

DETECT



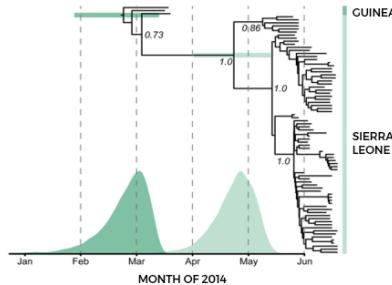
EMPOWER



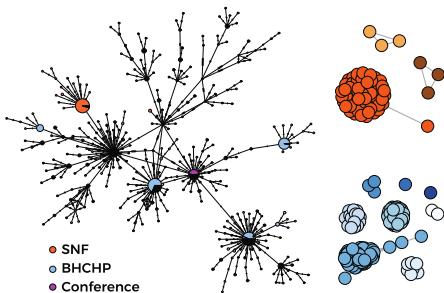
CONNECT

Pathogen Genomic Surveillance

Transmission Patterns

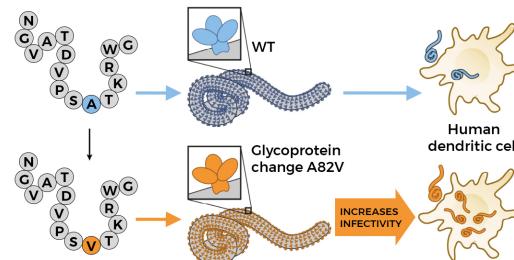


Ebola was spreading human to human

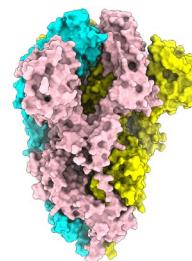


COVID driven by superspreader events

Novel Mutations

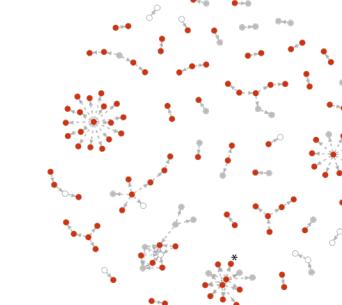
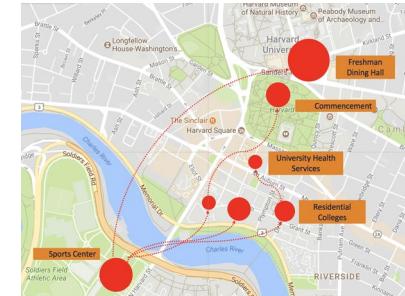


