CrisisReady

Annual Report | 2023

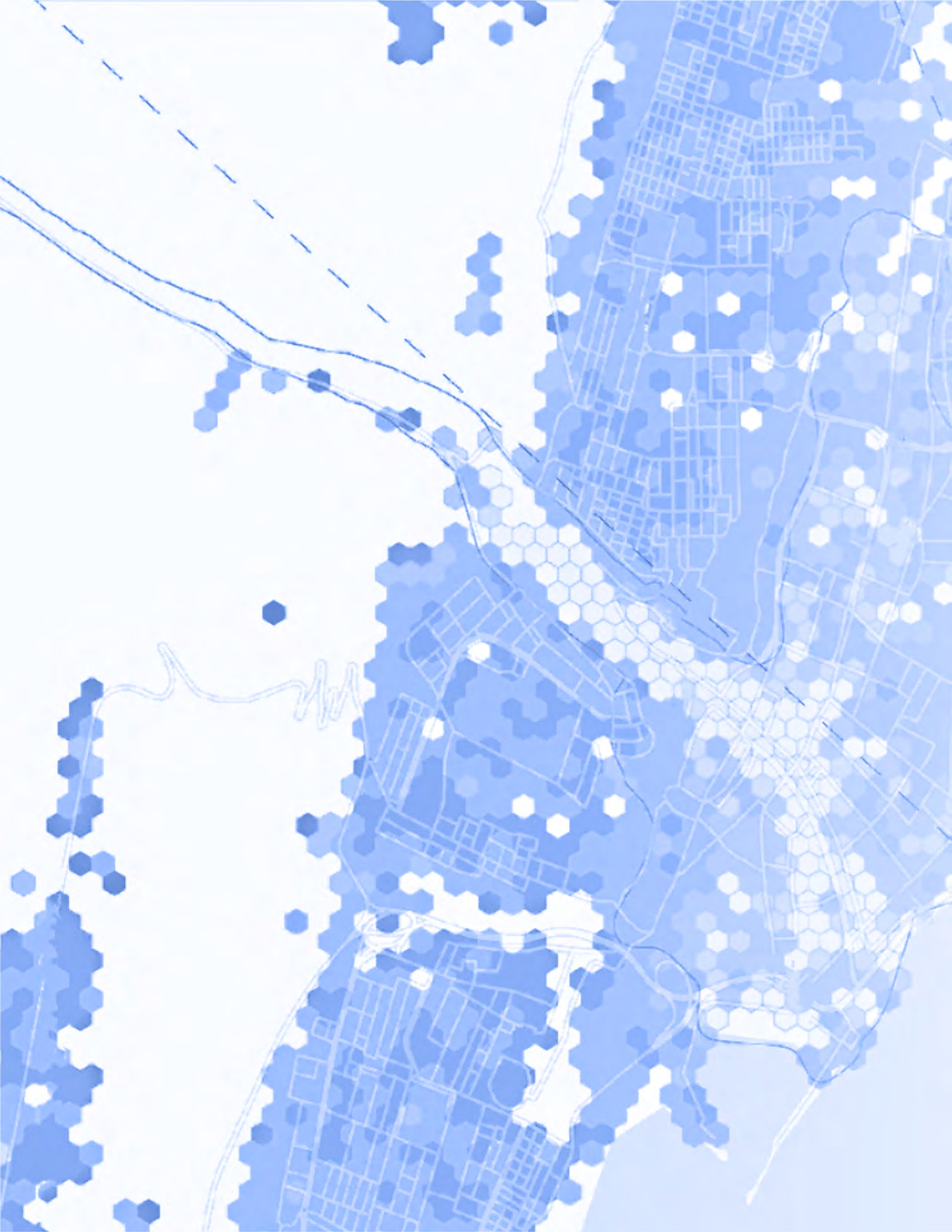
HDSI | Harvard Data Science Initiative
Affiliate Project

Direct Relief

Year in Review

September 2022 - September 2023

CrisisReady | HDSI Harvard Data Science Initiative Affiliate Project | DirectRelief



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Message from the Directors

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We are thrilled to share CrisisReady's second annual report with you highlighting the team's work in the past 12 months.

CrisisReady has seen significant expansion in our scope of work, programming, and international network. Our team's analytic outputs contributed to disaster response efforts around the world, including those for wildfires in California, hurricanes in the United States, earthquakes in Turkey and Syria, and floods in Libya. This year, CrisisReady hosted in-person training workshops in the United States, Colombia, Nicaragua, Thailand and Brazil.

We have three new developments to report this year:

ReadyReports

In the past year, we have published over 90 situation reports, or "ReadyReports", during 23 disasters. These reports were shared with state agencies, international humanitarian organizations, and local response teams. Data pipelines are now in place to generate these reports within 24 hours of a disaster event occurring anywhere in the world.

ReadyMapper

ReadyMapper, our data visualization tool to monitor real-time population mobility, health infrastructure status, disaster perimeters, disaster impact, and population vulnerability, has been deployed across two dozen disaster events. This tool has been especially useful in regions of the world where data access is limited. In the coming months, ReadyMapper will become publicly accessible and be applicable to an even broader range of disaster events.

Climateverse

Climateverse is a growing repository of curated, cleaned, and annotated datasets for research and policy making in the context of climate change and human health. Users can access data from the repository using an AI chatbot that offers insights into data provenance, relevance, uncertainty, bias, and potential use cases. Currently, Climateverse focuses on climate data in South Asia. The next version — Climateverse 2.0 — will be launched in the coming year and will expand its data coverage to include Central America and other regions.

Finally, the periodic Data in Crises event series will continue, fostering discussions with leading humanitarian and public health practitioners, academics, and technologists from around the world. We hosted four sessions in the past year, attended by over 500 participants from five countries, culminating in a live event on the Harvard campus on September 28, 2023.

We are grateful to our dedicated teams at Harvard and Direct Relief, our global collaborators, supporters, and donors for their continued backing.

We look forward to your continued support and engagement.

Satchit Balsari, Caroline Buckee, Andrew Schroeder.

September 2023

About Us

CrisisReady is a research-response platform at Harvard University and Direct Relief that aims to improve data-driven decision making in emergency response, thereby improving resource allocation and planning during disasters. We achieve this by offering solutions that address the technical, regulatory, and operational challenges that hinder the use of data in emergency management cycles.

We follow a Data-Methods-Translational Readiness framework at CrisisReady. The framework emphasizes the use of an evidence-based approach for integrating data and technology into preparedness, response, and recovery models.

Our work includes the creation and dissemination of situation reports during crises, hosting events and workshops that advance dialogue on data utilization in disaster contexts, conducting research that contributes to the body of knowledge in the field, and undertaking technical projects that aim to improve data accessibility for those in the global response community.

Looking Ahead

Expand Scale and Scope of Our Data Toolkits

In the upcoming year, we aim to establish and enhance novel data pipelines. This will allow access to various data layers used in our online analytic tools and ReadyReports, ensuring critical information is readily available when needed. Improved data pipelines related to health infrastructure, service availability, medical vulnerability, structural damage, and human mobility will support our responses to a range of global disasters.

Further Develop the Climateverse Platform

Climateverse currently focuses on climate and health data in South Asia, catering specifically to researchers and policymakers in the region. In the coming year, we plan to expand our data repository to include a broader range and geographic scope of climate data. This expansion will not only enhance climate analysis in South Asia but also extend its benefits to other regions, starting with Central and South America.

Amplify the Impact of Our Reporting Technologies

Our team plans to enhance the ReadyMapper platform, extending its scope to cover more countries and disasters. These improvements will provide a comprehensive analysis of data and serve as a vital resource for response agencies, enabling real-time monitoring, data querying, migration pattern analysis, and logistics planning.

The upcoming ReadyMapper 2.0 will focus on some of the world's most disaster-prone regions, incorporating data for various disasters like wildfires, heatwaves, hurricanes, floods, and armed conflicts. It will feature new machine learning models for decision support analytics and capabilities to integrate environmental and building data. The platform will also allow easy redeployment in localized versions for integrating specific local data sources.

Broaden Our International Network of Collaborators Through Regional Hubs

Following successful workshops with our collaborators worldwide, CrisisReady plans to establish regional hubs with our existing international partners. These hubs will enhance capacities by leveraging a global network of team members embedded in local response environments. Located closer to potential disaster zones, the hubs will also expedite and tailor responses by situating specialized teams within regional contexts.

Advancing Dialogue on Data and Technology in Emergency Response

CrisisReady will continue to foster discussions on the use of novel data and technology in disaster response through our 'Data in Crises' series. We aim to collaborate with a range of stakeholders to examine recent disasters, identify challenges in the field, and explore innovative solutions.

Responding to Crises

Emergency response can benefit from innovations in technology and new data sources. Real-time information through satellite imagery, drones, and mobile devices can now supports strategies that enable targeted aid to vulnerable populations in crisis. The potential for transforming decision-making during disasters has yet to be realized, however; challenges remain in data integration, analysis, and translation, with many response organizations still relying on outdated and incomplete data.

CrisisReady is addressing some of the key challenges in emergency response through a multifaceted approach. This includes the establishment of a cross-functional framework for data-driven responses, development of a data reporting platform,, and the near real-time dissemination of our ReadyReports during emergencies that offer insights into population dynamics and displacement during disasters.

From Hunger to Havoc in Malawi

April 10, 2023

Tropical Cyclone Freddy hit Malawi in March 2023, worsening its existing food insecurity, where one-third of the population faced extreme hunger, 37% of children under 5 were malnourished, and 70% lived in poverty.

The cyclone caused floods, destroyed homes and crops, and left over 1,000 people killed or missing.

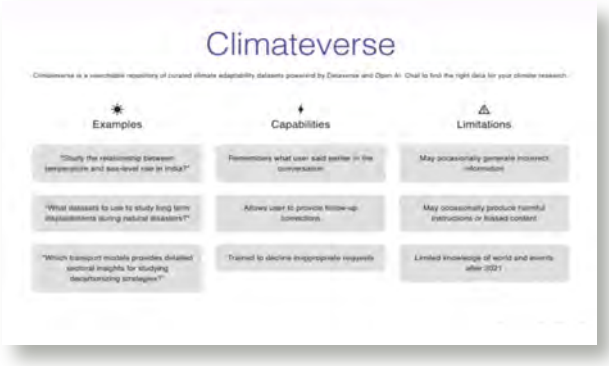
Climateverse

Leveraging the Power of Generative AI and Public Data for Improved Climate Action

In South Asia, a region heavily affected by climate change and home to nearly two billion people, policymakers often lack evidence about how climate change impacts communities and livelihoods on regional and local scales, preventing progress on impactful policymaking. One of the reasons for this evidence gap is the disconnect between global models that predict sea level rises, temperature shifts, and changes in rainfall patterns, and data on the spatial and temporal granularity relevant to how communities actually experience these environmental changes.

Data sets exist to fill this gap between climate models and the human scale, but while academic work has shown how novel data streams, such as human mobility data, satellite imagery, electronic health records, and population health databases, may provide insight into the lived experience of climate change, they are often siloed, inaccessible, and hard to combine in meaningful ways. Additionally, gaps in local capacities to integrate this data into decision-making mean that useful tools are not translated into action.

We believe that the growing accessibility of online data sets and sophisticated analytic tools, including the emergence of AI-assisted data mining approaches, can help craft better policies to support climate action. CrisisReady, in collaboration with the Lakshmi Mittal and Family South Asia Institute at Harvard University, launched the Climateverse project to address the need for evidence-based decision making for climate adaptation strategies. This initiative aims to gather the fragmented climate data within South Asia in one place, presenting it in a well-structured and user-friendly manner to make it easier for people to find and use it, ensuring its relevance, and guiding users on its proper use.



Climateverse presents users with a standardized method for organizing public datasets, illustrating optimal data sharing methods while also underscoring potential risks. It uses an AI approach to allow even non-experts to query climate data and understand the associated uncertainties. Moreover, it offers guidelines for data creators to make their information more user-friendly. This includes providing the appropriate context for their datasets and suggesting intuitive interaction methods. We anticipate that these recommendations, coupled with Climateverse's expanding data repository, will lead to wider discussions on the management and utility of climate data.

Our Approach

01. Stakeholder Input

We consult with stakeholders across government, academia, and the private sector to identify domestic gaps, challenges, and opportunities in availability, access, and usage of climate-related data.

02. Data Sources

We collect climate-related data from local, regional, and international sources to provide users with a comprehensive collection of relevant data.

03. Tagging

Data are tagged with features most useful for researchers and analysts to find and use the correct sources.

04. Intuitive AI Interface

Our approachable AI chatbot performs all searches and provides guidance on the use of each data source, allowing easy application across use cases and technical skill levels.

05. Standardization

Many of the data sources will be standardized to integrate seamlessly with others, ensuring cohesive analysis and optimal utility.

06. Uncertainty and Limitations

Uncertainty, error rates, and the limitations of each dataset will also be reported to ensure appropriate usage.

ReadyMapper

A Digital Solution to Optimize Emergency Response

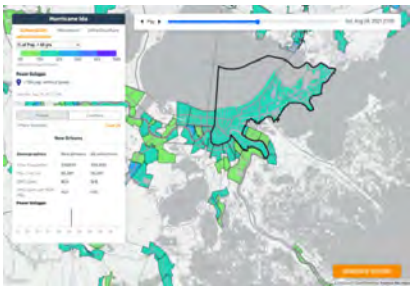
Disasters in the 21st century have resulted in persistent increases in morbidity and mortality long after the acute events have passed. Such disasters, ranging from earthquakes to armed conflicts, frequently lead to power outages, evacuations, and damaged transportation and communication networks. These disruptions hinder access to essential services and resources, including healthcare and stable housing.

With climate-related disasters on the rise, it has become evident that the global response community often lacks the tools to provide useful information as such crises unfold. In these contexts, data is a critical resource that can enhance the effectiveness of response operations. However, the data needed for these operations often comes from disparate sources and can be challenging to access. This is particularly true during time-sensitive disaster events.

Data relevant to disaster response is often siloed across various platforms, corporations, and data systems. For example, disaster perimeter information might come from satellite imagery, population movement data might come from mobile network operators, community health vulnerabilities might be sourced from public health records, and local health system status and infrastructure data might come from government databases. Each of these sources has its own access protocols, data formats, and update frequencies, making it difficult to gather and harmonize this information quickly.

Hurricane Ida | Map showing population mobility in New Orleans, Louisiana.

Hurricane Ida | Map showing local healthcare infrastructure in New Orleans, Louisiana.



Hurricane Ida | Map showing community vulnerabilities in New Orleans, Louisiana.

