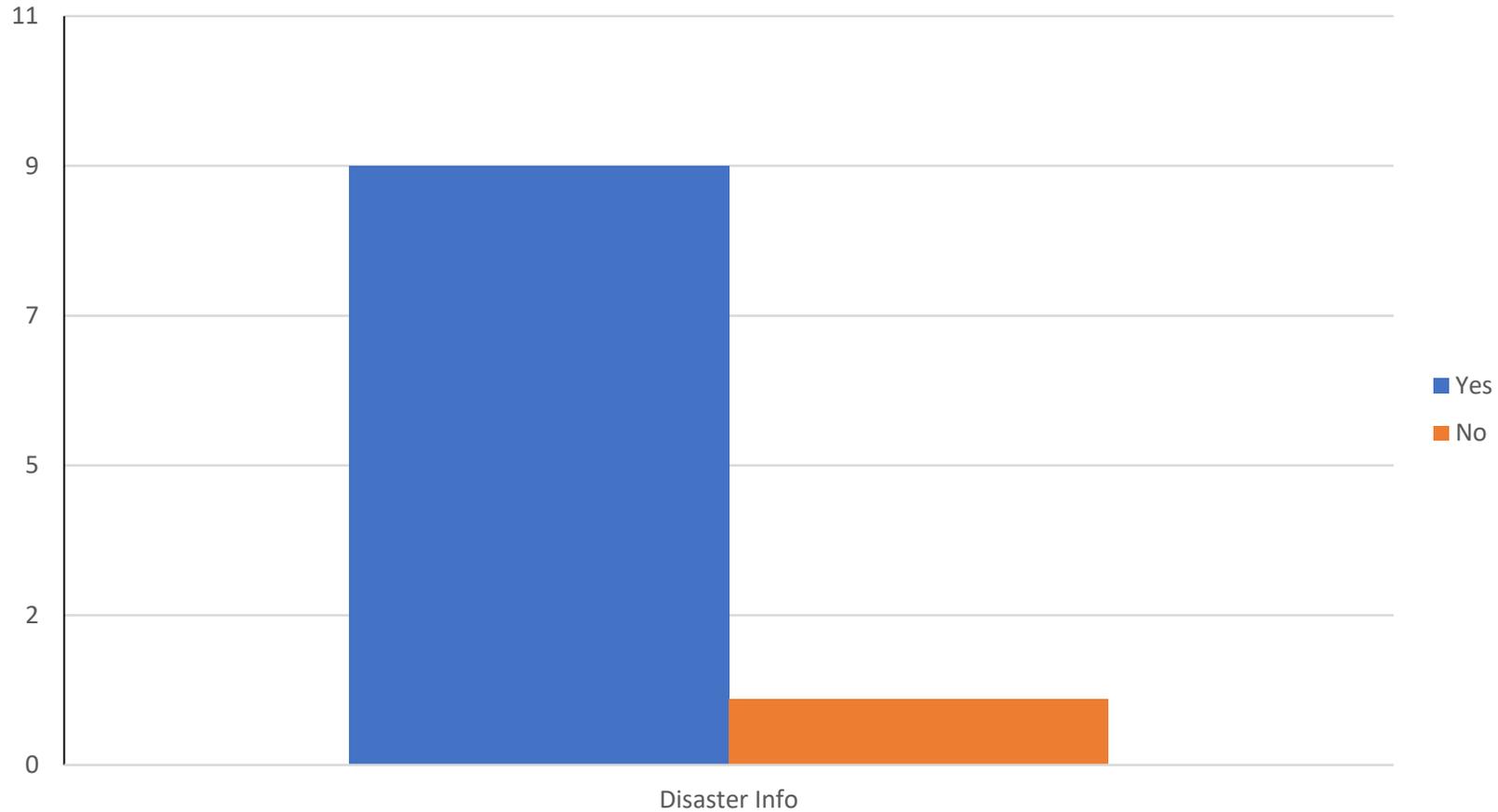
# Pre-Survey Findings

How familiar are you with disaster planning?



# Pre-Survey Findings

Would you like to receive information about how to be prepared for a disaster?





# Test Delivery of iPad as a Device to Facilitate Remote Telehealth Sessions

During a natural emergency such as the flooding that almost annually affects Eastern Kentucky, it can be challenging to assess the health needs of persons whom the floodwaters have isolated in our remote rural places.

The USA Drone Port tested whether drone aircraft might provide a workable solution by testing how effectively drones might deliver an iPad which could enable a live visual conversation among local people and healthcare providers who might not be accessible during flooding.

