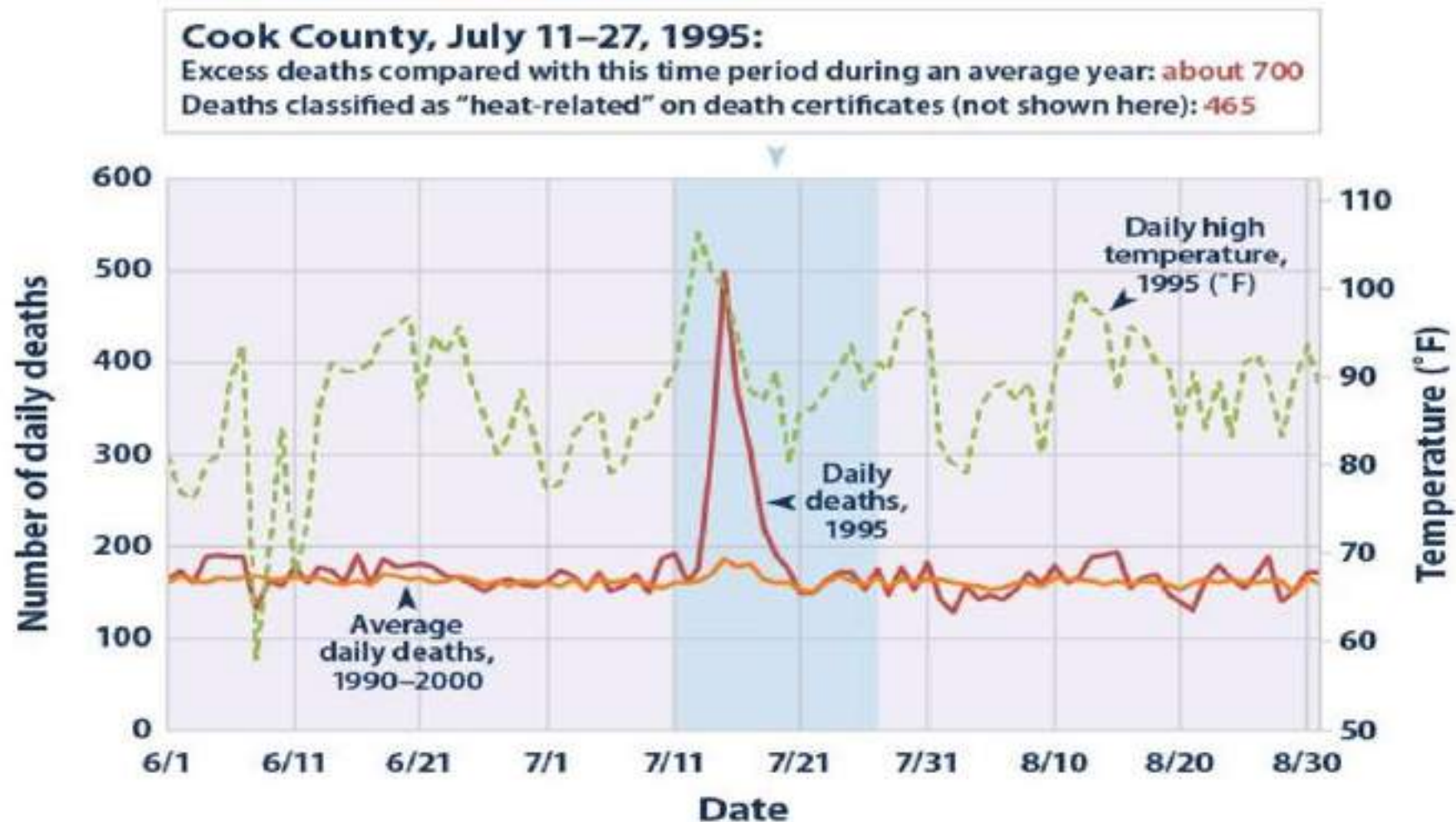# Climate change changes everything

Climate change affects the social and environmental determinants of health—clean air, safe drinking water, sufficient food, and secure shelter. According to the recent IPCC Climate Change Report, climate change has harmful impacts on human health, ranging from mortality from extreme events, morbidity from increasing temperatures and heat waves, malnutrition and disease susceptibility.

Climate change is expected to further worsen the risks. We are already witnessing "irreversible" damage from climate change. According to the IPCC report, over three billion people—nearly half of the world's population—live in "contexts that are highly vulnerable to climate change." And the direct costs of climate change to the health system, not including health determining sectors such as agriculture, water and sanitation, is estimated between US$2 and US$4 billion a year by the WHO.