ReadyMapper, CrisisReady's disaster reporting tool, addresses this challenge by bringing together relevant data onto a single platform, eliminating the need to navigate multiple systems and formats. Having a single, integrated platform makes the data more accessible to all stakeholders involved in the disaster response. This can enhance collaboration and coordination among different response teams. With comprehensive data readily available, responders can make more informed decisions about where to allocate resources, targeting aid more effectively to those most in need.

The ReadyMapper platform combines the following:

- **Disaster Perimeter:** The tool maps the perimeter and expected trajectory of a disaster, enabling organizations to accurately predict impacted areas. Knowing the evolving geographical scope of a disaster is critical when planning for response.

- **Community Vulnerability:** ReadyMapper provides data on baseline community vulnerabilities, such as the percentage of a population that is reliant on advanced medical care. This information is particularly useful in the event of power outages, which may impact the ability to administer, manage, or access critical health care. With this data, medical aid can be more efficiently distributed to those who need it most.

- **Population Movement:** Using aggregated and anonymized population mobility data from the Data for Good program at Meta, which provides consented location data from users using Meta applications on their mobile devices, the tool identifies population displacement dynamics as a disaster event evolves. This helps response teams pinpoint areas of greatest need for material aid, shelter, and medical services. It can also help reevaluate distribution plans.

- **Healthcare and Power infrastructure:** This maps locations of a range of healthcare facilities for all regions of the world where such data are available. Wherever possible, bed capacity data are also displayed. This allows responders to know what facilities are available in the area, and their capacity. If a disaster hits, responders need to know if the local healthcare facilities can take care of all the injured people, or if we need to send more medical help.

ReadyMapper also allows users to generate customizable reports in portable document format (PDF). These reports can be filtered by geography, time, and other attributes of interest. This ensures that all members of a disaster response team have easy access to relevant, up-to-date information in a format that is consistent and easy to share.

The tool is a valuable asset for disaster response coordination, and is increasingly in demand by state agencies and humanitarian aid organizations.

ReadyReports

Insights on Population Dynamics During Disasters

Shortly after a disaster occurs, the CrisisReady team generates reports presenting an array of insights from the data streams described above. One key aspect is understanding how populations move in the regions most affected by a disaster. This is achieved using human mobility data from Data for Good at Meta, a research initiative that aims to leverage existing mobility data for public good.

Identifying Patterns of Displacement

By analyzing the number of users with location services enabled within Meta's platforms, our reports estimate the current population density of a specified area. Comparing this to baseline population data recorded 90 days before the disaster takes place, the reports reveal how populations shift as the emergency event evolves. These fluctuations provide insight on the movement patterns of communities during disasters, providing critical information on population displacement dynamics.Visually, changes in population densities are represented on maps through clusters of dots in a gradient transitioning from blue (signifying population increases) to red (signifying decreases). The transparency of these dots is indicative of the data's representativeness. These visuals are accompanied by tables that list the counties and towns within the geographical bounds of analyses. Also provided are trend lines, showing the overarching patterns of density fluctuations over time. This component of the reports empower users to pinpoint areas of concern quickly. For response teams, it's important to access and understand this information quickly, as it helps guide the efficient allocation of resources and identifies areas in immediate need.

Evaluating Community Health Vulnerabilities

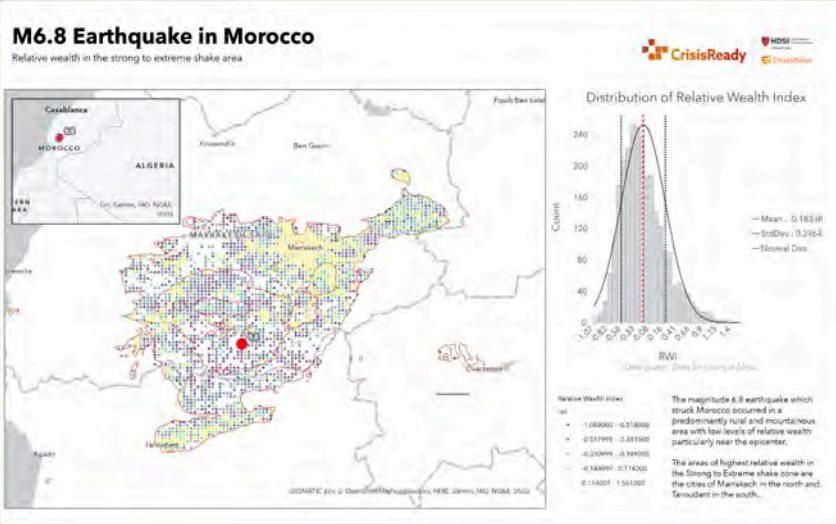
CrisisReady's ReadyReports also shed light on baseline population vulnerabilities. Metrics like the percentage of residents aged 65 or older are particularly useful in this context, as this demographic often grapples with preexisting medical conditions, relying heavily on medical equipment that might be electricity-dependent. Given the frequency of power outages during disasters, this information can help arrange necessary medical interventions. Additional vulnerability metrics, such as the proportion of the population living below the poverty line and the count of Durable Medical Equipment (DME) users, can further improve the deployment of personnel, material aid, and medical services.

Assessing Healthcare Infrastructure

Supplementing these insights is data on the healthcare infrastructure of the region. The report categorizes facilities by type: hospitals, clinics, hospices, or home health agencies. It provides more granular information like bed count and travel times to these facilities, bringing to attention potential constraints in healthcare access during a crisis.

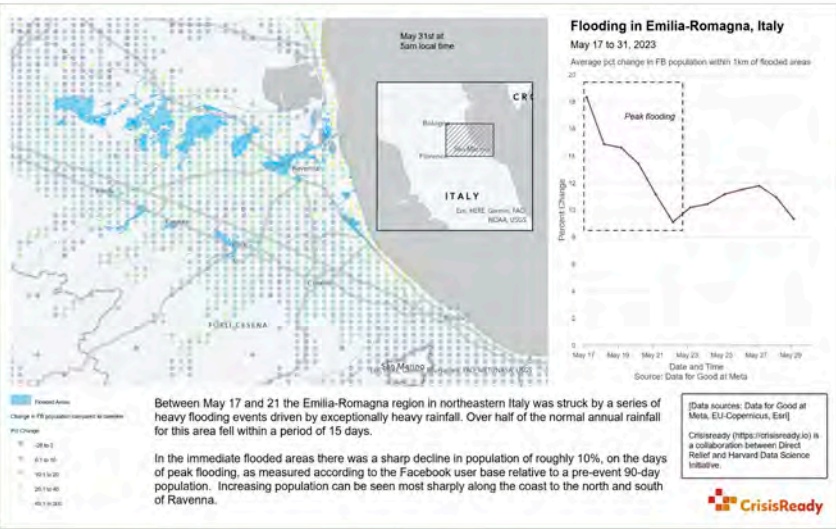
Other pieces of information, such as damage assessments from satellite imagery, socio-economic data, network connectivity data, and the strength of connectedness between two geographic areas as represented by Facebook friendship ties, is included when possible.

ReadyReports have helped relief efforts for over 30 global disasters, from earthquakes in Turkey to hurricanes in South Asia. The following page offers a closer look at some of the reports created over the past year.



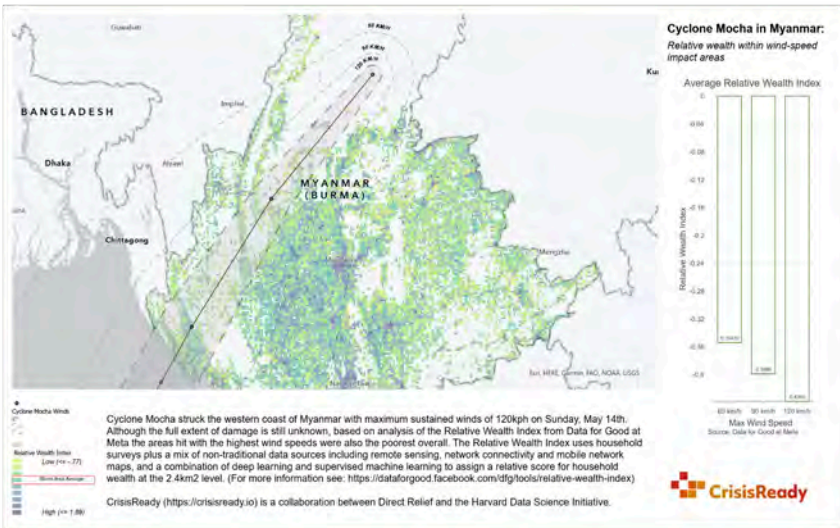
Earthquakes | Morocco
September 9, 2023

To provide deeper insights into the socio-economic impacts of the earthquakes, this report uses Meta's Relative Wealth Index (RWI) to illustrate the distribution of wealth across the areas in Morocco most affected by the disaster.



Floods | Emilia-Romagna, Italy
May 31, 2023

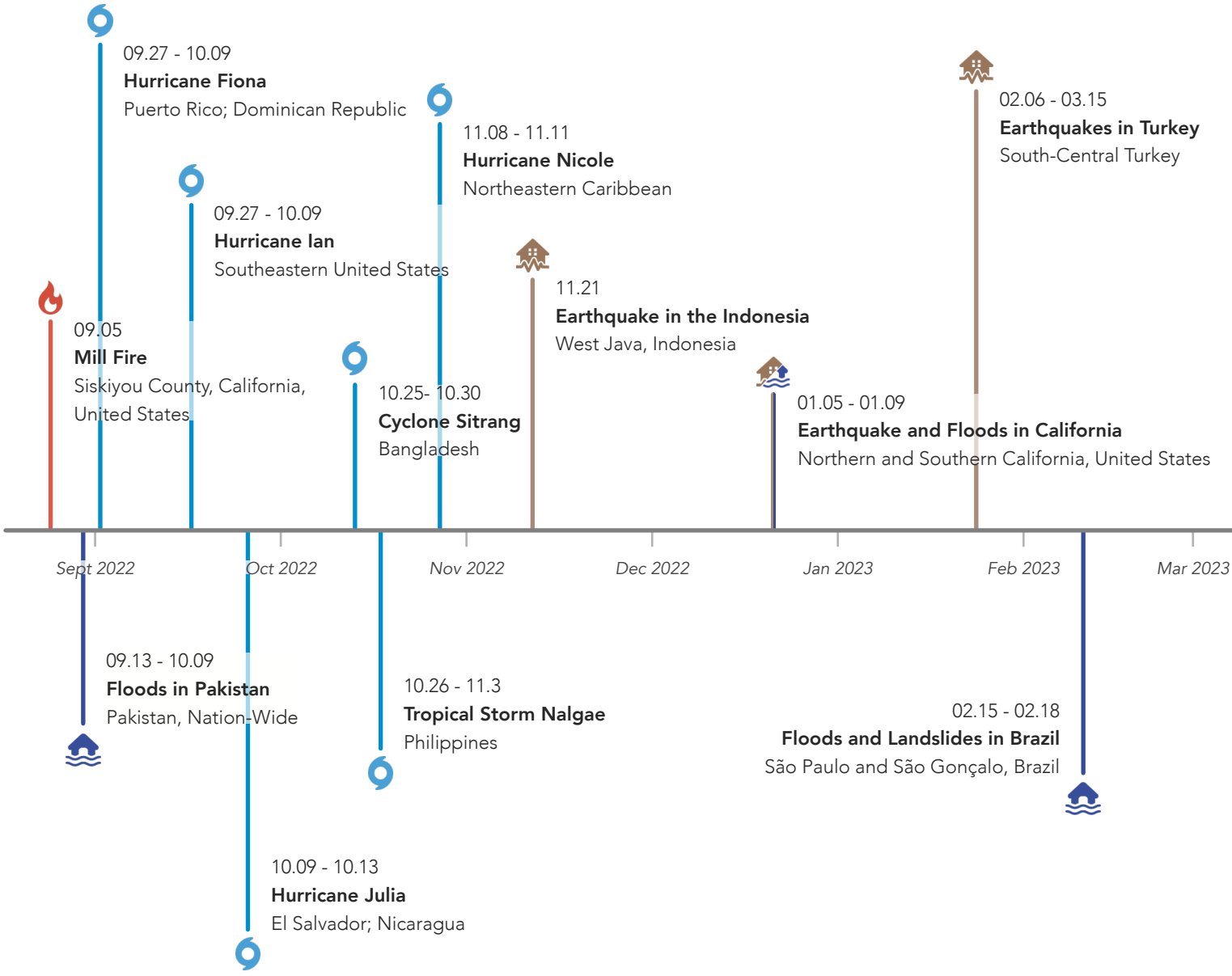
This report provides information on population movement in northwestern Italy, especially in the Emilia-Romagna region, where floods swept across the region from May 17 to May 21, 2023.