The Drone Port and its many partners—including UKCERH and Kentucky Homeplace as well as local EMS agencies and community volunteers—faced a number of challenges to find out whether drones can operate effectively in Eastern Kentucky in the midst of challenging weather.

# Key Aerial Technologies

## DJI—M300

According to MJI's website, the Matrice 300 RTK is the firm's latest commercial drone platform that takes inspiration from modern aviation systems. It offers up to 55 minutes of flight time, advanced AI capabilities, and 6 Directional Sensing & Positioning. It also features hot-swappable battery and the ability to operate in temperatures between -20 degrees and 50 degrees Centigrade.

## RadioMaster TX16S Radio Controller

The TX16S features an industrial-grade 4.3" IPS 480\*272 screen with touch, compatibility with OpenTX, wheel menu button, and full-size HALL sensor gimbals with CNC Aluminum Fascia.

## Winch System and Controller (proprietary)

The proprietary Winch System and its controller has been jointly developed by the USA Drone Port and Aerial Robotics in Frankfort KY. It is not yet available commercially.



Alternate #1 - 1.8 Miles

**Delivery - Confluence Church**

Trace Branch Campground

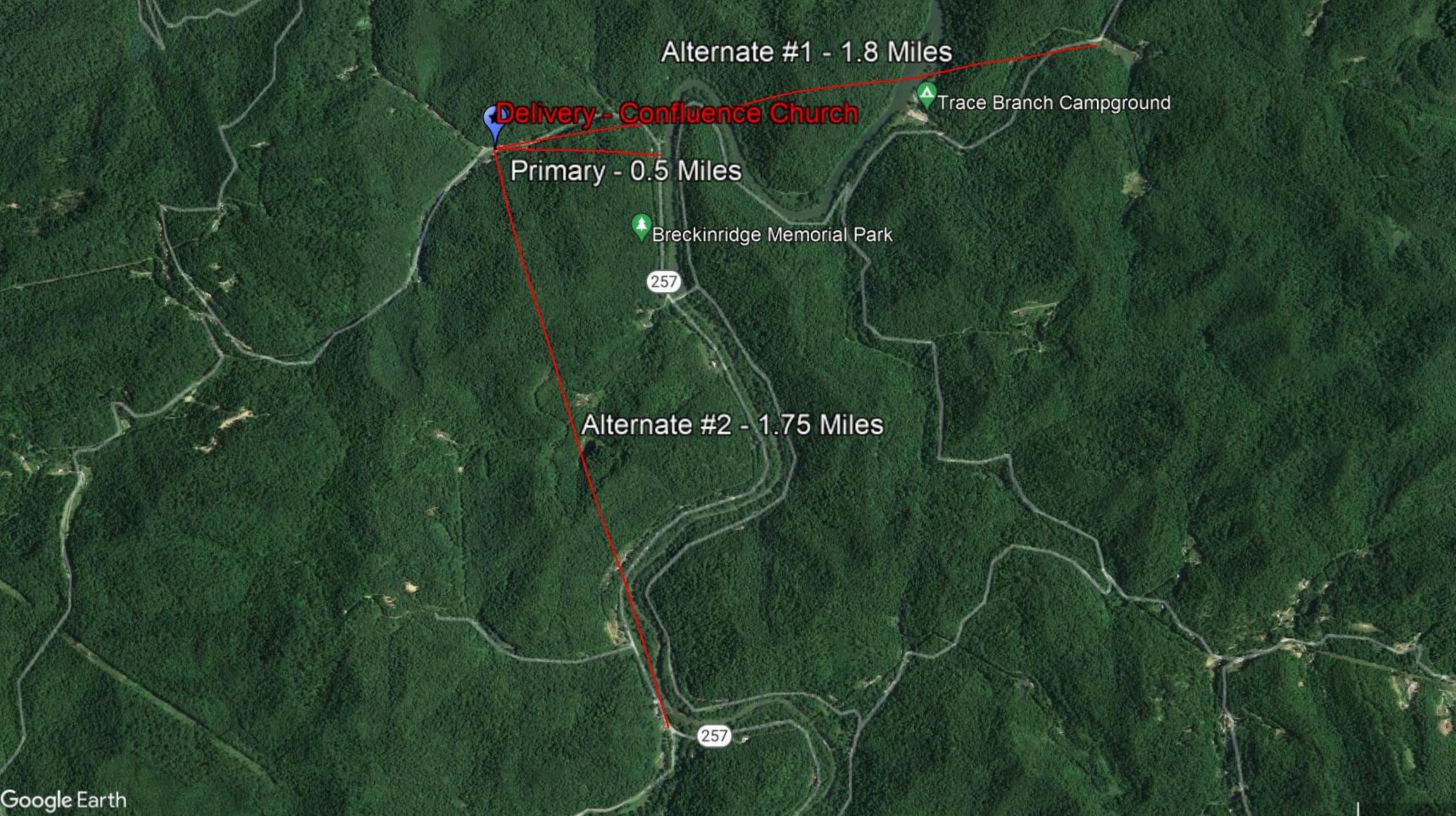
Primary - 0.5 Miles

Breckinridge Memorial Park

257

Alternate #2 - 1.75 Miles

257



# Selecting Primary and Alternate Drone Launch and Delivery Sites

Based on map survey data, the USA Drone Port selected one primary and two alternate **launch sites**. It then tested the viability of aerial flight routes connected with each of these sites. Ultimately the Drone Port selected as its primary launch site, the parking area adjacent to the boat ramp at Confluence onto the Middle Fork Kentucky River. It offered genuine accessibility.