Ebola mutations increased infectivity



COVID's D614G mutation does as well

Contact Tracing

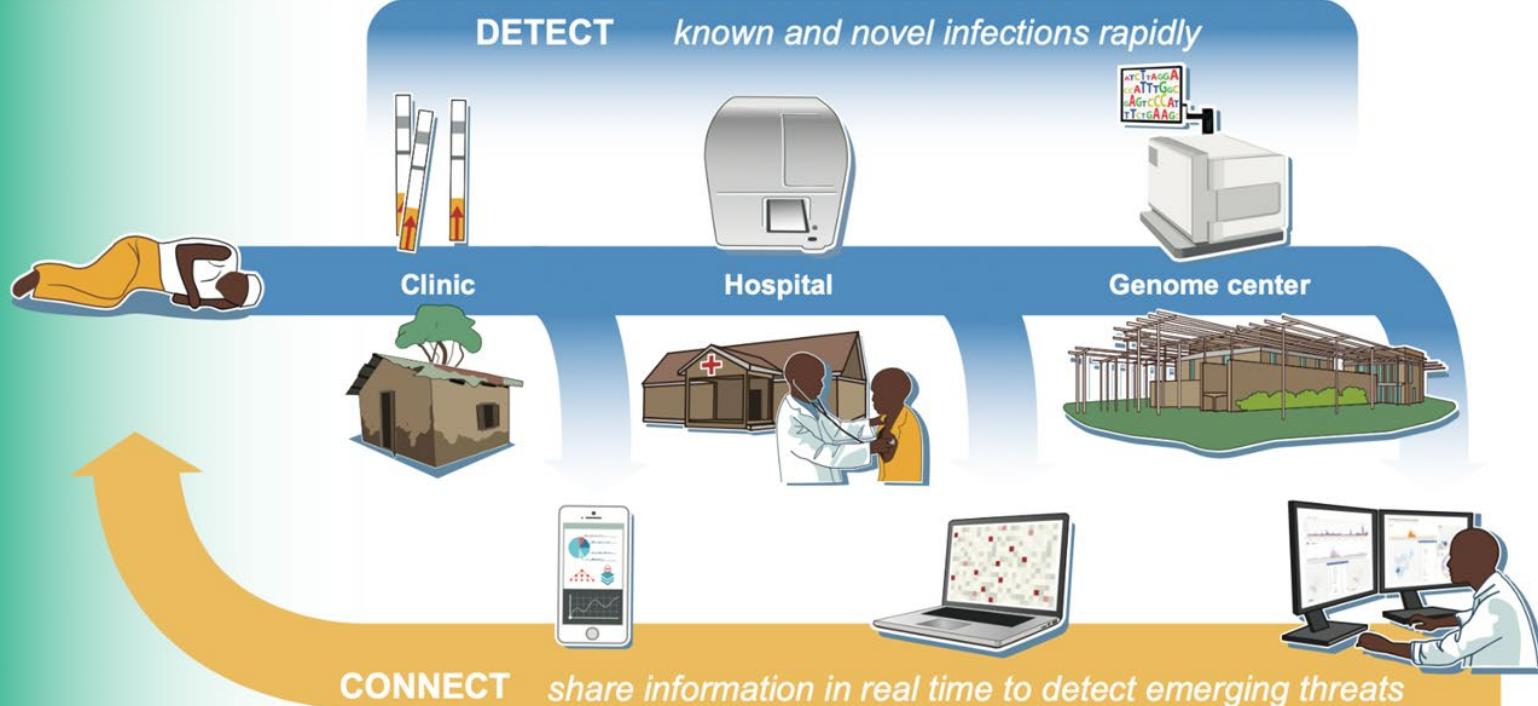


COVID was transmitting from

Sentinel: Outbreak Prevention & Response

THE
**AUDACIOUS
PROJECT**

EMPOWER
the public
health
community to
improve
pandemic
preparedness
anywhere in
the world



Sentinel: Outbreak Prevention & Response

EMPOWER
the public
health
community to
improve
pandemic
preparedness
anywhere in
the world



Clinic



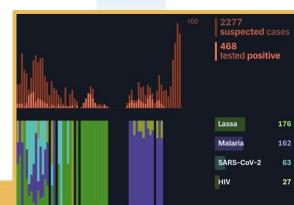
Hospital



Genome center

DETECT

known and novel infections rapidly



CONNECT

share information in real time to detect emerging threats



CRISPR- and AI-Based Diagnostics

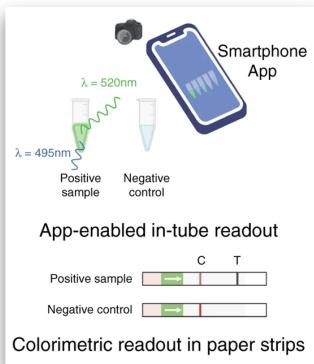
The New York Times

Pregnant Women Anxious as Florida's Zika Test Results Take Weeks

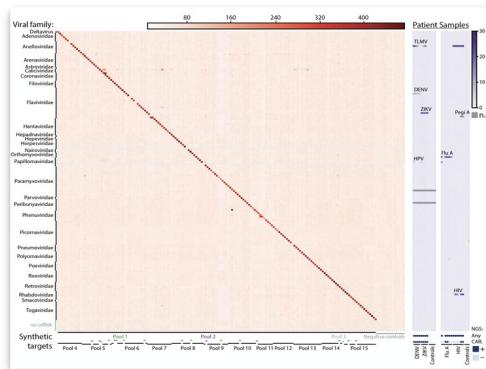
By LUCILLE ALVAREZ SEPT. 12, 2016



Point-of-care (SHINE)