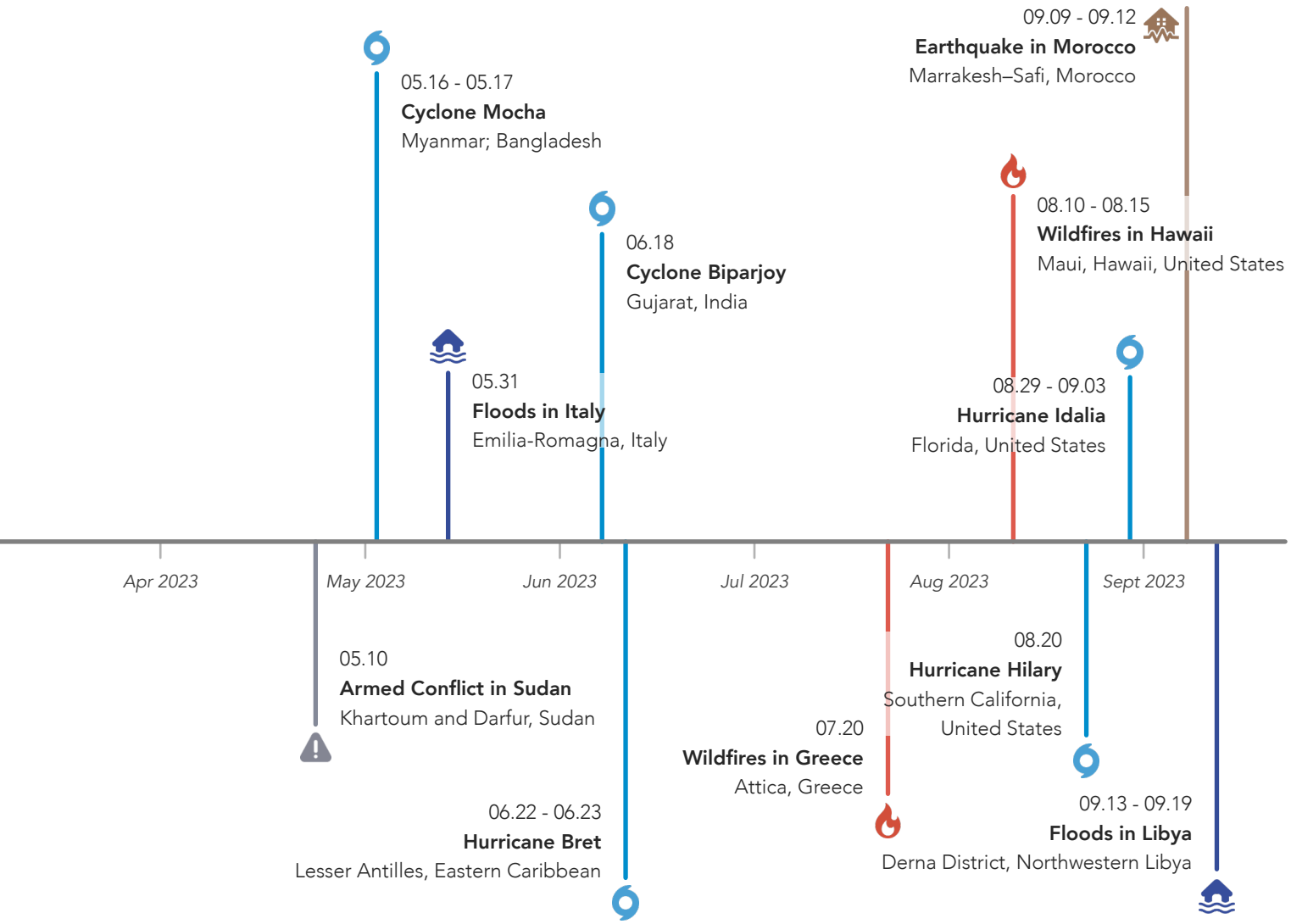


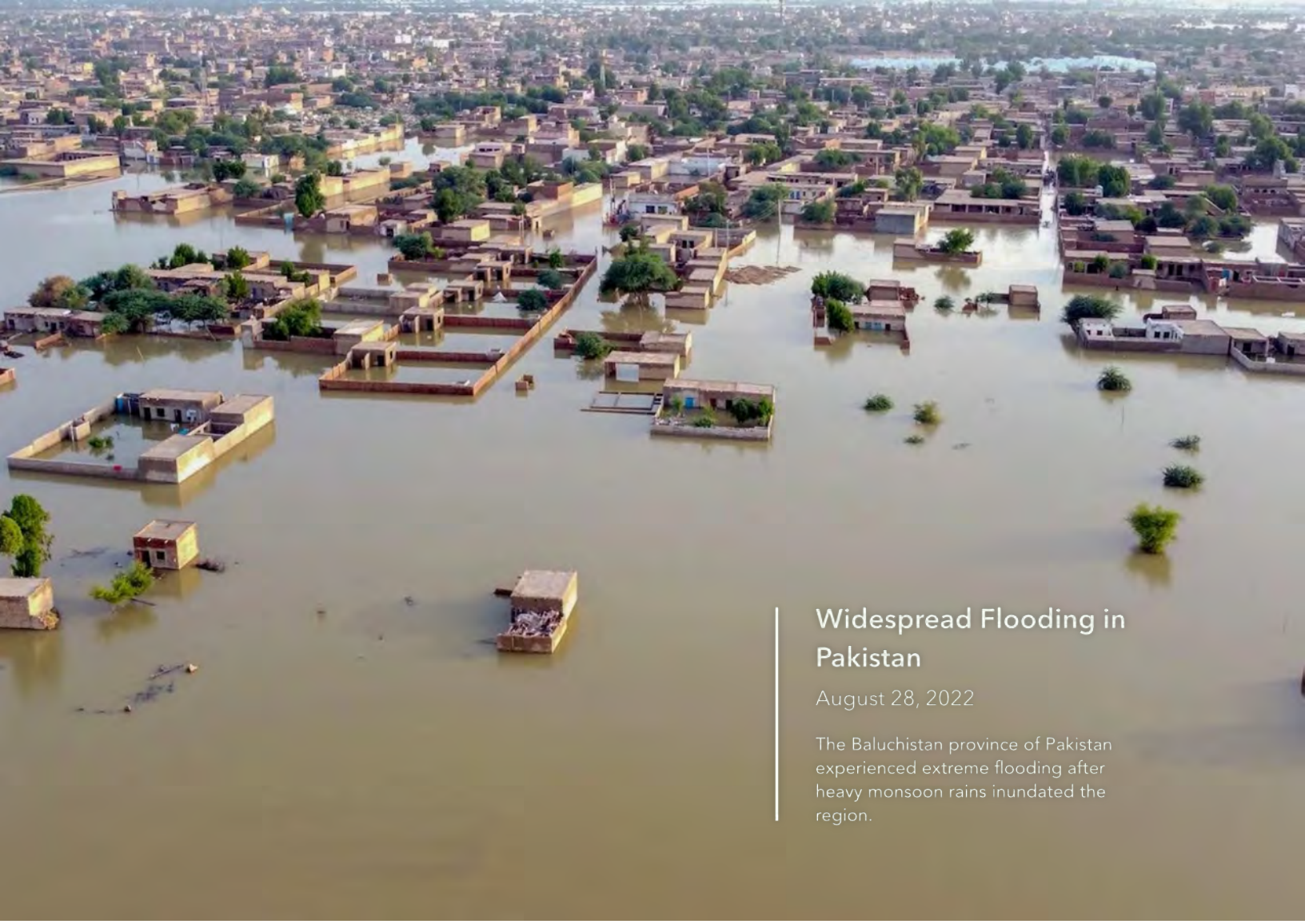
Cyclone Mocha | Myanmar
May 15, 2023

Using Meta's Relative Wealth Index (RWI), this report provides information on the economic status of the regions in Myanmar most affected by the Cyclone, which made landfall in the country on Sunday, May 14., 2023.

ReadyReport Timeline




09.09 - 09.12
Earthquake in Morocco
Marrakesh–Safi, Morocco
08.10 - 08.15
Wildfires in Hawaii
Maui, Hawaii, United States
05.16 - 05.17
Cyclone Mocha
Myanmar; Bangladesh
06.18
Cyclone Biparjoy
Gujarat, India
05.31
Floods in Italy
Emilia-Romagna, Italy
08.29 - 09.03
Hurricane Idalia
Florida, United States
Apr 2023
May 2023
Jun 2023
Jul 2023
Aug 2023
Sept 2023
05.10
Armed Conflict in Sudan
Khartoum and Darfur, Sudan
08.20
Hurricane Hilary
Southern California,
United States
07.20
Wildfires in Greece
Attica, Greece
06.22 - 06.23
Hurricane Bret
Lesser Antilles, Eastern Caribbean
09.13 - 09.19
Floods in Libya
Derna District, Northwestern Libya



Widespread Flooding in Pakistan

August 28, 2022

The Baluchistan province of Pakistan experienced extreme flooding after heavy monsoon rains inundated the region.

August 2022 - October 2022

Disaster Focus: **2022 Pakistan Floods**

In 2022, Pakistan's intense monsoon led to widespread floods and landslides affecting millions. A year on, recovery remains challenging. Pakistan faces significant vulnerability due to high disaster risks such as floods, earthquakes, and conflicts, which are exacerbated by widespread poverty.

CrisisReady released reports during the Pakistan floods, analyzing the humanitarian situation, especially in Khyber-Pakhtunkhwa, Sindh, and Balochistan. These updates revealed population displacement patterns. Serving as a response tool, the reports helped authorities pinpoint critical areas and prioritize resources, guiding aid distribution.

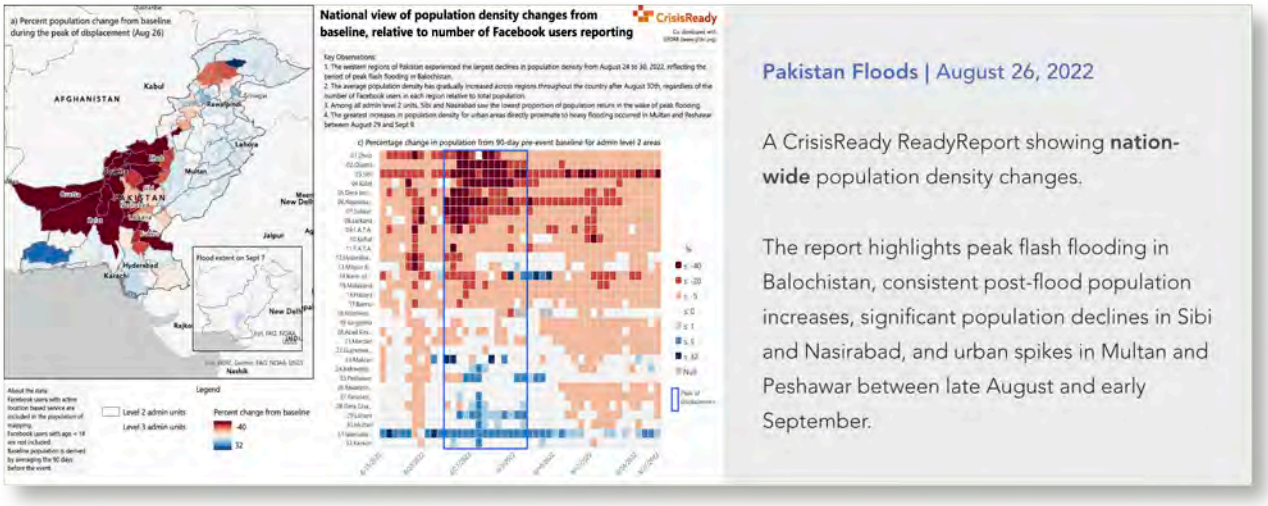
Overview of Impact

- Floods **affected at least 33 million people**, according to reports from UN OCHA, and **killed at least 1,739** from the beginning of monsoon season in mid-June 2022 to November 18, 2022.
- UN OCHA reported that the floods **displaced at least 7.9 million people**.
- According to the post-disaster needs assessment, the flooding caused **$14.9 billion in damages** and **$15.2 billion in economic losses**. Estimated needs for **reconstruction are at least $16.3 billion**.

CrisisReady's Response

In response to the floods, CrisisReady generated a series of ReadyReports to analyze the disaster as it evolved, tracking population shifts in flood-hit areas, especially in Khyber-Pakhtunkhwa, Sindh, and Balochistan.

These reports revealed patterns of population movement, helping authorities identify evolving displacement dynamics and prioritize resource allocation, ensuring material and personnel were efficiently distributed.



Key Observations

- By September 13, 2022, Northeast Pakistan saw population densities returning to pre-crisis levels, but southern areas continued to show decreased densities.
- At the time of analysis, notable movement from Hyderabad and Karachi towards northern cities like Lahore and Multan was seen.
- Khyber-Pakhtunkhwa and Sindh saw major displacement peaks between August 20-31, 2022. Reduced mobility persisted until September 21, coinciding with these displacement peaks.
- Areas of Balochistan saw significant drops in population densities between August 23 - September 4.
- Western Pakistan saw major declines in densities during peak flash flooding from August 24 to 30.

Hurricane Fiona's Aftermath in Puerto Rico

September 20, 2022

Floodwaters engulf homes in Aguadilla, Puerto Rico following Hurricane Fiona's devastating passage.

U.S. Coast Guard

September 27, 2022 - October 9, 2022

Disaster Focus: **Hurricanes Fiona & Ian**

Hurricane Fiona hit multiple regions from the Caribbean to Canada in September 2022, with Puerto Rico and Atlantic Canada facing severe impacts. Puerto Rico experienced extensive flooding and power outages, while Atlantic Canada's farming and fishing sectors, especially in Port aux Basques, Newfoundland, suffered major losses.

Following closely, Category 3 Hurricane Ian wreaked havoc from Cuba to the US Carolinas, resulting in billions in damages and multiple fatalities.

CrisisReady generated ReadyReports for the hardest-hit areas in Florida and South Carolina to help guide hurricane relief efforts.

Overview of Impact

Hurricane Fiona: September 17 - September 19, 2022

- In Puerto Rico, the hurricane resulted in significant flooding and triggered widespread **power outages that affected around 1.5 million consumers**.
- Fiona caused **at least 22 deaths in Puerto Rico**, with more fatalities still under investigation due to the storm. **47 deaths were reported in Florida**, while another **4 deaths were reported in North Carolina**.

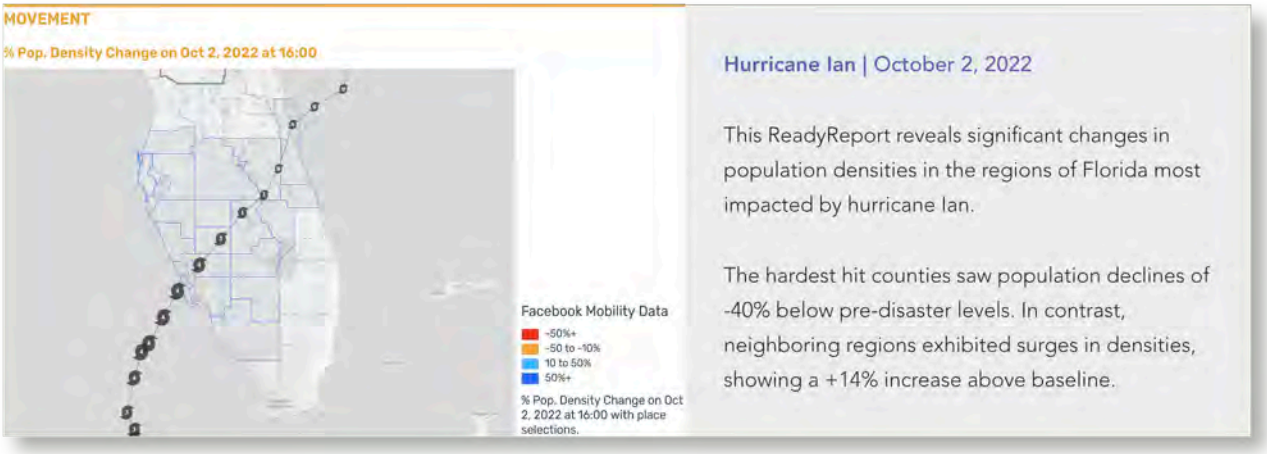
Hurricane Ian: September 23 - September 30, 2022

- Hurricane Ian left a trail of destruction with estimated **damages costing between $53 billion and $74 billion**. In total, the Hurricane caused **161 deaths**.