During its flight tests, the Drone Port also realized that making **drone deliveries** to individual residences was not a good strategy. Few remote dwellings have large grassy areas free of entangling power lines and tree branches. What's more, providing training and equipment at each site to facilitate package delivery would not be efficient.

The Drone Port soon decided to establish one key delivery site that could serve the larger community. It selected an open outdoor area at Confluence Baptist Church. It's also a good place to store equipment for upcoming missions.



# Visual Observer Training



Two community health workers, a local educator, and a local banker who also is a volunteer firefighter all enthusiastically took part in the Visual Observer (VO) training.

Visual Observers are local volunteers who assist licensed drone pilots maintain a required visual line of sight with drones while they are in the air. VOs also may operate a remote controller that lowers a package close to the ground once the aircraft is stationary above the delivery site.

Winch systems are essential to the safe delivery of packages in rural places. But they are not yet standard gear for commercial drones. The Drone Port collaborated with Aerial Robotics in Frankfort, KY to develop the pioneering winch system used for the Confluence test flights.



# Maintaining Visual Line-of-Sight (VLOS)

There were no unanticipated issues maintaining VLOS from the primary launch site. The relatively large size and bright red color of the aircraft made it easier to track across the rugged mountain terrain and its skyway.

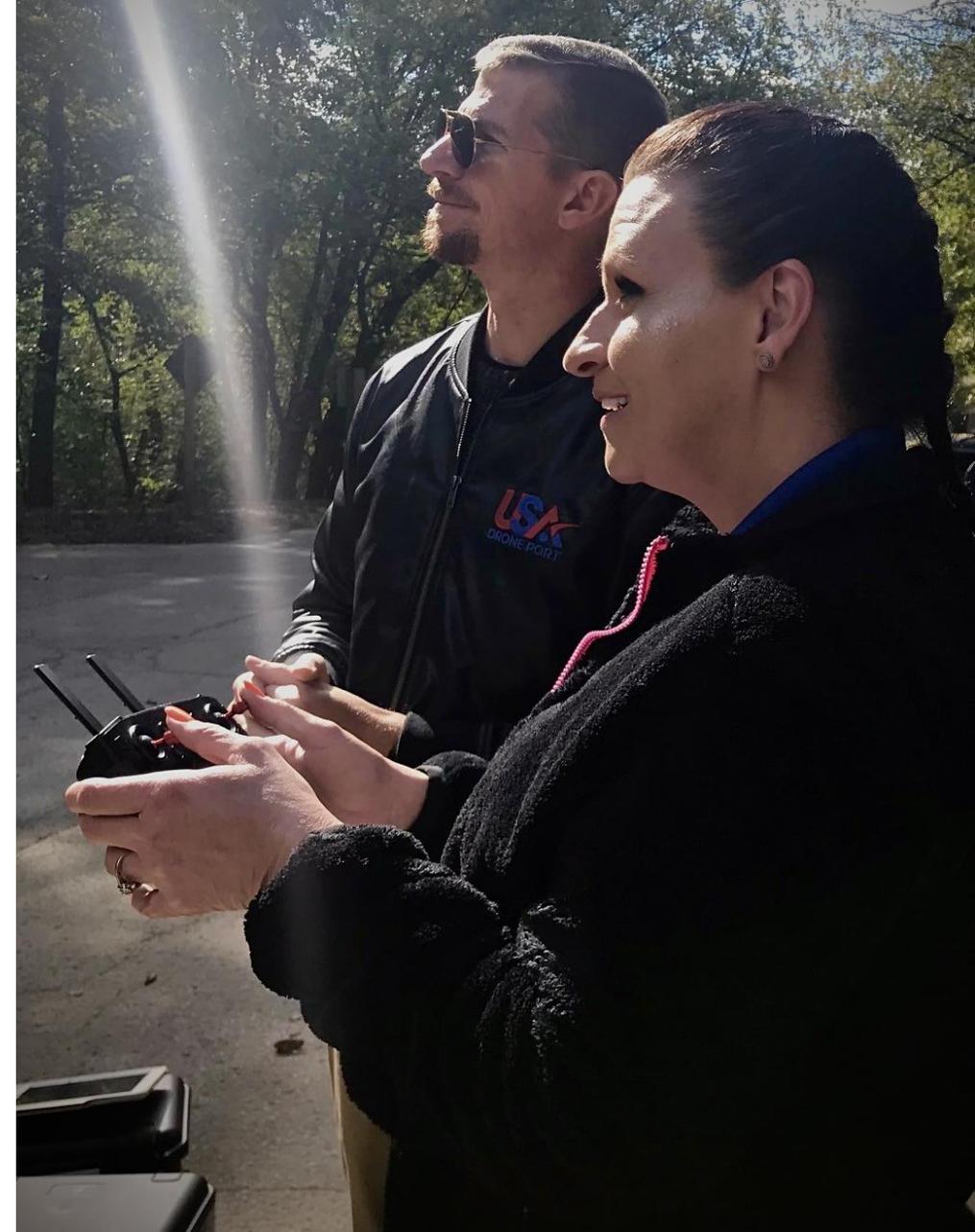
Coming down the back side of the mountain, of course, necessitated that the two pilots hand off control of the aircraft about halfway through the flight, regardless of which direction it originated. The pilots and visual observers at the receiving sites had to wait until the drone popped up over the back side of the mountain before they could see it.