UNFPA, Hurricane Matthew

Climate extremes affects the most vulnerable

Cook County, July 11–27, 1995:
Excess deaths compared with this time period during an average year: about 700
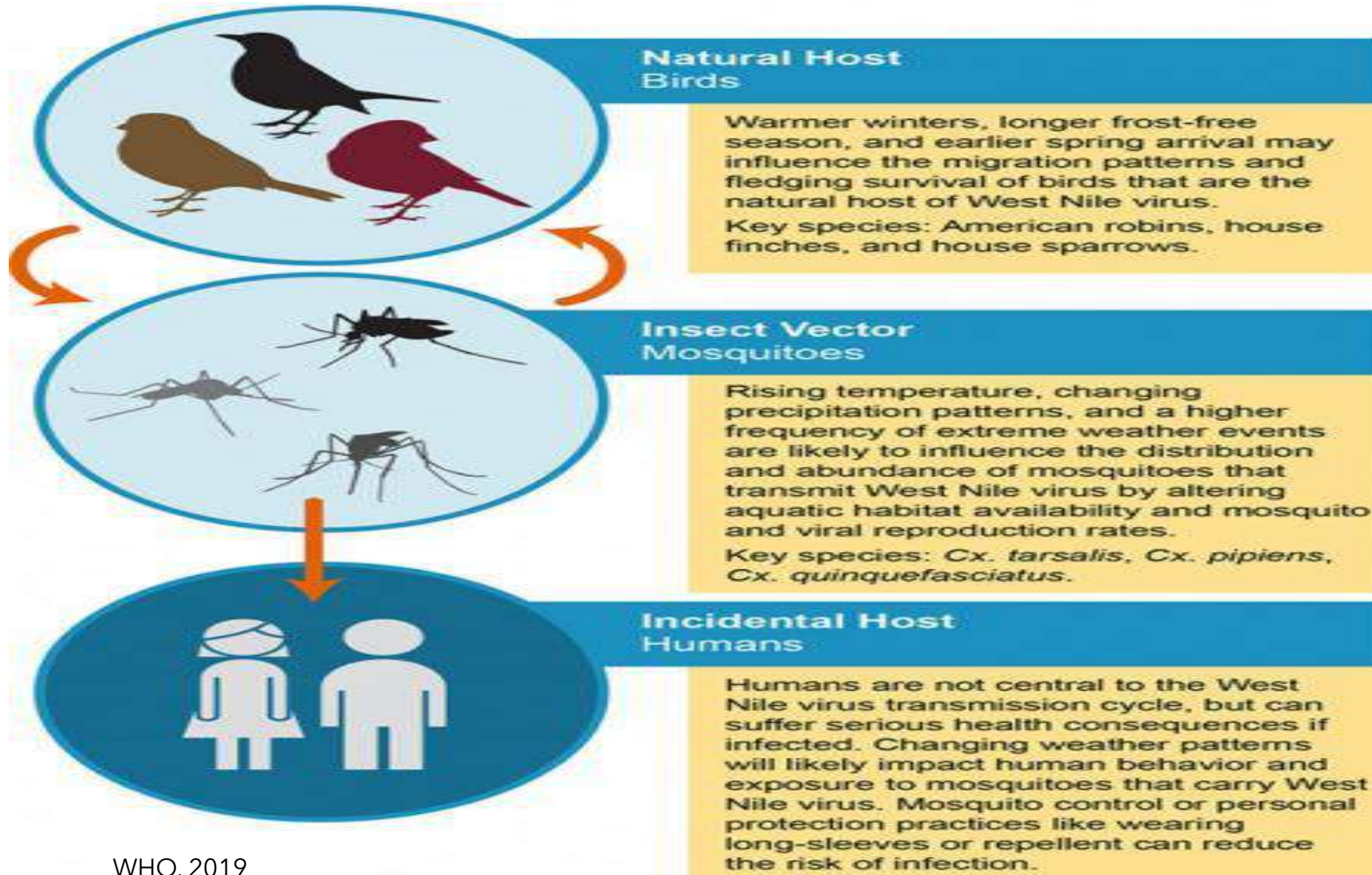Deaths classified as "heat-related" on death certificates (not shown here): 465

This graph shows data for the Chicago Standard Metropolitan Statistical Area.

Climate change changes our food

Farm to Table
The Potential Interactions of Rising CO₂ and Climate Change
on Food Quality and Safety

Temperature and precipitation extremes (like flooding) can increase pathogen load.