CrisisReady's Response

In response to the hurricanes, CrisisReady generated a series of ReadyReports to provide information on population movement, healthcare infrastructure, and community vulnerabilities in the most affected regions. The reports were shared with response agencies in the area, enhancing the delivery of aid and providing information to streamline operations.

CrisisReady hosted a "Data in Crises" event in September 2022, which fostered inter-agency dialogue and collaboration on hurricane response strategies.



Key Observations

- On September 28, the western coast of Florida saw significant evacuation-driven population decreases between -74% and -65%.
- Later on October 1, areas north of Charleston, South Carolina saw declines in population densities between -13% and -14%, indicating the Hurricane was moving north.

EU Civil Protection and Humanitarian Aid

February 6, 2023 - March 15, 2023

Disaster Focus: **Earthquakes in Turkey & Syria**

On February 6, 2023, southern Turkey experienced a magnitude 7.8 earthquake near the northern border of Syria, followed about nine hours later by a 7.5 magnitude tremor approximately 59 miles southwest. These seismic events marked the most catastrophic earthquakes Turkey had witnessed in over two decades. The epicenter was close to Gaziantep in south-central Turkey, a city populated by thousands of Syrian refugees and numerous humanitarian aid organizations.

In the aftermath, CrisisReady supported response efforts by generating ReadyReports, which provided insights on population displacement dynamics, community vulnerabilities, and healthcare infrastructure in the region, helping in directing crucial aid where it was most needed.

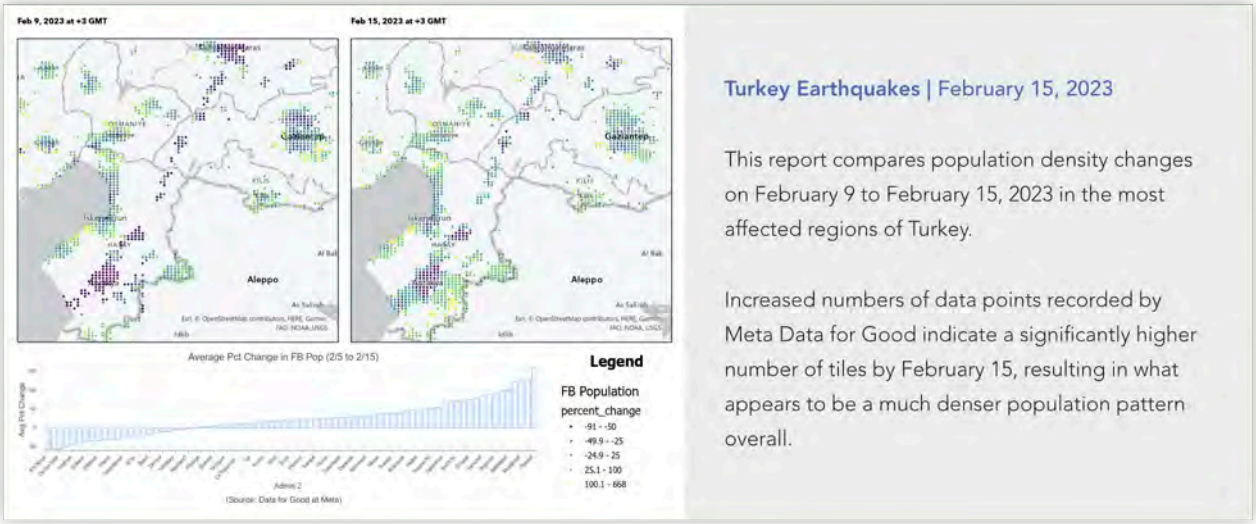
Overview of Impact

- The earthquakes resulted in **over 59,000 deaths** in Turkey and Syria, with the actual count likely higher.
- The International Organization for Migration states that the earthquakes in Turkey **displaced 3 million people**. By August 8, 2023, 81,264 households were in temporary shelters in the hardest-hit provinces, down 59% from March 2023.
- In total, **8.8 million people in quake-affected areas were in Syria**, spanning 170 sub-districts across 10 governorates.

CrisisReady's Response

After the earthquakes struck Turkey and Syria, CrisisReady released ReadyReports highlighting changes in population densities, which provided insights on forced displacement. By combining this with data on community vulnerabilities and quake-damaged healthcare facilities, the reports provided a comprehensive view of the affected areas' needs. These insights were shared with partners, aiding organizations like the World Food Programme in refining their response efforts.

Later, CrisisReady hosted a "Data in Crises" event at Harvard, where experts discussed the challenges of the earthquakes and the pivotal role of data in disaster response, emphasizing both immediate and long-term impacts.



Key Observations

- Hatay's corridor between Antakya and the Syrian border saw a rise above 100% compared to baseline.
- Increased population densities were also registered in the areas around Kahramanmaraş and Osmaniye.
- Downtown Gaziantep, down by -50% to -90% on February 9, rebounded with increases between +1% and +25% by February 15.

Wildfires Run Rampant in Hawaii

August 11, 2023

Devastating wildfires engulfed Maui in the Summer of 2023, leading to numerous fatalities and causing widespread destruction to the historic city of Lahaina.

August 10, 2023 - August 15, 2023

Disaster Focus: **Wildfires in Maui, Hawaii**

In early August 2023, a series of devastating wildfires erupted predominantly on the island of Maui in the U.S. state of Hawaii. Fueled by dry conditions from a high-pressure area to the north and Hurricane Dora to the south, these wind-driven fires prompted significant evacuations and widespread destruction. The northwest town of Lahaina was particularly impacted with 97 deaths and 31 individuals reported missing.

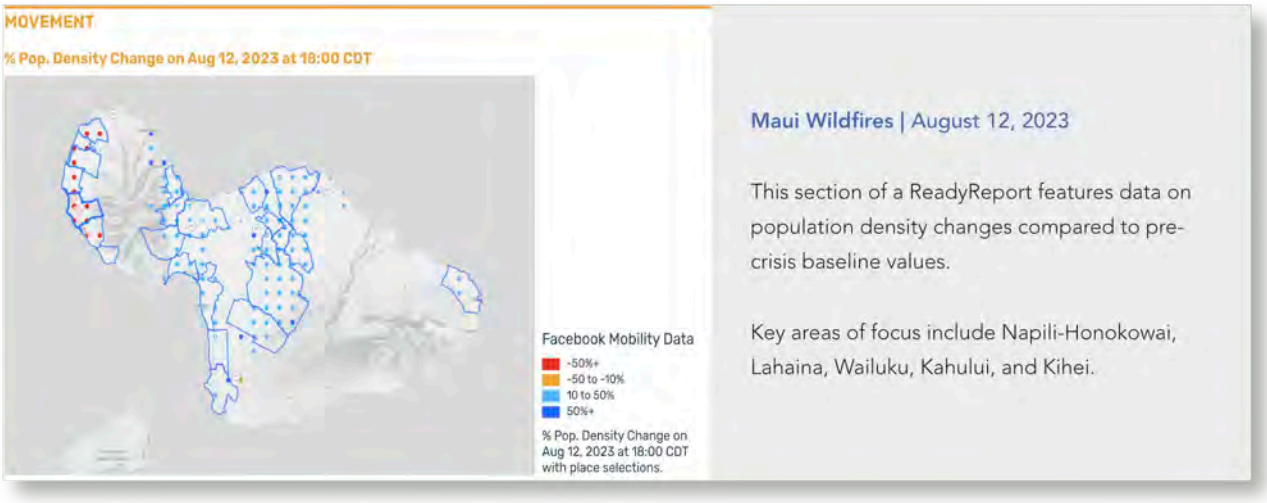
In response to the crisis, CrisisReady produced periodic ReadyReports, merging vital data on population density shifts, community vulnerabilities, and healthcare infrastructure to assist in relief and recovery operations.

Overview of Impact

- The wildfires caused **115 reported deaths** and resulted in the **destruction of over 2,000 homes** on the island. Lahaina, in particular, bore a significant portion of the wildfire's destruction.
- Since August 9, 2023, Maui experienced an estimated **daily economic setback of $11 million** due to business closures and decreased visitor expenditures.
- The wildfires, having destroyed thousands of structures, led to **losses ranging between $4 billion and $6 billion** due to property damages and business interruptions.

CrisisReady's Response

After the wildfires began burning, CrisisReady produced ReadyReports from August 10 to 15, 2023, providing information on changes in population densities, baseline community vulnerabilities, and healthcare infrastructure in Lahaina. These reports, shared with partners like FEMA, NetHope, and the American Red Cross, helped regional response efforts.



Key Observations

- Western areas of Maui, like Napili-Honokowai and Lahaina, experienced decreases in population densities ranging from -56% to -95% below baseline. 15% to 38% of residents in these areas were elderly.
- Wailuku and Kahului saw increases in population densities of up to +34%. Shelters were set up in various places, notably Kahului and Kihei, as per local reports.

NASA Earth Observatory

September 13, 2023 - September 26, 2023

Disaster Focus: **Floods in Northeast Libya**

On September 10, 2023, Libya was hit by Tropical Storm Daniel, which resulted in the country's most devastating flooding in more than a century.

The onslaught of the storm, characterized by its powerful winds and torrential rains, led to the catastrophic failure of two major dams. This, in turn, unleashed further destruction across the nation, obliterating homes, hospitals, vital roadways, and essential power infrastructure. The human toll has been equally tragic, with thousands reported dead and countless others still missing.

CrisisReady helped support response efforts by producing timely ReadyReports that provided key information and insights for organizations involved in the relief and recovery operations.

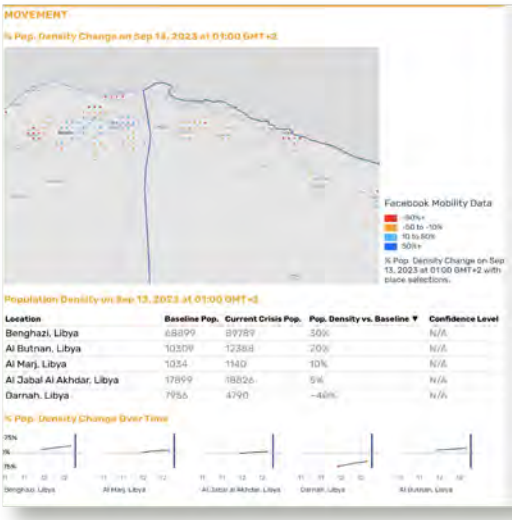
Overview of Impact

- As of September 15, 2023, the floods in Derna have **killed at least 4,000 people**. **170 fatalities were reported** in other parts of eastern Libya including Susa, Marj, Bayda, and Um Razaz.
- As of the end of September, **at least 8,500 individuals still remain missing**. Potential displacements may have been caused by disruptions to communication networks.
- UN OCHA's data from September 15 indicates that the floods have **adversely affected nearly 900,000 residents** living across the five Libyan provinces hit by the disaster.

CrisisReady's Response

CrisisReady generated ReadyReports, which, like other reports, provided insights on evolving population displacement dynamics, disruptions in network access, and healthcare infrastructure statuses.

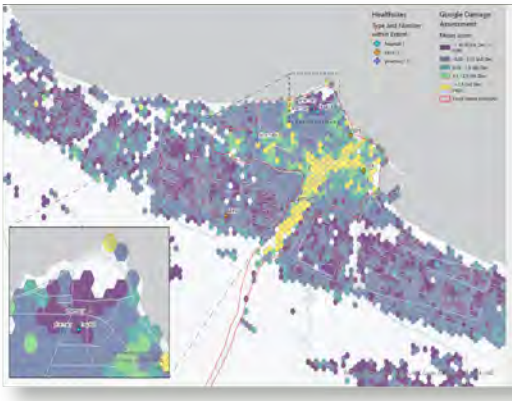
These reports also leveraged Google's machine learning tool used to assess building damage. The ReadyReports combine Google's data with other satellite imagery to provide a thorough evaluation of damage severity in the affected areas.



Libya Floods | September 13, 2023

According to this report, the Derna District experienced a significant population decline of 40% on September 13th. The coastal city of Derna, which was heavily inundated by the floods, witnessed a complete population decrease, suggesting that everyone might have been displaced.

In potential displacement areas, there were marked population increases in neighboring cities such as Maturba, Umm al Rizam, Bomba, Timimi, and Tobruk. Surrounding districts also saw increases in densities, with Benghazi seeing the most pronounced surge at +30%.



Libya Floods | August 25, 2023

Data indicated severe impacts on healthcare facilities within Derna. Specifically, two clinics located in the central region of Derna were likely to have experienced significant damage.

Additionally, two pharmacies and the public hospital were situated in zones where there was a lower probability of major damage occurring.

Learning from Crises

The field of emergency response has seen progress with new reporting technologies, data collection mechanisms, and analytic methods. These have enhanced the efficacy and timeliness of interventions, yet challenges persist. Gaps in funding, local technical capacities, and data accessibility hinder full implementation, creating disparities in emergency preparedness.

CrisisReady seeks to address these challenges by examining past disaster responses, deriving insights from them to inform future strategies, and sharing knowledge with the global community of practice.

Through a series of events and workshops, CrisisReady fosters collaboration on the use of novel data and emerging technologies in the field, aiming to enhance preparedness and response models that can be used for a wide range of disasters. The goal is to build more resilient and effective emergency response frameworks around the world that recognize and overcome the existing obstacles.

Widespread Flooding from Pakistan Monsoon

July 2010

Monsoon rains flooded one-fifth of Pakistan, causing over 1,500 deaths and displacing millions. A study from NASA found the flood was made more likely by global warming.

Data in Crises Event Series

The Data in Crises event series brings together practitioners from the global emergency response community to share their experiences and the insights they gained in the field. The main focus of the series is to explore the challenges and opportunities of global preparedness, response, and recovery efforts, especially as they relate to the utilization of novel data sources and technologies.

The Data in Crises event series is designed to cover a wide range of disasters and topics. It aims to capture the diverse nature of crises and the contextual challenges that each of them pose. Events have been organized to discuss specific disasters, such as Hurricane Fiona that struck Puerto Rico, the Dominican Republic, Grand Turk, and Canada in September 2022.

They also cover broader topics, such as preparing for climate migration in Southeast Asia, which brought attention to the growing issue of population displacement due to climate change in the region. In all topics discussed, the series focuses on the use of technology and data in response operations. These discussions delve into the innovative applications of data and technology throughout response and recovery operations.