With the two alternate launch sites, the significantly longer flight paths meant the pilots and visual observers could maintain VLOS in either direction throughout only about three-quarters of the flight plan. Even so, they decided to hand over control of the drone aircraft about in the middle of the flight. This handoff at the flight's midpoint was necessary anyway with all flights involving the second alternate launch site, for which it was not possible to sustain active electronic control (ELOS) more than halfway through the anticipated flight plan.

# Visual Observer Training Feedback

## Open-Ended Comments from Visual Observer Evaluations

- Would love to help more with this project
- Everything went great
- Better communication
- Better radio
- Easiest was the drone flying; hardest was the drops
- Most difficult was finding locations to take off and land; easiest was how the drones made it so simple
- Easiest would be the simple concept; hardest would be the rules and laws to follow



# Lessons Learned



- Given the rugged terrain, maintaining an electronic link between pilots and the aircraft proved more challenging than originally anticipated. Even so, we were able to establish flight paths that assured safe handoffs from the launch sites to the delivery sites.
- Cellular communications between flight crew members also were vexing. The best solution was to use handheld radio devices, boosted by using an auxiliary drone to keep a radio aloft throughout the test flight to relay the signal.
- Weather conditions were generally favorable. Even so, natural wind funnels in the mountains created cautionary winds at altitude. While a cause for concern, wind speeds never spiked into the red zone.
- Most community drone teams will not have the technical expertise to solve some of the equipment issues that the Drone Port and Aerial Robotics were able to overcome. It would be advantageous for commercial solutions to become more widely available.

# Key Outcomes / Future Plans after Confluence Test Flights

- The USA Drone Port and its mission partners are confident that our flight crew, including local community members, as well as all of our technical solutions are functioning at a high level that will assure the likely success of future missions.
- The high-level ability of our USA Drone Port development team to make further innovative modifications even following the work of our development partner, Aerial Robotics, also bodes well for the future adaptability and safety of future missions, especially as we explore opportunities to return medical data from remote sites, including Covid tests and/or blood samples for lab work.
- Our plan for the next stage of this project, called Jericho 3, is to make sure Confluence Baptist Church, the primary delivery site, is equipped with pre-training opportunities and the necessary tools, including landing pad markers, the second aircraft controller, and the winch system controller. In a real emergency, they will be prepared simply to activate their game plan and receive via drone the supplies that they need.



# Dissemination/Community Report Back

Findings from this project will be shared:

- With the Leslie County Fiscal Court
- On digital and social platforms including the UK-CARES Website and the UK CERH YouTube Channel and Facebook
- During Appalachian Research Day: Come Sit on the Porch, April 5, 2023, Paintsville, KY

# Acknowledgements



**Center for Appalachian Research  
in Environmental Sciences**

This project was funded by the University of Kentucky Center for Appalachian Research in Environmental Science, a National Institute of Environmental Health Sciences (NIEHS) Core Center established to enhance research capacity focused on major environmental health impacts to air and water quality that have been implicated in environmentally induced disease.

# For More Information

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