Climate can also alter weed, insect, and fungal populations and increase pesticide use.

Rising carbon dioxide can directly influence nutritional content of foods.

Warmer temperatures can result in greater food spoilage.

Extreme climate events can disrupt food distribution.

WHO, 2019

Climate change transform illness transformission and vectors

Natural Host
Birds

Warmer winters, longer frost-free season, and earlier spring arrival may influence the migration patterns and fledging survival of birds that are the natural host of West Nile virus.

Key species: American robins, house finches, and house sparrows.

Insect Vector
Mosquitoes

Rising temperature, changing precipitation patterns, and a higher frequency of extreme weather events are likely to influence the distribution and abundance of mosquitoes that transmit West Nile virus by altering aquatic habitat availability and mosquito and viral reproduction rates.

Key species: *Cx. tarsalis, Cx. pipiens, Cx. quinquefasciatus.*

Incidental Host
Humans

Humans are not central to the West Nile virus transmission cycle, but can suffer serious health consequences if infected. Changing weather patterns will likely impact human behavior and exposure to mosquitoes that carry West Nile virus. Mosquito control or personal protection practices like wearing long-sleeves or repellent can reduce the risk of infection.
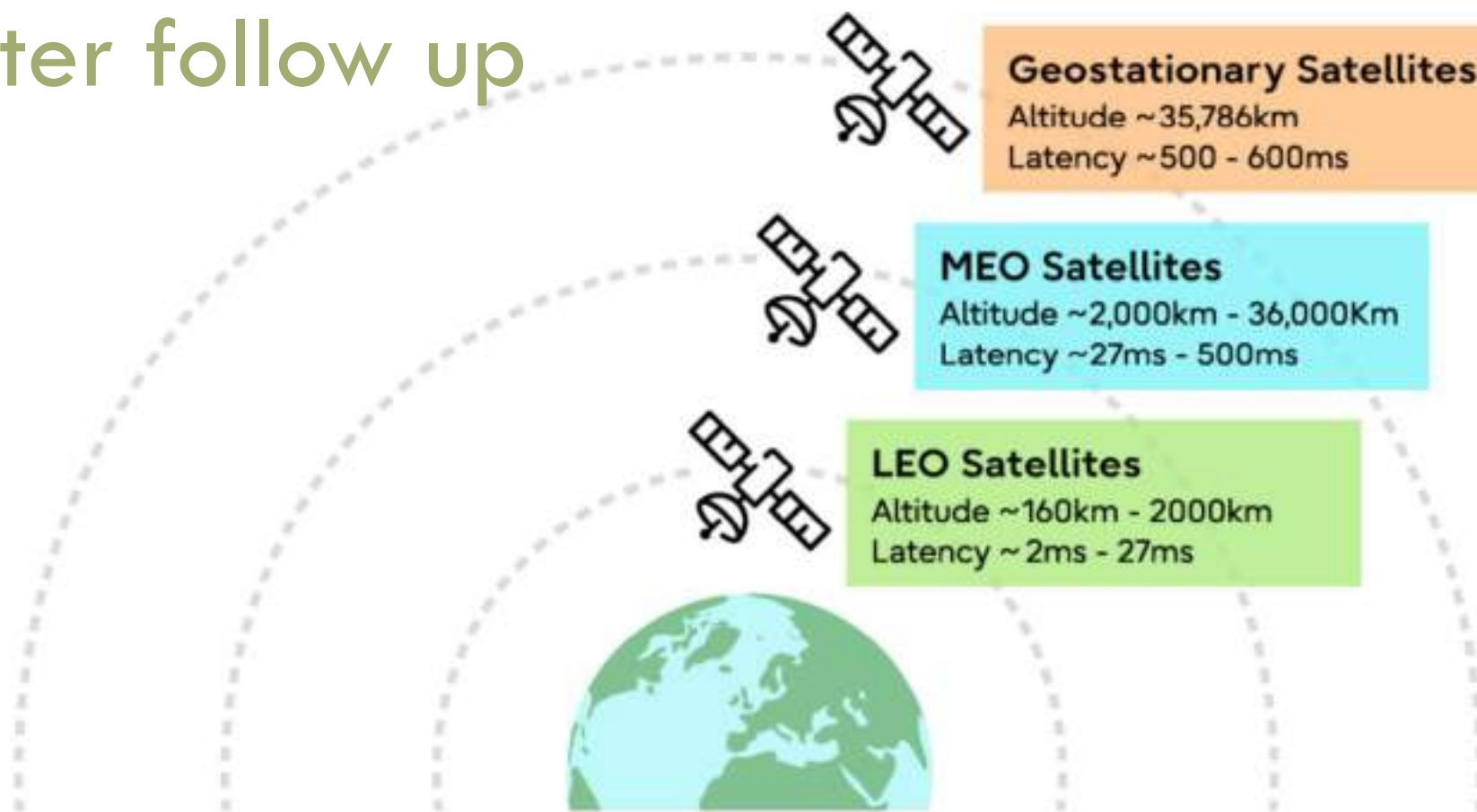
WHO, 2019