By featuring events that focus on a wide range of disasters and topics, the series provides a platform for practitioners to exchange ideas, share best practices, and collectively work towards improving the use of data in emergency preparedness, response, and recovery.

Hurricane Fiona from Above

September 20, 2022

An image of Hurricane Fiona captured from NASA's International Space Station, orbiting 259 miles above the Atlantic Ocean north of Puerto Rico.

NASA Earth Observatory

September 29, 2022

Data in Crises: **Responding to Hurricane Fiona**

Hurricane Fiona was a Category 4 storm that formed on September 14, 2022. It passed over Guadeloupe and the Caribbean Sea before hitting Puerto Rico on the 18th, where it caused severe flooding, an island-wide blackout, and 25 deaths.

Fiona then made landfall in eastern Canada on September 24, where it was downgraded to a tropical storm, but still caused record-breaking destruction. This included torrential rain, winds up to 99 mph, and widespread power outages.

Hurricane Ian followed Fiona, making landfall in Cuba as a Category 3 storm, resulting in extensive damage and three deaths. It later hit Florida, resulting in over 150 deaths and over $112 billion in damages, becoming Florida's costliest hurricane and the third-costliest in U.S. history.

At this Data in Crises event, the speakers and moderators explored the varying effects of the hurricanes on different communities. They discussed how response organizations can address these diverse impacts and how to predict changes in where people live due to these disasters. The main goal of the discussions was to determine how data, if used properly, could lessen the risks and damage caused by hurricanes and other related disaster events.

Moderators

Dr. Andrew Schroeder

Co-Director, CrisisReady
Vice President of Research, Direct Relief

At CrisisReady and Direct Relief, Andrew Schroeder leads the analysis of novel data, and partners with international organizations to deploy innovative data products during crises.

Dr. Pamela Martinez

Assistant Professor of Microbiology,
University of Illinois Urbana-Champaign

Pamela Martinez's research specializes in infectious diseases. She has published work on the impact of socioeconomic factors on COVID-19 and mortality.

Speakers

Major Dr. Gail Ranglin-Edwards

Active Duty Officer, Medical Officer,
Jamaica Defence Force

Major Gail Ranglin-Edwards leads multiple public health initiatives, including the US Department of Defense-led HIV/AIDS Prevention Program.

Dr. Michael Johansson

Infectious Disease Biologist,
Center for Communicable Disease Dynamics

Michael Johansson is an infectious disease biologist who specializes in modeling and forecasting. He is also an adjunct lecturer of Epidemiology at Harvard T.H. Chan School of Public Health.

Dr. Hamish Patten

Senior Data Scientists, International Federation of Red Cross and Red Crescent Societies (IFRC)

Hamish Patten is a solutions architect at the United Nations Office for Disaster Risk Reduction, where he is responsible for building the Risk Information eXchange platform.

Ivonne Rodriguez-Wiewall

Executive Advisor,
Direct Relief, Puerto Rico

Ivonne Rodriguez-Wiewall is the head of Direct Relief's Puerto Rico office, where she leads projects to safeguard lives and facilitate medical access during disasters.

Beyond the Eye of the Storm: The Overlapping Impacts of Hurricanes

During the event, Hamish Patten of the IFRC outlined the short-term and long-term impacts of hurricanes. He categorized immediate effects into four areas: economic, environmental, infrastructural, and societal.

Patten illustrated how these effects can be interconnected, using the example that multiplying the number of destroyed homes by the average household size can estimate the minimum population displacement in the short term. He stressed that the long-term effects of hurricanes, which may persist for months or even years, are equally significant as the short term impacts, and include ongoing impacts on communities and increased death rates after landfall.

Michael Johansson, an infectious disease biologist at Harvard T.H. Chan School of Public Health, highlighted four types of long-term impacts from hurricanes, using his experiences in Puerto Rico during Hurricane Fiona as context.

- **Mass Migration:** Post-Fiona, Johansson explained that Puerto Rico saw a significant exodus, especially among the young and healthcare professionals.
- **Educational Disruptions:** Hurricanes disrupt schooling, and technology constraints pose barriers to remote learning.
- **Political Consequences:** Poor disaster handling can have political ramifications, exemplified by Puerto Rico's governor resigning partly due to his response to Hurricane Maria.
- **Mental Health:** Continued hurricane exposure can intensify mental health challenges, made worse by infrastructure damage.

In addition, health challenges related to communicable diseases and their proliferation are a critical concern. After Hurricane Fiona, there was a rise in health issues related to infectious diseases, as highlighted by Ivonne Rodriguez-Wiewall from Direct Relief.

Displacement's Impact on Local Resilience

Repeated disasters strain local expertise, further exacerbated by economic migrations, as pointed out by Gail Ranglin-Edwards. The Caribbean, despite high internet usage, lacks comprehensive human mobility data during crises. Collaboration with local mobile service providers might offer a solution.

Predicting post-disaster displacement is complex. Patten noted inconsistencies in data collection, while Johansson emphasized gaps, especially concerning power outages, which is vital for understanding healthcare disruptions.

Final Takeaways

Hurricanes present immediate and long-term health challenges, with some effects remaining underreported. Novel data sources and predictive models can help, but data gaps, limited local resources, and regulatory challenges pose obstacles. Effective hurricane response requires strategies addressing these long-term impacts and data deficiencies to navigate the aftermath of such events more holistically.

Higüey, Dominican Republic | September 2023: Neighbors attempt to recover their belongings after intense flooding.

Ricardo Hernandez

Higüey, Dominican Republic | September 2023: Residents work to remove mud in a small neighborhood following Hurricane Fiona.

AP Photo/Ricardo Hernandez

UN Women Asia and the Pacific

December 8, 2022

Data in Crises: **Preparing for Climate Migration in South Asia**

Over the past decade, Southeast Asia has experienced severe weather disasters, with countries like Bangladesh and India facing heatwaves, floods, and cyclones, leading to widespread damage and health issues.

As climate change exacerbates these events, the region's most vulnerable face greater risks, including food insecurity and disease during extreme weather. The threats are not just immediate; rising sea levels and agricultural impacts pose long-term challenges. Addressing these requires both climate change mitigation, to reduce emissions, and adaptation strategies to manage current and future climate impacts.

Speakers from Bangladesh, India, and the Philippines discussed climate adaptation and the importance of data in decision-making. These discussions covered a wide array of topics, such as structuring data for disaster response, the priorities of relief organizations in the region, and recent advancements in climate adaptation research and policy.

Moderator

Dr. Satchit Balsari

Co-Director, CrisisReady
Emergency Physician, Beth Israel Deaconess Medical Center
Assistant Professor, Harvard Medical School

Dr. Satchit Balsari leads several research initiatives across Harvard University, investigating the effects of climate change-induced disasters on population health, healthcare infrastructure, and health system resiliency.

Speakers

Dr. Liakath Ali

Director, Climate Change Programme &
Urban Development Programme,
BRAC (Bangladesh)

As a Director at BRAC, an international development organization in Bangladesh, Dr. Liakath Ali brings to bear extensive experience in climate change adaptation and disaster management.

Michael Andrew Manalili

GIS Innovation and Development Lead,
World Food Programme

At the World Food Programme, Michael Andrew Manalili works on the Impact AI project. He was formerly a GIS Developer at the organization, and led the development of the Automated Disaster Analysis and Mapping (ADAM) of Floods Project.

Bhargav Krishna

Research Fellow,
Centre for Policy Research (India)

Bhargav Krishna's work focuses on the impact of air quality and climate change on health. He previously managed the Centre for Environmental Health at the Public Health Foundation of India (PHFI) and served on government expert committees on air pollution.

Challenges of Climate Adaptation in India: Insights from Bhargav Krishna

Accessing essential data presents significant challenges in India. Open access to foundational data can lead to improved data quality and foster trust among stakeholders. Recognizing these challenges, CrisisReady introduced the Climateverse initiative. This platform provides researchers and policymakers with processed, organized, and user-friendly data. It addresses specific local challenges in data procurement, processing, and analysis, aiming to develop a regional data ecosystem vital for evidence-based policymaking.

Bhargav Krishna, a Fellow at India's Centre for Policy Research, discussed the challenges of climate adaptation in India. He noted that data collection and interpretation often occur in reverse, leading to inefficiencies. Accessing essential climate change data is challenging, requiring multiple sourcing methods. Krishna emphasized the importance of proactive data collection and real-time analysis to expedite insight generation.

Accurate data on climate-related health impacts is crucial for adaptation planning, but obtaining such data can be complex. Enhancing data-sharing agreements between public and private entities can help prevent duplication of efforts and ensure better data quality. Streamlining processes, adopting automated methods, and utilizing new technologies can improve both the speed and accuracy of data analysis.

Sirajganj, Bangladesh | October 12, 2022: Houses are nearly submerged due to flooding caused by intense rainfall in Bangladesh.

Moniruzzaman Sazal/Climate Visuals Countdown

New Delhi, India | July 2023: Evacuees take refuge in temporary shelters after monsoon rains flooded their homes.

Mayank Makhija

Challenges of Climate Adaptation in Bangladesh: Insights from Liakath Ali

In Bangladesh, similar to India, limited data access hinders efforts to understand climate-induced migration. Collaborations with city authorities and government entities can improve data collection and inform effective response strategies. A unified analytic framework is essential, combining scientific data with local knowledge. However, combining these data with local insights is challenging due to limited resources, language barriers, and varying views on climate change. Enhancing data management skills, fostering trust through transparent communication, and emphasizing the local relevance of climate issues are necessary to address these challenges.

Challenges of Climate Adaptation in the Philippines: Insights from Michael Andrew Manalili

In the Philippines, combining local knowledge with scientific data for climate change adaptation is challenging. Effective methods are needed to integrate local wisdom and traditional practices into adaptation strategies. Engaging communities in planning through participatory research or tailored community-based plans can bridge this divide. Traditional flood management techniques, like embankments and raised houses, have proven effective, highlighting the importance of localized solutions.

However, the rise of artificial intelligence (AI) often overlooks the nuanced factors that impact different communities. While AI has potential in climate adaptation, it must be balanced with localized insights and socioeconomic factors. The data used should represent the local context to avoid misleading results. Transparency is essential, and AI model outcomes should be accessible to local communities for better adaptation planning.

Final Takeaways

In conclusion, regions like Southeast Asia, encompassing nations such as India, Bangladesh, and the Philippines, are grappling with intensified climate adversities. Particularly vulnerable communities, those at social or economic disadvantages, bear the brunt of these changes. Enhanced, data-driven climate adaptation efforts are imperative to fortify resilience in these regions. The discussions at the "Data in Crises" event shed light on the pivotal role of data in crafting a resilient future for Southeast Asia amidst growing climate challenges.

Voice of America

March 3, 2023

Data in Crises: **Responding to the Earthquakes in Turkey and Syria**

On February 6, 2023, two major earthquakes with magnitudes of 7.8 and 7.5 struck Turkey's southern Kahramanmaraş province, ranking among the most severe in a century. The aftermath was immense, with a death toll of 59,259 and an impact on 17.9 million people across Turkey and Syria, leaving about 1.5 million without homes.

Following the disaster, CrisisReady and the Harvard Data Science Initiative (HDSI) held a Data in Crises event to assess the immediate response and the complex recovery process. Despite the vital role of data analysis in relief efforts, organizations encountered legal, ethical, and technical challenges in a region already beset with conflicts and displacement.

The event featured speakers from several organizations, including the Humanitarian OpenStreetMap Team (HOT), the Syrian American Medical Society (SAMS), Yale University, and NeedsMap Social Cooperative, alongside CrisisReady's co-directors. Together, they explored innovative data-driven approaches to life-saving measures and equitable long-term recovery in Turkey and Syria.

Moderators

Dr. Caroline Buckee

Co-Director, CrisisReady
Professor of Epidemiology,
Harvard T.H. Chan School of Public Health

Caroline Buckee is an expert in digital epidemiology, utilizing mathematical models and data sources like mobile and satellite data to study infectious disease spread.

Dr. Andrew Schroeder

Co-Director, CrisisReady
Vice President of Research, Direct Relief

Andrew Schroeder leads the analysis and reporting of novel data, namely mobility data, during crises. During the earthquakes in Turkey and Syria, Schroeder worked with international response agencies to analyze patterns of population displacement.

Speakers

Özge Acar

Technical Coordinator, NeedsMap Social Cooperative

Özge Acar works to connect people in-need with individuals, institutions, and organizations that can support them. She has an extensive experience in geospatial informatics, especially in the context of disaster response.

Dr. Samer Attar

Orthopedist, Northwestern Memorial Hospital, Lurie Children's Hospital of Chicago
Medical Volunteer, Syrian American Medical Society

Dr. Samer Attar has served as a volunteer with the Syrian American Medical Society on multiple medical missions, including in the response to the 2023 earthquakes in Syria, the besiegement of Aleppo, and the 2022 Ukraine War.

Dr. Abdulfatah Elshaar

Chairman, Syrian American Medical Society
Internal Medicine Physician, Sturdy Memorial Hospital

Dr. Abdulfatah Elshaar has served on the board of the Syrian American Medical Society (SAMS) for the last four years. As a physician, Dr. Elshaar has a vested interest in improving healthcare for vulnerable communities in Syria.

Nathaniel Raymond

Lecturer, Yale University School of Public Health; Jackson School of Global Affairs

Nathaniel Raymond's research focuses on the health implications of displacement, methods for disaster assessment, and the rights and security of vulnerable populations.

Can Unen

Senior Manager of Community and Partnerships, Humanitarian OpenStreetMap

Can Unen specializes in GIS-based applications for disaster management. He led damage assessment efforts in the aftermath of the 2022 earthquakes in Turkey and Syria.

The role of innovative data and advanced analytics has been instrumental in the aftermath of earthquakes, as prominently discussed during the Data in Crises event focusing on Turkey and Syria. Satellite imagery, complemented by machine learning techniques, allowed the Humanitarian OpenStreetMap Team (HOT) to assess damages effectively, optimizing aid distribution. This data was pivotal in monitoring population displacements. The synergy of predictive analytics with platforms such as NeedsMap Social Cooperative has transformed both immediate relief coordination and long-term recovery initiatives.

Health consequences of the earthquakes were met with proactive actions by Direct Relief and the Syrian American Medical Society (SAMS). Both organizations provided communities with essential medical resources, and supported overwhelmed local health infrastructures by allocating resources for medical personnel to ensure effective patient care.