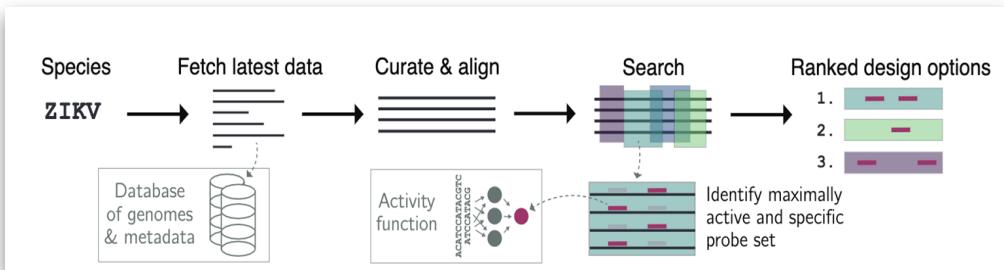


Multiplex (CARMEN)



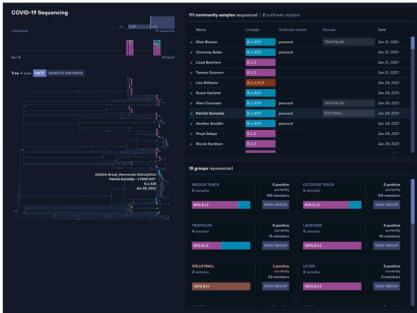
ATCACCGCTGTGGGCACTGAGAGTCATCCTCTGCAAGGGAT
TTGATTGAACTTCTAGCAAGGACCTTGGTATCTCTGATT
TTCAACATACGAAACACAACGTGTCAAGGAGCAATTGAGCTA
ATATCTCAAGTTAAACGAATTGGAGCTCTACATGTTG
ATTGAAATGGGACTCAAATCATACATCATATACTCGA
TCCAAGAACCCGACAAATCGCAAAACCGCAAGAGCCTG
TGAGTCCACACTGAAGACATTACAGGGTCTCGACAGC
AATAGCTCTCTGGTATCTACATACAGGAGTACTCTCATAT
AATAGTAACTTGTGACATCTCATATAATCAGATATA
TCTGATAATGTTGACACAACTATATCCTACAUAG
AAAACCCAGACTCAGAATTCTCTATAAGAGATTCAGA
ATATAAATAGCATTATCACTAGAAATCCAAATATAGGAAA
GTCATGTGTAGTTTACAAATTATATATTACTA
AGTGGTTAAGAAAAAGCTTGAGGAAGATAAGAAA
GATGAGACAGTTGACATTCTCTTGTATGTTAAATGGCT

Assay design for any virus (ADAPT)



Myhrvold et al. *Science* 2018, Ackerman et al. *Nature* 2020, Arizti-Sans et al. *Nature Comms* 2020, Metsky et al. *Nature Biotech* 2022, Welch et al. *Nature Medicine* 2022, Arizti-Sans et al. *Nature Biomed Eng* i2022

Data Analysis and Visualization with Fathom



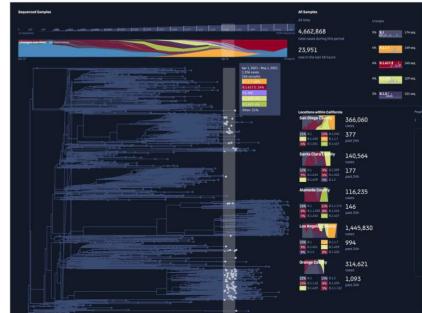
Understanding community transmission

Using genomic data to understand intra-community spread vs. outside introductions



Multiplex testing

Integrating multiplex testing systems like CARMEN into community surveillance tools