• **Increasing climate change-induced disasters pose a significant threat to global populations and health systems. Technology plays a vital role in revolutionizing disaster management and emergency response, specifically in health systems**
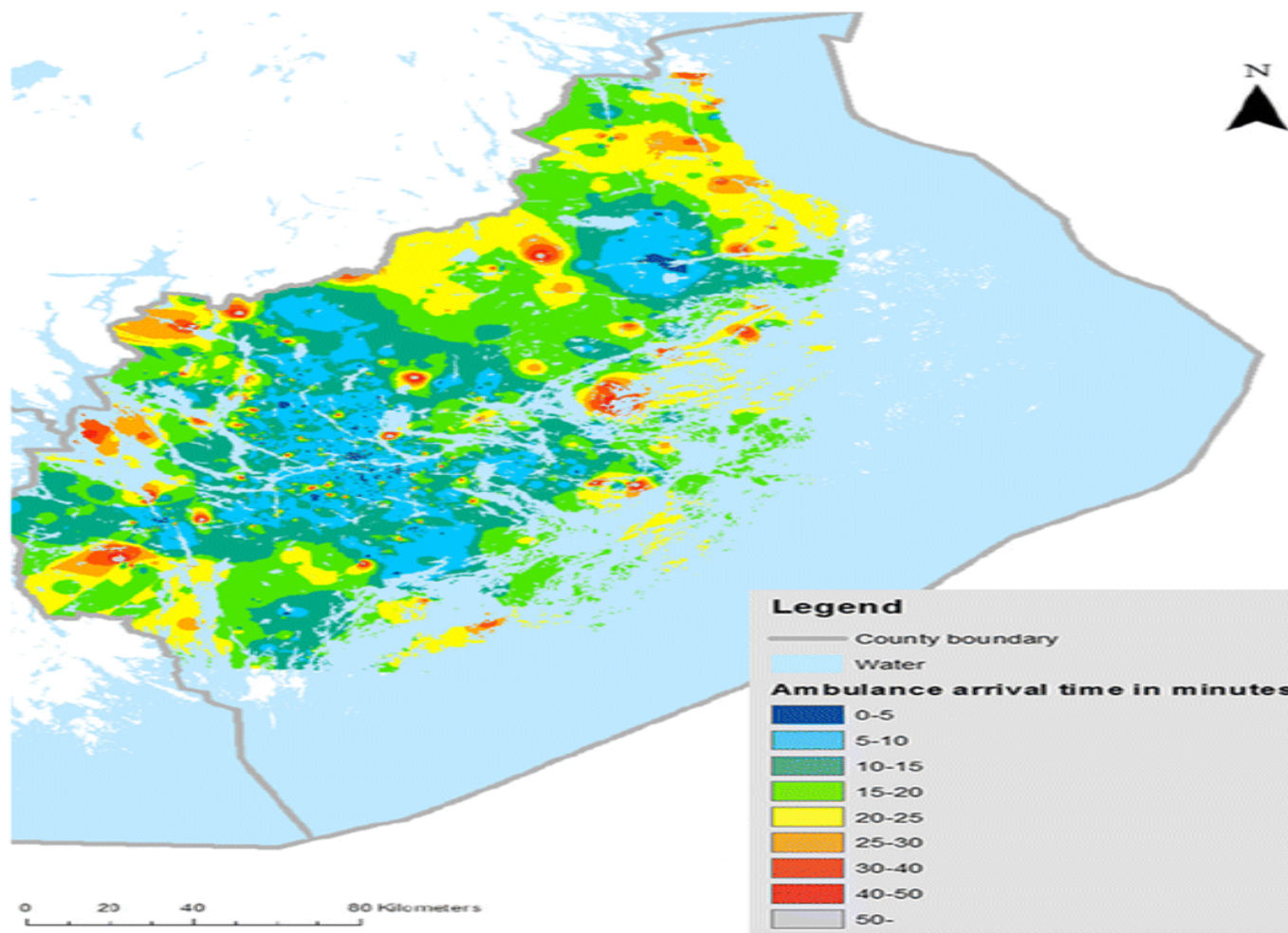
Artificial intelligence: the core of the response

- OMSZ in Hungary is using AI for capacity and logistics allocation in its daily operations. With daily cases of over 3000 patients and cars that cover over 40 million km each year, their operations create huge amounts of data, by using smart algorithms, they can use this data for predictions.