The Ethical Considerations of Data

However, data's power in these situations brings forth ethical considerations. Nathaniel Raymond, a lecturer at Yale School of Public Health and the Jackson School of Global Affairs, emphasized the difference between Personally Identifiable Information (PII) and Demographically Identifiable Information (DII). He pointed out that while PII often captures attention, the broader risks associated with DII in disaster contexts can be more concerning. Ensuring ethical data practices, like limiting unnecessary data collection and pre-crisis data preparedness, remains central to safeguarding affected communities.

Using Data for Infectious Disease Modeling During Disasters

Dr. Caroline Buckee highlighted the amplified risks of disease outbreaks during disasters, intensified by disrupted services, overpopulated shelters, and compromised sanitation. The damage to healthcare infrastructures further aggravates disease spread, especially impacting vulnerable groups, including the elderly and those with specific health dependencies.

During her presentation, Dr. Buckee outlined the critical steps in responding to these challenges:

- **Identifying Populations at Risk:** Post-disaster situations often provide outdated population data, complicating risk assessments.
- **Determining Infection Cases:** Obtaining real-time disease counts in disaster zones is challenging. Pre-disaster data partnerships and preparations can address this gap.
- **Forecasting Disease Spread:** When initial stages are effectively managed, forecasting is typically reliable, with validation as a key concern.
- **Communicating Risks:** Swift, updated, and tailored communications are pivotal. Strong partnerships ensure that decisions are based on accurate forecasts.

Dr. Buckee highlighted the importance of adaptable models, continuous stakeholder engagement, and updated data inputs for successful epidemiological modeling in crises. She advocated for simpler models in dynamic crises and prioritizing real-time needs over theoretical analytics. She noted the challenge of relying on traditional population

data sources, which can become outdated during mass displacements, referring to these as "denominator" issues. Her main takeaway was the crucial need for flexible, current data sources in disease modeling during crises.

Medical Interventions in Syria's Turmoil

Drs. Abdulfatah Elshaar and Samer Attar of the Syrian American Medical Society (SAMS) addressed medical challenges post-earthquake in Turkey and Syria, magnified by pre-existing conflicts and health crises. With a significant portion of northern Syria's medical professionals displaced, SAMS collaborated with NGOs like The White Helmets and Direct Relief, focusing on critical care in regions like Idlib City.

Geographic Data's Role in Disaster Relief

Can Unen of OpenStreetMap highlighted collaborative mapping post-disaster, documenting vast affected regions with the assistance of over 7,600 contributors. Open data resources, such as Open Aerial Map, became instrumental in sharing essential satellite imagery.

İskenderun, Turkey | March 10, 2023: A man walks by collapsed buildings in southern Turkey nearly a month after the earthquakes struck the region.

Thomas Hakl

İskenderun, Turkey | March 10, 2023: A month following the initial seismic events, southern Turkey continued to reel from extensive devastation.

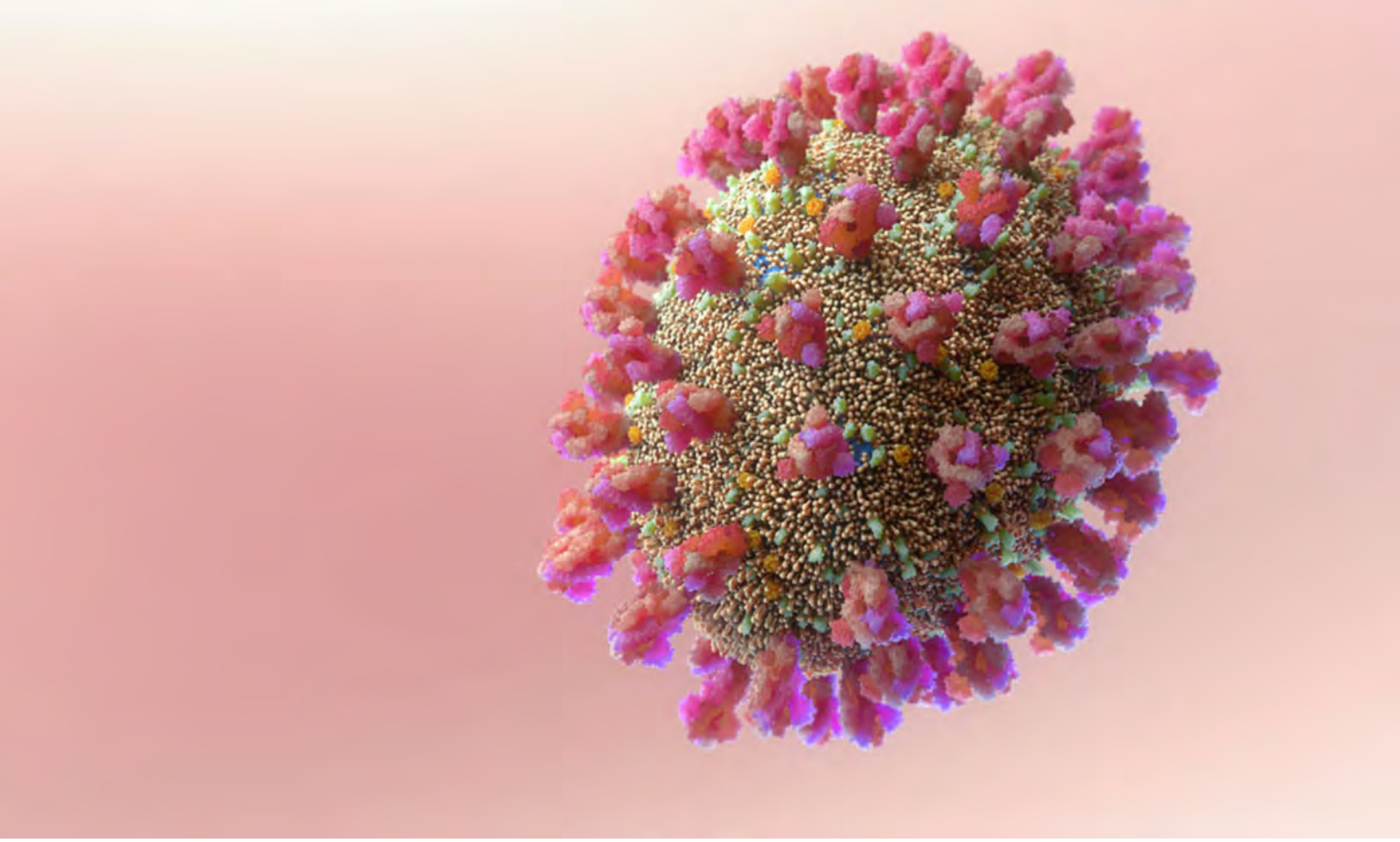
Thomas Hakl

Aid Connectivity via Technology

Özge Acar introduced "NeedsMap," a digital tool connecting aid providers with those affected. Post-earthquake, the platform utilized crowd-sourced data to depict damages and facilitate aid, benefiting around 35,000 individuals. Some operational challenges were acknowledged.

Final Takeaways

The event emphasized real-time data's paramount role in disaster management. SAMS highlighted urgent data needs for effective response, while concerns about post-disaster data reliability and coordination were discussed. The overarching themes were the importance of accurate data, strategic planning, and robust communication during crises.



October 17, 2022

Preventing the Next Pandemic: New Tools for Global Surveillance

The unprecedented challenges of the COVID-19 pandemic revealed significant gaps in the world's ability to respond efficiently to global health emergencies. As countries grappled with the rapid spread of the virus, healthcare systems were overwhelmed, economies strained, and international coordination proved complex. These vulnerabilities emphasize the pressing need for stronger preemptive measures and comprehensive strategies in anticipating and managing potential future outbreaks.

The specter of another pandemic, whether emerging naturally or through other means, demands that nations invest in predictive tools, research, and collaborative frameworks. Only through a proactive approach can we hope to mitigate the devastating impacts of a future health crisis and safeguard global wellbeing.

In a panel hosted by the Harvard School of Public Health, scientists and researchers, including CrisisReady Co-Director Dr. Satchit Balsari, shared insights on the innovative tools they are employing to monitor and respond to emerging healthcare crises.

Moderated by Betsy McKay, a global health reporter from The Wall Street Journal, this event delved into the invaluable lessons learned from the pandemic while assessing our level of preparedness for future public health threats.

Moderator

Betsy McKay

Senior Writer, The Wall Street Journal

Betsy McKay specializes in covering public health and medicine, exploring the impact of diseases and health policies on society. Her articles encompass a wide range of topics, from public health institutions and groundbreaking scientific research to preventive measures and patient care for various global diseases, including heart disease, diabetes, COVID-19, HIV, and tuberculosis.

Speakers

Dr. Satchit Balsari

Co-Director, CrisisReady
Emergency Physician, Beth Israel Deaconess Medical Center
Assistant Professor, Harvard Medical School

With fellow CrisisReady Co-Directors, Dr. Satchit Balsari formed the COVID-19 Mobility Data Network, a global partnership of over 70 researchers, scientists, and policymakers that used novel data to track the transmission of the COVID-19 virus. His research spans multiple disciplines, but primarily focuses on health system resilience in the face of disasters.

Dr. Alexandria Boehm

Professor of Civil and Environmental Engineering, Stanford University

Dr. Alexandria Boehm's work focuses on pathogens in the environment and their transmission to humans, as well as developing interventions to reduce disease burdens globally. Her research is focused on critical problems in both developed and developing countries with the overarching goal of designing and testing novel interventions and technologies for reducing the burden of disease.

Dr. Marc Lipsitch

Professor of Epidemiology,
Harvard T.H. Chan School of Public Health
Director of Science, Center for Forecasting and Outbreak Analytics, Centers for Disease Control and Prevention (CDC)

Dr. Marc Lipsitch is an epidemiologist and Professor at Harvard T.H. Chan School of Public Health. As the Director of the Center for Communicable Disease Dynamics, he played a pivotal role in modeling the transmission dynamics of the COVID-19 pandemic, providing vital insights to inform public health responses.

Dr. Sikhulile Moyo

Laboratory Director,
Botswana Harvard AIDS Institute Partnership

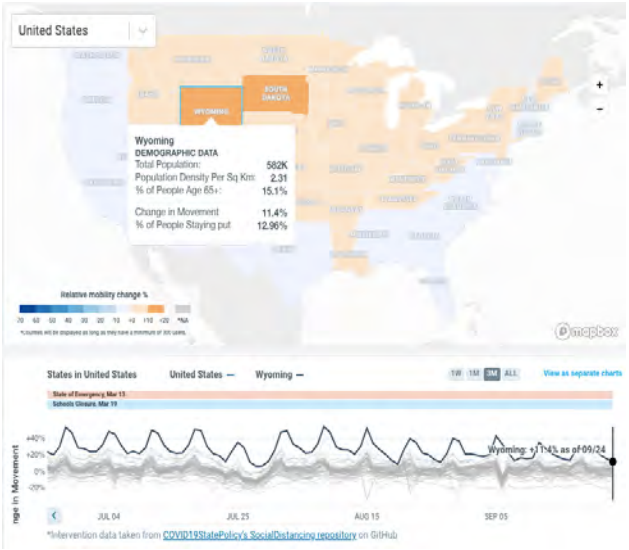
Dr. Sikhulile Moyo is a virologist, currently holding a research associate position at the Harvard T.H. Chan School of Public Health. Notably, in November 2021, Moyo and his laboratory were the first to identify the SARS-CoV-2 Omicron variant, marking a significant milestone in the global fight against COVID-19.

Pandemic Reflections: Lessons, Challenges, and Global Disparities

The initial global response to COVID-19 in 2020 saw swift measures like border closures and lockdowns. However, these actions were not enough to prevent the virus's spread, straining healthcare systems worldwide. This period was pivotal in public health, emphasizing the need for agility, preparedness, and international collaboration for future crises.

Rethinking Response with Novel Data

Dr. Satchit Balsari noted that pandemic responses in the Global South often lacked adaptability, with measures like physical distancing being unfeasible in overcrowded areas. He stressed the need for solutions tailored to specific community circumstances. In response, Balsari, Dr. Caroline Buckee, and Dr. Andrew Schroeder formed the COVID-19 Mobility Data Network in 2020. This global partnership used cell phone location data to track viral transmission, providing granular insights into virus spread and mobility restrictions' impacts.



The COVID-19 Mobility Data Network's dashboard analyzing mobility metrics to assess the effectiveness of U.S. lockdown orders, featuring data from multiple countries.

Balsari emphasized the importance of privacy and transparency in data handling, using differential privacy techniques to preserve anonymity. Despite limited regulations outside Europe and parts of California, he advocated for a balance between public health benefits and individual privacy.

The network evolved into CrisisReady, a global initiative using mobility data to inform policy during crises. CrisisReady aims to provide real-time, data-driven insights to enhance global disaster response and mitigation strategies.

Wastewater Surveillance: Unlocking New Data Streams for Public Health Response

During the pandemic, tools like next-generation sequencing, PCR testing, and digital contact tracing apps were used to understand viral spread. Environmental surveillance, such as wastewater testing, was a significant but underutilized tool for early detection of transmission. Dr. Alexandria Boehm highlighted the potential of wastewater tracking in public health crises, which can detect specific pathogens and provide insights into the health status of large populations. Trust between public health authorities and the experts overseeing wastewater surveillance is crucial, especially in low- and middle-income countries where accurate and timely data collection is essential for effective use of wastewater insights.

Advancing Genomic Sequencing

Dr. Sikhulile Moyo highlighted the role of genomic sequencing in guiding the global response to the COVID-19 pandemic, as evidenced by the early detection of the Omicron variant. This identification enabled nations to prepare for potential infection waves and intensify preventive measures. Dr. Moyo emphasized the importance of timely data dissemination and the significant contribution of Southern African scientists in shaping global health policies. However, he expressed concerns over reflexive travel bans following new variant discoveries. Looking forward, Dr. Moyo underscored genomic sequencing's potential in public health, particularly in tracking viral mutations and guiding vaccine modifications. He stressed that transparent communication, unreserved data sharing, and collaboration between scientific communities worldwide are key to success.

On November 19 scientists at the Botswana Harvard HIV Reference Laboratory first discovered the variant Omicron.

Botswana Harvard Partnership

Researchers at the Botswana Harvard Partnership (BHP) lab have sequenced over 2,300 SARS-CoV-2 samples since early 2021.

