Implementation of an Acute Febrile Illness Surveillance Network in Belize, 2020-2021

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BACKGROUND

Emerging pathogens are global public health threats, with low- to middle-income countries in Central America having disproportionately high risks for transmission due to large population centers, areas of extreme poverty, and tropical climates. In Belize, approximately 380,000 residents are at risk, with more than 150,000 living in poverty(1,2). In addition, 1.3 million tourists visit the country, increasing the risk of introduction of pathogens. The true incidence and prevalence of parasitic and bacterial vector-borne diseases are not well understood. In collaboration with the CDC and the Belize Ministry of Health and Wellness (MOHW), we created an acute febrile illness (AFI) surveillance network to detect and diagnose vector-borne, respiratory, and enteric pathogens within sentinel healthcare facilities. We aim to meet our overall goal to understand, detect, and respond to infectious disease threats in this unique, high-risk region.

PURPOSE

To determine the etiologies of AFI among children and adolescents (60 days-16 years) and adults (16+ years) attending selected health facilities in Belize to inform public health programs at these facilities, including capacity development to identify, monitor, and assess pathogens of potential public health importance, programmatic improvement for patient care and treatment, and resource allocations.

METHODS

- Patients were screened and enrolled in 11 MOHW healthcare facilities.
- Eligible patients were enrolled, and demographic, epidemiological, and geographic data was collected.
- The following specimens were collected from patients: whole blood and serum (all enrolled patients); nasopharyngeal swab (≥2 respiratory symptoms); stool sample (≥2 gastrointestinal symptoms); and/or eschar swab (if eschar 0.5-3cm was present).
- All patients who had a whole blood sample collected were tested on a vector-borne multiplex PCR panel, testing for ZIKV, WNV, CHIKV, DENV serotype, *Rickettsia* spp., *Trypanosoma cruzi*, and *Plasmodium* spp.
- Patients who had a nasopharyngeal swab collected were tested on the BioFire® Respiratory 2.1 Panel (22 pathogens total).
- Patients who had a stool sample collected were tested on the BioFire® Gastrointestinal Panel (22 pathogens total).
- Patients who had an eschar swab collected had their sample shipped to Houston, TX, for *Rickettsia* spp. testing.
- Data was collected on paper forms and then entered in REDCap.
- Data was presented to implementing partners on a bi-weekly basis using ArcGIS Dashboards and Storymaps.
- All data was analyzes using STATA v17 (STATA Corp, College Station, TX).

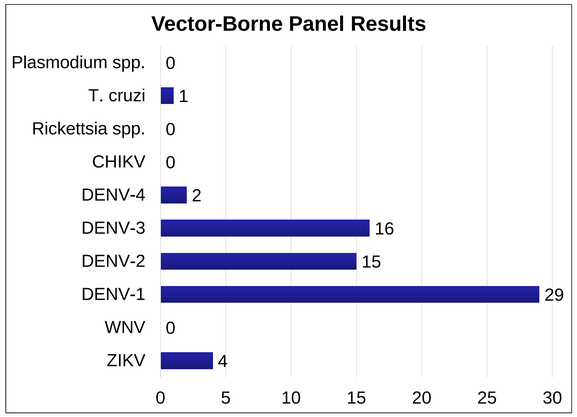

Fig 1: Vector-borne testing results. There are three PCR multiplex panels: viral (ZIKC, WNV, pan-DENV, CHIKV); parasitic/bacterial (*Rickettsia* spp., *Trypanosoma cruzi*, *Plasmodium* spp.); and dengue serotype (DENV1-4).

Fig 2: Description Distribution by districts of participants enrolled in the Acute Febrile Illness Surveillance Network.