- Sofware HxGB OnCall Dispatch | Smart Advisor system uses real-time operational data to find patterns and recognize major events as they occur. With abnormalities noticed sooner, emergency services teams can coordinate and react quicker,
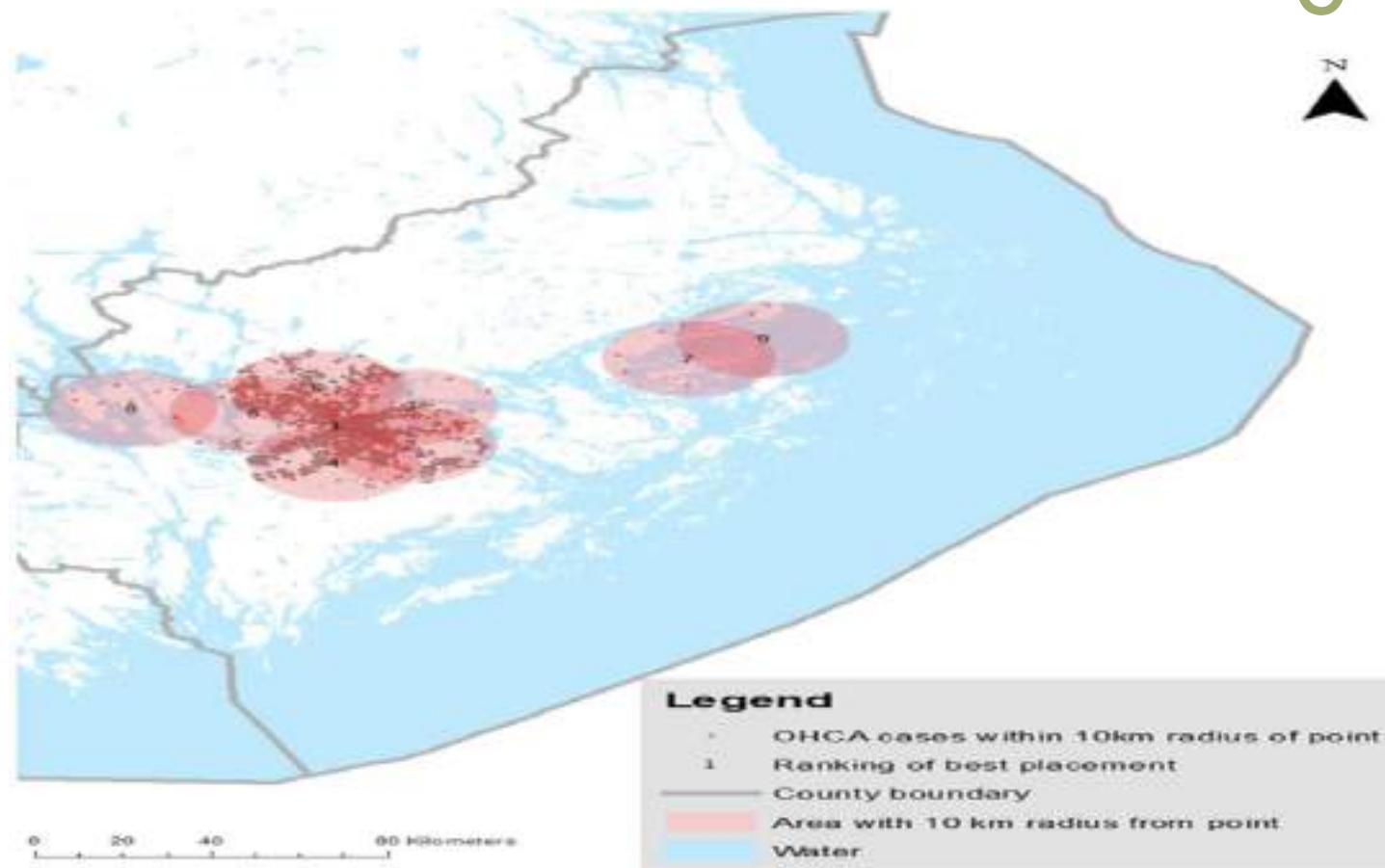
Satellite technology is a crucial component of climate change and disaster follow up