Botswana Harvard Partnership

Data Integration for Advanced Forecasting

Dr. Marc Lipsitch from the CDC emphasized the crucial role of integrating diverse data sources in managing pandemics. He highlighted the CDC's initiative to combine genomic data with comprehensive clinical information during the Omicron wave, enabling a more informed assessment of the variant's severity. This combined analysis was pivotal in concluding that Omicron's severity per case was notably lower than Delta's. Lipsitch noted that while genomic data provides an understanding of an individual's genetic makeup, clinical data offers insights into their health trajectory. Their joint analysis can be transformative in personalized medicine, tailoring treatments to a patient's specific genetic and health backdrop. Lipsitch concluded by asserting that integrating genomic sequencing could reshape disease prevention and management in future outbreaks.

Final Takeaways

The COVID-19 pandemic revealed global health vulnerabilities and underscored the critical role of international cooperation. The discussions during the event underscored the importance of global collaboration in leveraging technologies for public health crises, emphasizing that such technologies can only have a transformative impact at scale when there is widespread cooperation and data sharing among nations.

CrisisReady Regional Workshops

International collaboration is essential in emergency preparedness, response, and recovery. It brings together resources, expertise, and knowledge, ensuring a unified and efficient approach to address a range of crises.

CrisisReady's regional workshops aim to strengthen regional and local responses to natural disasters and emergency events. The workshops — which have been hosted in Hungary, Colombia, Nicaragua, Brazil, Thailand, Panama, and more — are designed to address the specific, contextual challenges faced by the country in which they are held.

The workshops, which bring together interdisciplinary groups of experts including emergency response leaders, healthcare practitioners, and representatives from private companies, foster an environment for innovative problem-solving through a combination of technical expertise and local knowledge. They specifically focus on the effective use of data in response operations, from procurement to interpretation and dissemination.

The importance of the right data for making quick, informed decisions during a crisis is emphasized, with each session examining the global, national, and regional data landscape to identify localized solutions. The culmination of these workshops is the creation of policy briefs advocating for improved data collection, analysis, interpretation, and use in emergency situations. These briefs serve as guides for governments, organizations, and other stakeholders to enhance their response operations based on evidence and expert insights.

Several workshops have already been hosted by CrisisReady, in collaboration with partnering organizations like the Global Facility for Disaster Reduction and Recovery (GFDRR) and Direct Relief. CrisisReady plans to host more workshops in the future, which will continue to contribute to the discussion on developing more resilient systems for managing disasters around the world.

Colombia Struck by Deadly Landslides

December 4, 2022

Heavy rain from La Niña, an oceanic and atmospheric phenomenon, caused massive landslides in Risaralda, Colombia, a disaster that is becoming more common in the country.

Colombian Disaster Management Agency

August 1-2, 2022

Regional Workshop: **Supporting Response in Colombia With Innovative Data Tools**

In response to the rapid evolution of disruptive information technologies, and the accelerated frequency of events that threaten human populations, CrisisReady, in collaboration with the Universidad del Rosario and the Universidad Nacional de Colombia, organized a workshop in Bogotá, Colombia to discuss with policymakers the importance of the availability and timely use of data in crisis response, with an emphasis on health emergencies.

The participants of this workshop included multilateral organizations, national NGOs, academic research groups, government agencies, and private corporations.

The main goal of the workshop was to discuss the need to build a network composed of multiple actors that facilitates the response to humanitarian crises.

Goals of the Workshop

- Build a network of key actors surrounding humanitarian crisis response.
- Identify the role data analysis can play at the different junctures throughout the development of a crisis.
- Identify the information, analyses, and data access needed that will facilitate resilience in times of humanitarian crises.

The Nature and Use of Data

Discussions that took place during the workshop focused on three overarching themes: data availability; data sources; and data resolution. These themes could be used to determine appropriate modes of analysis to address policy concerns.

- **Data Availability** (*e.g. public, private)*
  Data availability dictates who can use the data (i.e. certain data programs like Data for Good will not allow governments to access their data) and will therefore inform both the need for partnerships and the need for privacy protection strategies.

- **Data Sources** (*e.g. mobility, satellite mapping, remote sensing*)
  The source of the data informs what type of biases the data might carry, what coverage it has, and what kinds of technological solutions will be needed to store and analyze the data properly. It also determines the privacy measures to take into account before proceeding.

- **Data Resolution** (*e.g. spatial, temporal, spectral, radiometric*)
  Data resolution dictates the granularity of possible analyses as well as the need for aggregation techniques, which themselves can introduce bias. Aggregation is a common technique to protect data privacy, however, it is often not enough to ensure it. Low resolution data doesn't necessarily imply anonymous data.

Migration and Human Displacement

The participants of the workshop were particularly interested in exploring innovative methods in accessing data that could inform predictive mobility models. This was due in part to the concerns over migration and internal displacement, and their impact on emergency response operations in Colombia.

The discussion highlighted two major concerns, the first being that private institutions, namely telecommunication companies, are reticent to share data with other actors, making it hard to incorporate novel data sources into analysis flows; and the second being that migration patterns often include vulnerable populations, which heighten concerns about individual privacy and identification. Despite these concerns, participants agreed that using novel data to visualize large-scale patterns of displacement could optimize the allocation of resources and deployment of aid during emergency events.

The Use of Data During Emergency Events

Additional questions discussed during the workshop included:

1. How do we collect and share data between different actors during an emergency?
2. How do we complement routine collection with data collected later in an emergency?
3. How can we use these datasets to allow for a more efficient and equitable distribution of resources during an emergency?

The timeframes of enacting policy are often misaligned with the timeframes given to research efforts. Collaboration between policy makers and researchers is further complicated by the need to establish data-sharing agreements and collaboration protocols. Participants voiced the difficulty of maintaining funding in between crises, which frequently causes the collaborations initiated in the midst of response efforts to run out of steam and dissolve prematurely. As a consequence, the skills, resources, and networks that were developed during this period are often lost.

Participants of the workshop stated that analytic pipelines can be useful tools for decision makers and can allow for knowledge translation when tools are created in collaboration between policy makers and researchers. In this context, analytics pipelines can be designed to encourage the iterative development of short data flows that can serve as a point of communication between policymakers and researchers. As common understanding between policy makers and researchers is achieved, the pipeline can be further developed to support more sophisticated data flows. These new streams of data can be used to adjust research methodologies to policy-specific issues.

Privacy and Data Providers

Governments may feel the need to loosen data privacy regulations when they are put under pressure during emergency events. Organizations of the civil society may deter urgent response efforts in their goal of protecting individual rights. The introduction of differential privacy and federated learning methods were proposed to be included in methods of data analysis to safeguard individual privacy.

Differential Privacy (DP) is widely considered the "gold standard" of privacy protection for statistical releases. The system introduces random noise into released statistics to ensure that each individual is hidden while population-level signals are preserved. Conventional methods of removing personally identifiable information (PII) or aggregating data above the individual level tend to be antiquated, inadequate, and vulnerable to attacks.

Design Thinking Workshop

During a mapping exercise, participants identified key stakeholders and processes integral to emergency management, resulting in a data journey infographic. They also discussed the role of data analytics throughout the six distinct stages of emergency response, from understanding the context and vulnerabilities to assessment and redesign.

Conclusions and Key Takeaways

- **Pre-crisis Preparedness and Network Building**
  Standards for data sharing and pre-established social connections can greatly influence the effectiveness of crisis response. Existing inequalities can amplify the vulnerabilities of specific groups, and logistical challenges can disrupt cooperation. Without pre-established data sharing agreements and collaborative networks among response teams, response to crises can become disjointed.

- **Incentivizing Private Sector Collaboration**
  There's an essential need to establish motivations for private enterprises to share data during emergencies. Governments should forge incentives, such as grant programs that promote academic and corporate partnerships. This collaboration can help in developing methods to leverage privately-held data in crisis response without ceding control to governmental bodies.

- **Addressing Data Privacy Concerns**
  Especially in situations like those in Colombia where data privacy standards are ambiguous, the importance of privacy can be overshadowed during emergencies. In such contexts, the onus often falls on civil society to oversee potential privacy breaches. To address this, stringent data privacy laws that safeguard personal information, even during emergencies, need to be established.

- **Enhancing Analytics with Human Insight**
  Moving beyond analytics and dashboards is crucial. Alongside technological tools, integrating a human perspective is essential. Moreover, there's a pressing requirement for sustained efforts to translate contextual knowledge and community insights into actionable public policies.

- **Supporting Public Sector Engagement with Data**
  When response organizations have to delve into data analytics, they often resort to external services. However, the emphasis is frequently placed on technological products and outputs, neglecting the essential inclusion of policy expertise. Public sector actors should be involved in data analysis before policymaking to ensure the data's accuracy, relevance, and fairness, and to align the policies with public interests.

UN Women/Pathumporn Thongking

February 6-7, 2023

Regional Workshop: **Leveraging Mobility Data for Crisis Response in Thailand**

At the beginning of the COVID-19 pandemic, Thailand promptly initiated several public health measures, with over 1,000 response teams and 1.1 million village volunteers managing contact tracing, isolation, and quarantine protocols.

Despite the country's proven ability to quickly respond to public health crises, Thailand remains particularly vulnerable to imported zoonotic coronaviruses due to its status as a travel, trade, and medical tourism hub. This is especially true considering climate change is intensifying the natural hazards that Thailand faces, including severe storms, flooding, and drought. Fortunately, novel sources of data offer possible solutions to these growing concerns.

In February 2023, CrisisReady hosted a regional workshop in Bangkok that brought together representatives from government agencies, non profits, and academia to discuss how mobility data can be used to improve responses to public health crises, natural disasters, and other emergencies.

Goals of the Workshop

- Introduce the range of different types of mobility data.
- Highlight the strengths, limitations, and representativeness of these datasets.
- Share previous analyses by MORU using these data.
- Present example use cases from the public health literature.
- Identify and discuss potential use cases of various travel data for guiding public health responses in participating countries.

On February 6, the workshop commenced with a welcome address from CrisisReady affiliate researcher Professor Richard Maude, the Head of the Epidemiology Department at Mahidol-Oxford Tropical Medicine Research Unit (MORU) in Bangkok, Thailand. In 2019, Maude published research with CrisisReady Co-Director Dr. Caroline Buckee on methods of eradicating Malaria through the use of new technologies and data sources. In his opening remarks, he discussed the findings of this research in greater detail, and its relevance to public health efforts in Thailand.

The Use of Novel Mobility Data During Public Health Crises

Dr. Kavita Patel, a primary care physician and former nonresident fellow and managing director of clinical transformation at the Center for Health Policy at Brookings Institution, provided an overview of the different types of mobility data that are available. Her discussion focused on the use of these data in public health research and response, and their applicability during the COVID-19 pandemic, as countries scrambled to contain the spread of the virus.

Joining Patel were speakers from Facebook, Google, Apple, and the Mahidol Oxford Tropical Medicine Research Unit (MORU), who discussed the strengths and limitations of these datasets, and how they can be used to improve public health responses. Patel and others on the panel cited examples of how mobility data were used to track the spread of disease, identify areas at risk of infection, and target public health interventions.

Referring to his 2019 research with Dr. Buckee, Professor Maude examined the use of human mobility data, sourced from mobile phones and platforms like Facebook, to analyze the transmission dynamics of dengue and malaria in Thailand.

The Promises and Challenges of Novel Data in Managing Disease Outbreaks

Maude and Dr. Greta Tam, a fellow researcher at MORU who specializes in geospatial analysis and its applications in epidemiology, then discussed research they conducted together that analyzed data on human population movement for the containment and elimination of Malaria in Southeast Asia.

Maude and Tam explained that human population movement poses a major obstacle to malaria control and elimination, but with recent technological advances, a wide variety of data sources and analytical methods have been used to quantify population movement that can be applied to strategies to control and eliminate malaria in the region.

They stated that although there are studies that have quantified varying types of human population movement covering different spatial and temporal scales, there remain significant methodological gaps that warrant further studies related to malaria control and elimination. They stated that these methodological challenges must be addressed in order to utilize new data sources available, which have proven to be effective in identifying communicable disease dynamics and reducing viral transmission.

Combining Data to Better Understand Infectious Disease Dynamics

Sazid Ibna Zaman, a Data Manager & GIS Specialist for the Epidemiology and Mathematical and Economic Modeling (MAEMOD) departments at MORU, discussed how disparate streams of information could be combined to provide a clearer and more comprehensive picture of infectious disease outbreaks and patterns of transmission. His discussion focused primarily on the use of novel data in responding to malaria outbreaks in Bangladesh, which has seen significant progress in the elimination of the disease in the past decade.

Kulchada Pongsoipetch, a spatial data engineer at MORU, discussed the applications of GPS tracking for malaria in the Greater Mekong Subregion (GMS), a trans-national region of the Mekong River basin in Southeast Asia. She also discussed the use of mobility data gathered from Facebook in responding to and managing the COVID-19 pandemic in Thailand.

Professor Maude introduced CrisisReady, and the ways it is using mobility data to track population displacement and respond to a variety of disasters, whether they be related to infectious disease outbreaks, natural disasters, or man-made conflicts. He explained how the reports generated using the mobility data, which is collected through a partnership with Meta's Data for Good program, help response agencies better understand evolving displacement dynamics as an emergency unfolds, and also allows them to better allocate resources during such crises.

Comparing Data from Facebook, Google, and Apple in Public Health Contexts

Representatives from GroupMappers, a crowdsourcing initiative based in Bangladesh, showcased their use of geospatial technology to address public health concerns within the region. Founded in 2017, this initiative is a collaboration between MORU and the Communicable Disease Control division of Bangladesh's Directorate General of Health Services.

The GroupMappers team compared data from Facebook, Google, and Apple. They highlighted how each platform's data can support public health initiatives in Bangladesh, Thailand, and Laos. These data sources offer different insights to the field of epidemiology.

The choice of data set often depends on the specific challenges a country faces during a health crisis. While Bangladesh, Thailand, and the PDR share some public health challenges, their strategies differ based on their unique national priorities. As a result, they each require specific information to address their distinct needs and societal structures.

Conclusions and Key Takeaways

- **Potential of Novel Data Sources**
  Human mobility data holds significant promise for tracking the transmission of communicable diseases. However, challenges such as data accessibility, the lack of data sharing agreements, issues of trust, and disjointed cross-sector collaboration hinder its impact.

- **Distinguishing Between Data Sources**
  Major tech companies like Apple, Facebook, and Google provide distinct datasets. While each offers valuable insights for public health emergencies, the differences in the datasets must be understood and factored into decision-making processes.

- **Contextual Relevance of Data**
  It's crucial that the data collected is contextually relevant to the specific public health challenges a country faces. Not all data is universally applicable.

- **The Utility of Human Mobility Data**
  As demonstrated by CrisisReady, human mobility data acts as a proxy for understanding changing population movement patterns. This is valuable information in a variety of contexts, from public health crises to post-disaster scenarios.