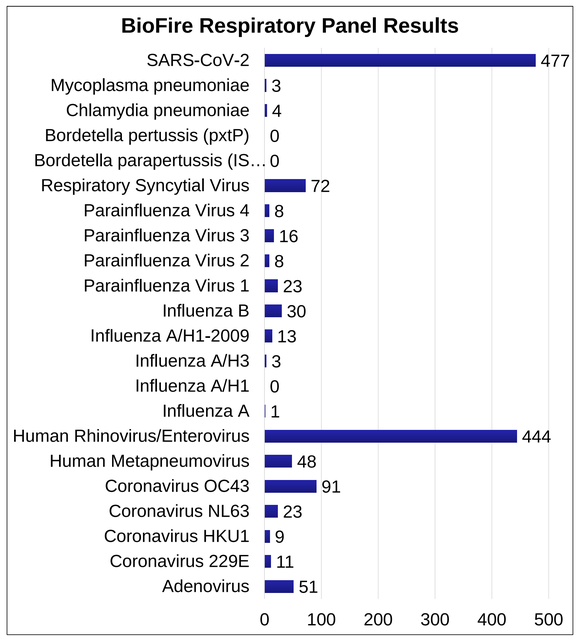

Fig 3: Respiratory testing results. SARS-CoV-2 was initially tested on PCR, and if a participant was negative, they were tested on the BioFire® Respiratory Panel.

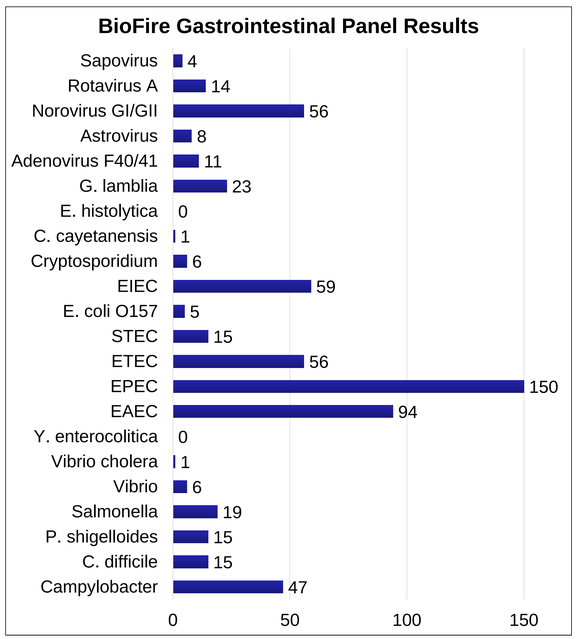

Fig 4: Gastrointestinal testing results. Majority of the positive results are for the various pathogenic *E. coli* on the panel.

RESULTS

- Between January 16, 2020, and December 31, 2021, healthcare staff enrolled 3,015 participants. A total of 7 patients were excluded from the analysis as they were less than 60 days old at enrollment.
- Average participant age was 28.8 years (range 2 months to 97.7 years) at screening date.
- A total of 1,597 (53.0%) of participants were female, and only 33 (2.1%) were pregnant.
- Of 2,877 participants with VBD PCR panel testing, 51 (1.8%) patients had a positive result.
- The most common VBD results were DENV-1 (n=29), DENV-2 (n=16), DENV-3 (n=15), and DENV-4 (n=2).
- We detected one acute Chagas case in a 7.5 year-old child; this was the first reported case of acute Chagas in Belize.
- Of 1,877 patients with two or more respiratory symptoms, 1,339 (71.3%) were tested for respiratory pathogens, and 893 (47.6%) had at least one positive result.
- The most common respiratory results were SARS-CoV-2 (n=477), human rhinovirus/enterovirus (n=444), and RSV (n=72).
- Of 759 patients with two or more gastrointestinal symptoms, 328 (43.2%) were tested on the BioFire® Gastrointestinal Panel, and 267 (81.4%) had at least one positive result on the gastrointestinal panel.
- The most common gastrointestinal results were EPEC (n=150), EAEC (n=94), and EIEC (n=59).

CONCLUSION

The AFI surveillance network has been a very successful implementation of sentinel surveillance in Central America. With the start of the pandemic, we were able to continue our work enrolling patients and provide Belize with SARS-CoV-2 testing in the Central Medical Laboratory for general population, as well as part of AFI. The AFI study has provided the MOHW in Belize with the first detected case of acute Chagas disease, and the MOHW was able to quickly act on providing medication to the child. The results gained through enrolling patients in all districts of the country have allowed the MOHW and BCM to gather important data in determining disease outbreaks and monitoring. The AFI study is continuously enrolling patients. In the future, we plan to do further analyses on co-infections, sequence patient samples that are thus far undiagnosed by our current testing panels.

REFERENCES

1. World Bank. Accessed March 20, 2022. https://data.worldbank.org/country/belize?locations=BZ
2. Belize Tourism Board. Accessed March 20, 2022. https://belizetourismboard.org/belize-tourism/statistics/