State-level monitoring

State-level sequencing for lineage surveillance



Zoonotic crossover

Lassa surveillance program



Multi-pathogen surveillance

State-level sequencing for lineage surveillance



Multiple outbreak monitoring

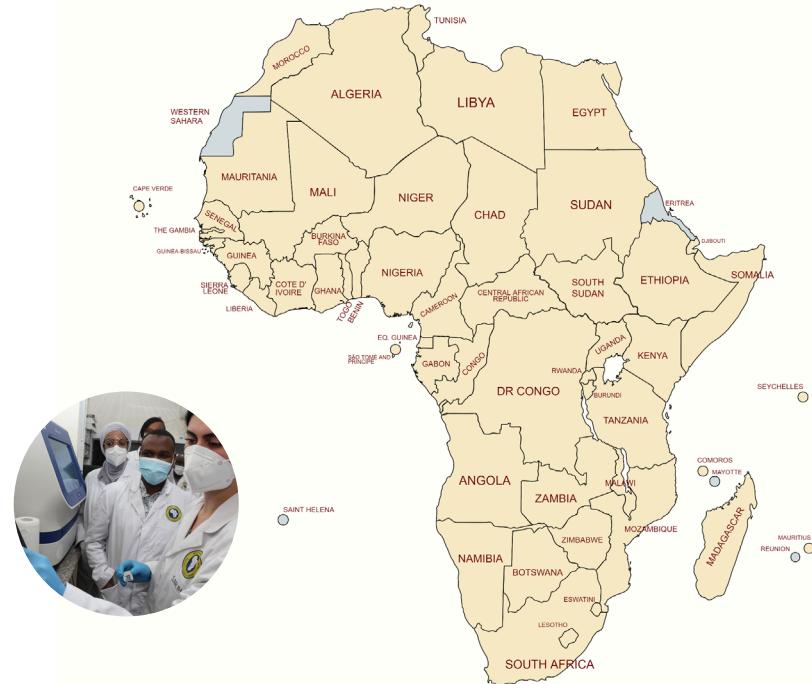
Different levels of fidelity depending on scale and type of outbreak aimed at a national surveillance team

Developing capacity across African continent with ACEGID

- Education and Training
 - Next Generation Sequencing (NGS)
 - Metagenomic Sequencing
 - Bioinformatics
 - Instrumentation

53 of 54 Countries across Africa trained

- Over 1600 participants



Outbreak Education – Operation Outbreak

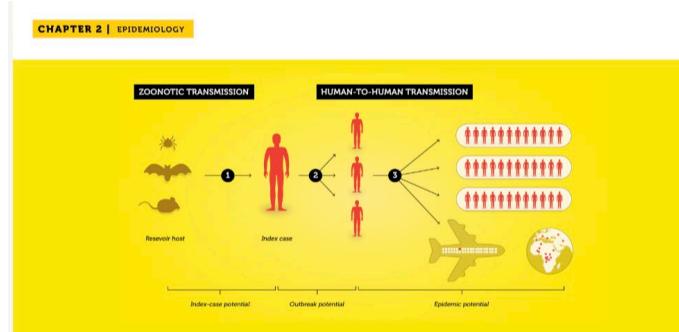


FIGURE 2.3 | Index case. This graphic shows an example of the progression of viral from the reservoir host, to the index case (who may or may not be the primary case), to more individuals, with the potential for epidemic proportions.

COVID-19 app has been used by 16.5 million people out of a population of 34.3 million smartphone users. App users were notified whenever they had been in close contact with another user reported as positive, as well as if they had been exposed by visiting a high risk location. They would also receive information about how to prevent further spreading and suggestions to quarantining after a close contact exposure notification. Although this is a rather new technology, this app proved to be a helpful community measure, and these strategies are being replicated to prepare for future threats.

These digital methods have demonstrated benefit, but as you can imagine, adverse feelings towards the technology may limit uptake. Concerns about digital privacy and government involvement in social contact tracing technologies can not only make the general public wary, but also make the technology dangerous to particular communities – notably undocumented people and survivors

of domestic violence. For these reasons and many more, these technologies need to be used thoughtfully and designed to protect the data privacy of users.

Index Case

By following the course of an outbreak back to its source, epidemiologists are often able to get a better understanding of who may have been exposed, how a disease may be spreading, or what risk the disease may pose to the population. The first case identified by health officials in an outbreak is referred to as the **index case** (colloquially known as "patient zero"); for known infectious diseases that are not endemic, this is often the first signal to researchers that an outbreak could be on the horizon (Figure 2.3). While the index case is the first *identified* case, it may not be the first individual to bring a pathogen into a specific population, who is known as the **primary case**. It often takes some