- **Combining Data for a Holistic View**
  Integrating foundational epidemiological data, like incidence rates, prevalence, mortality rates, and vaccination coverage, with novel data sources, especially human mobility data, offers a deeper, more encompassing understanding of the factors influencing infectious disease transmission.

The Toll of Hurricanes in Central America

November 23, 2020

A child walks through debris after Hurricanes Eta and Iota struck central America, causing significant damages and hundreds of fatalities.

European Civil Protection and Humanitarian Aid/D. Membreño

March 28-29, 2023

Regional Workshop: **Improving Response Capacities in Central America**

Central America is witnessing escalating challenges from natural disasters, putting the safety of its most vulnerable communities at risk.

While emergency response entities have advanced operations to address climate-induced health threats, certain obstacles persist. Resource disparities, inadequate training, infrastructure limitations, and disjointed efforts hinder the execution of response initiatives.

As such, aligning strategies and investing in capacity development are crucial to protecting individuals against the increasing risks of climate-related disasters.

CrisisReady hosted a workshop to examine emergency response mechanisms in the region and advance the integration of information and communication technologies in disaster response. The workshop saw participation from all seven countries across Central America.

Goals of the Workshop

- Enhance health sector responses and manage humanitarian crises effectively across Central America.
- Utilize platforms like Meta and OpenStreetMap to improve emergency assessments and monitor global health threats.
- Prioritize responsible data stewardship and emphasize the role of streamlined data workflows in emergency management.
- Introduce tools such as CrisisReady's Mobile Kit for in-depth mobility data analysis.
- Engage in discussions about upcoming regional disaster simulations and emphasize the role of data analytics in disaster preparedness.

The Challenges of Disaster Preparedness and Response in Central America

Effective emergency response hinges on situational awareness: a comprehensive grasp of potential threats to public health and safety. This entails analyzing data on a spectrum of hazards, bolstering our readiness during crises. Strong data systems, collaboration, and technology are paramount for accurate, swift decisions. Yet achieving such awareness can be daunting, especially in resource-limited areas. Issues like delayed communication, intricate data analysis, and non-compatible sensor networks complicate disaster comprehension. While collaboration has grown between data custodians, government agencies, and emergency organizations, enhancing the analytical methods of situational awareness remains a priority.

The workshop highlighted the role of digital tools and innovative data in disaster response. Participants delved into practices from Data for Good at Meta and OpenStreetMap. Meta's program focuses on human mobility data, using it to discern trends in people movement post-disaster, thus aiding effective resource allocation. OpenStreetMap, a community-backed geospatial database initiated in 2010, provides invaluable data, especially in areas lacking updated geospatial details. Its adaptability, demonstrated by projects like Resiliency Maps, allows communities to tailor data to specific needs, supporting not just immediate relief but also climate change research and prediction. Tools utilizing OpenStreetMap's data, such as Flood Factor, offer insights into risks like flooding in various regions, enhancing emergency preparedness and response.

Data Modeling for Public Health

On the workshop's second day, the focus was on using innovative data source modeling for public health scenarios, including COVID-19 and tropical diseases. The CrisisReady team introduced their Python-based Mobile Kit, which processes mobility network data for disaster response. Ms. Claudia Herrera, President of CEPREDENAC, highlighted the importance of data analytics in enhancing emergency response efficiency.

Managua, Nicaragua | March 28, 2023: Participants of the workshop stand outside Nicaragua's National Institute for Emergency Preparedness.

Honduras | November 21, 2020: In Honduras, about 95,000 people had to seek refuge in temporary makeshift shelters in the aftermath of Hurricanes Eta and Iota.

European Union/D. Membreño

Colombia | December 16, 2020: Colombia's Caribbean coast, including San Andres and Providencia, saw the destruction of vital infrastructure and experienced extensive flooding from the two hurricanes.

European Union/Alianza por la Solidaridad

Conclusions and Key Takeaways

During the workshop, representatives from member countries across Central America shared their unique disaster management and analytics strategies, showcasing a diverse spectrum of innovative approaches to disaster preparedness and response.

Technology Integration

- **Guatemala:** Deployed web-integrated alert systems backed by real-time data.
- **Costa Rica:** Utilized remote sensing with satellites and drones for threat mapping.
- **Panama:** Conducted flood monitoring via river data from Amazon Web Services.
- **El Salvador:** Integrated ArcGIS into emergency service visualizations.

Community and Data-Driven Approaches

- **Honduras:** Conducted public surveys for forest fire risk perception to inform response plans.
- **El Salvador:** Engaged local communities for feedback on emergency preparedness operations.
- **Nicaragua:** Generated detailed neighborhood mapping using centralized ArcGIS information.

Innovative Communication Tools

- **Dominican Republic:** Deployed QR codes to assist crisis communications and risk analysis.

Clauber Cleber Caetano/PR

April 13-14, 2023

Regional Workshop: **Strengthening Brazil's Approach to Internal Displacement**

In 2023, Brazil grappled with a complex emergency response situation. A number of devastating natural disasters, namely floods and landslides, swept across the country, displacing thousands and upending critical infrastructure. The country's challenges were intensified by an influx of refugees, which further strained the country's infrastructure.

In response to the urgent situation, CrisisReady, in collaboration with UNHCR, organized a workshop in São Paulo in April 2023.

The workshop was designed to discuss the complexities of data collection and analysis related to refugee movements. It aimed to foster enhanced cooperation and establish robust protocols. The ultimate goal was to leverage data to understand refugee dynamics and movement patterns, and most importantly, to ensure the protection of their rights and overall welfare while in Brazil.

Goals of the Workshop

- Explore the potential of private data providers in tracing refugee movements and identifying migration trends.
- Assess challenges tied to data transparency, biases, and the ethical concerns of repurposing data for humanitarian purposes.
- Discuss the application of data in pinpointing potential risks and optimizing interventions.
- Promote a coordinated approach to refugee data collection and analysis.
- Advocate for the development of a shared data framework to enhance collaboration and resource allocation.

Minas Gerais, Brazil | January 10, 2022: Floods obstructed a main road in the Mangueira neighborhood of Coronel Fabriciano.
HVL

Minas Gerais, Brazil | January 9, 2022: Neighbors view the flooded Piracicaba River after torrential rains swept across the country.
HVL

Displacement Challenges: Climate Hazards and Land Conflicts

Brazil, situated within the inter-tropical convergence zone, is highly vulnerable to weather-related disasters like floods and landslides, leading to significant internal displacements. Ranking among the top 15 nations for riverine flood risks, it also faces temperature extremes, droughts, and wildfires. In 2022, disaster-related internal displacements reached 708,000, the highest since 2008. Two major events in Pernambuco and Minas Gerais accounted for a third of these displacements, while about 800 smaller events left 44,000 individuals displaced by year-end.

Land disputes, often fueled by land-grabbers and farmers, also cause displacements. In 2022, such conflicts led to 5,600 displacements, with central Brazil's Goiás being the epicenter. While data on displaced individuals is available and crucial for addressing displacement challenges, its effective utilization is hindered by access issues, limited analytical capabilities, and lack of collaboration between state entities and private companies.

Using Data for Refugee Response

Participants exchanged insights on data's role in humanitarian strategies for refugees. Government officials highlighted the challenges of data collection during crises, largely due to infrastructure and logistical issues. They emphasized data's importance in decision-making and resource allocation. Representatives from international agencies explained the significance of data in identifying refugee needs, discussing the associated trust challenges with this demographic.

Non-profit members detailed their use of data in evaluating their programs' impact and championing refugee rights, addressing the challenge of tracking long-term effects given refugees' transitory nature. Private sector data providers shared their methods of tracking refugee movements through social media and telecommunications. They highlighted the challenges in differentiating refugees from other migrants and the value of discerning trends in their movements.

Leveraging Private Data in Humanitarian Response

The value of private data providers in humanitarian efforts was emphasized by participants, especially given their ability to trace refugee movements and identify migration trends. However, ethical concerns arose about transparency, biases, and the repurposing of data originally collected for different intentions. In conclusion, participants called for a coordinated approach to refugee data, highlighting the need for a shared framework to facilitate collaboration in data sharing and analysis.

Conclusions and Key Takeaways

- **The Promise of Private Data Providers**
  These entities are not just repositories of information; they are invaluable assets in the humanitarian sector. Their data can trace the intricate patterns of refugee movements, helping stakeholders anticipate and respond to evolving migration trends.

- **Transparency is Key to Address Ethical Concerns**
  Ethically using data involves more than just its collection. It's crucial to use data, especially from private sectors, transparently, addressing biases and preserving refugee dignity and privacy. Repurposing data for humanitarian purposes brings up concerns about its original intent and moral implications.

- **Data is a Pivotal Resource for Humanitarian Response**
  In today's complex humanitarian landscape, guesswork isn't an option. With accurate data, agencies can predict potential hotspots, risks, and needs, allowing them to tailor interventions effectively and efficiently.

- **Collaboration Between the Public and Private Sector is Key**
  A siloed approach is ineffective regardless of the entity, be it governments or non-profits. A coordinated strategy avoids duplicated efforts, maximizes resources, and harmonizes responses.

- **Shared Data Frameworks are Essential**
  A common framework doesn't just facilitate data sharing; it provides standardization. Such a framework ensures consistency in the data collected, allowing for more accurate comparisons, analyses, and collaborative decision-making across all sectors involved.

COVID-19 Response in Taiwan

March 20, 2020

This image shows the Health and Welfare Department's COVID-19 testing and vaccine research center in Taiwan.

Taiwan maintained low COVID-19 infection rates throughout the pandemic, due in part to stringent travel restrictions.

Taiwan Office of the President/Mori

August 11, 2022

Regional Workshop: **The Potential of Novel Data During Public Health Crises in Taiwan**

From January 2020 to December 2022, Taiwan reported 8,872,955 cases and 15,253 deaths, underscoring the significant public health challenges it faced amidst the pandemic.

To manage the COVID-19 pandemic, outbreak officials swiftly established the Central Epidemic Command Center in early 2020 to coordinate resources and formulate impactful policies. However, despite this accomplishment, the threat of infectious disease outbreaks still looms large in the country. Continuous vigilance, preparedness, and adaptation to new data and methodologies remain crucial for Taiwan to maintain its exemplary health response.

On August 11, 2022, CrisisReady hosted a workshop at the National Taiwan University, bringing together public health researchers, academics, and government officials to discuss the use of novel data in public health contexts.

Goals of the Workshop

- Understand key mobility indicators and their collection challenges, and examine methods to access real-time mobility data during infectious disease outbreaks.
- Discuss how mobility data supports decision making, especially in the context of creating epidemic prevention policies.
- Examine global use cases of mobility data in disease control, and the challenges and opportunities that arose from these endeavors.
- Delve into the specifics of data collection and its uses and examine how telecom data is used by public sectors.
- Identify how mobility data can be used to design practical epidemic prevention methods.
- Analyze population movement patterns in Taipei City and examine its role in early warnings for communities.

Taoyuan City, Taiwan | April 7, 2020: Workers at the Taoyuan International Airport operate a COVID-19 testing station.
Wang Yu Ching/Office of the President, Taiwan

Taoyuan City, Taiwan | April 7, 2020: Health officials adhered to stringent pandemic prevention measures at Taoyuan Airport Customs.
Wang Yu Ching/Office of the President, Taiwan

Public Health Response in Taiwan: An Overview

Taiwan's successful COVID-19 response involved immediate action, efficient contact tracing, compulsory mask policy, and increased local mask production. Transparency and an open information policy managed public sentiment and ensured safety measure compliance. Data analytics, new technology, and proactive testing enabled early case detection and virus spread prevention. The Ministry of Health and Welfare and its affiliates played pivotal roles in this response. Despite the success, Taiwan recognizes the ongoing threat of public health emergencies and continues to invest in public health infrastructure for future crisis management.

Novel Data in Taiwan's Public Health Response

Taiwan has effectively used human mobility data, derived from smartphone and social media activity, for public health responses, as evinced in their response to the COVID-19 pandemic. This data informed epidemiological modeling,

situational awareness, and resource allocation. In partnership with Facebook Data for Good, Taiwan developed metapopulation models to identify high-risk areas and assess potential effects of local travel restrictions. They found mobility changes correlated with local case numbers and identified highly connected areas as potential outbreak sources. The risk of outbreaks was found to increase if initial infections occurred around holidays, aiding preventive measure planning. Despite the significant role of novel data like human mobility data in Taiwan's public health response efforts, challenges and gaps remain in its utilization.

Telecom Data in Infectious Disease Management

Telecommunications data, namely human mobility data, has become a key tool in public health strategies worldwide to manage infectious disease outbreaks. These data sets offer insights into population movement patterns, crucial for understanding disease spread. During the COVID-19 pandemic, telecom data was integrated into regional transmission models to identify strategies for reducing mortality. A study found that this data improves predictions of new COVID-19 cases, test positivity rate, and outbreak severity. Researchers have also used mobility data to construct models considering factors like "lockdown" to predict epidemic trends, demonstrating its potential application in other countries.

Utilizing Mobility Data in Public Health Responses

Mobility data is a crucial tool in infectious disease control research and decision-making. It can be integrated into Geographic Information Systems & Technology (GIS&T) to develop spatial data infrastructures that promote surveillance and data sharing, essential for monitoring disease spread. Additionally, incorporating mobility data into spatial epidemic models provides insights for epidemic preparedness and response, aiding in predicting disease spread and implementing preventive actions.

Geospatial technologies utilize mobility data for digital contact tracing, a key method in controlling disease spread. The integration of mobility data also enhances disease modeling, assisting in understanding disease progression and evaluating the impact of different interventions. Furthermore, it aids in studying geographic social vulnerabilities and health disparities, guiding public health strategies for equitable healthcare access. Lastly, mobility data assists in communicating the current state of the disease or facility readiness for regular operations.

Conclusions and Key Takeaways

- **Mobility Data For Public Health Response**
  Mobility data serves as a proxy for population movement patterns, helping to identify disease hotspots. It provides travel history information essential for tracing infections, and recognizes that areas with high density or crowding pose greater risks for disease spread.

- **Challenges in Collecting Mobility Data and Developing Relevant Indicators**
  Challenges include addressing privacy concerns, ensuring the accuracy and reliability of data, especially self-reported or from diverse sources, and managing the complexities of integrating this data with other essential health and community data.

- **Improving the Collection of Mobility Data**
  To enhance mobility data collection, it's essential to utilize technology like mobile apps, collaborate with tech companies for larger datasets, and establish clear policies for fast, ethical data use and sharing.

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