Geostationary Satellites
Altitude ~35,786km
Latency ~500 - 600ms

MEO Satellites
Altitude ~2,000km - 36,000Km
Latency ~27ms - 500ms

LEO Satellites
Altitude ~160km - 2000km
Latency ~2ms - 27ms

Source: Created by the author

Satellite mapping provide detailed information in early responses

Legend
— County boundary
Water
Ambulance arrival time in minutes
- 0-5
- 5-10
- 10-15
- 15-20
- 20-25
- 25-30
- 30-40
- 40-50
- 50-

Scandinavian Journal of Trauma, 2022

Unmanned aerial vehicles (drones) are versatile tools in disaster management

Legend
- OHCA cases within 10km radius of point
- 1 Ranking of best placement
- County boundary
- Area with 10 km radius from point
- Water

Scandinavian Journal of Trauma, 2022

Health systems - challenges

Lack of energy complicates healthcare services

- 1 billion people globally are served by health facilities without access to electricity[1]
- No access to reliable electric grid compromises cold chain integrity and requires costly standalone CCE (e.g., solar-powered refrigeration appliances)
- No access to green energy makes health systems dependent upon diesel generators for reliable electricity

1) WHO. "About the Health and Energy Platform of Action"

Lack of connectivity inhibits use of digital solutions and critical data collection

- It is estimated that 46.4% of the world lacks internet access, with 72.8% of the African population offline and facing connectivity costs that are outsized by 450%[2]
- Lack of connectivity at multiple health system nodes limits visibility into critical infrastructure dynamics and failure points
- If healthcare logistics and information management solutions are in place, they are disperse and management is decentralized

2) Based on global affordability target of 2% monthly income/GB; Barriers To Investing In Last-mile Connectivity, USAID 2020

Lack of credible data is a major impediment to delivery of essential goods and services

- No tracking of necessary data increases volatility of the system, complicates decision making, and ultimately undermines service delivery (e.g., energy system going out of service)[3]
- If critical parameters are tracked (e.g., vaccine storage conditions), it is passive and must be directly manually monitored, preventing proactive intervention to mitigate spoilage of sensitive goods

3) Yumkella, Dr. Kandeh (former United Nations Under-Secretary-General and Special Representative for Sustainable Energy for All). "Access to equitable vaccines distribution depends on renewable energy" (2021)

Lack of security prevents equitable access to care by creating both demand- and supply-side barriers

- Workplace safety for both healthcare providers and patients may be severely compromised, which reduces satisfaction rates of both and constrains intended programme outcomes dependent on health service provision[4]
- Healthcare facilities are vulnerable targets of cyber attacks[5]

4) Etiaba, Manzano, Agbawodikeizu, et al. "Fear of crime and security challenges in maternal acute care in Nigeria from a realist perspective" (2020)
5) KPMG. "Health Care and Cyber Security: Increasing Threats Require Increased Capabilities". (2020)

The challenges outlined above outlining systemic issues within the health system from energy, connectivity, data monitoring, and physical as well as cyber security are interdependent and require integrated solutions

Smart tools at health facilities can provide early data and improve resiliency

Smart Facilities

ENERGY & MOBILITY

- Renewable Energy
- Electric Vehicles
- Vehicle-to-Grid
- Energy Storage (Li-ion)

DATA & INTERNET OF THINGS

- Sensors based technologies
- RFID and Block chain
- Energy Consumption & Environmental
- Monitoring Artificial Intelligence and Machine Learning Intergration

CONNECTIVITY

- NextGen Broadband Connection - 5G, *LTE-M*, MultiFire
- Global Mobile Virtual Network Operator (*GMVNO*)
- OneICTbox+
- NextGen Satellite Comms - *SpaceX*, SatCube
- IoT Connectivity - *LoraWAN*, BLE, Zigbee, Sigfox, NFC

SECURITY

- End-point protection Anywhere
- Next Generation Firewall
- Solar Street Lamps
- Perimeter Security - Cloud-based CCTV and Premise Access System

"The whole is greater than the sum of its parts" - Aristotle

Interconnecting Smart Technologies and People in the Pursuit of Economic and Social Development

Smart Facilities | Digital Twin

The **Smart Facility model** allows to create a **Digital Twin** of the facility that can be **monitored remotely** through **real-time dashboards**
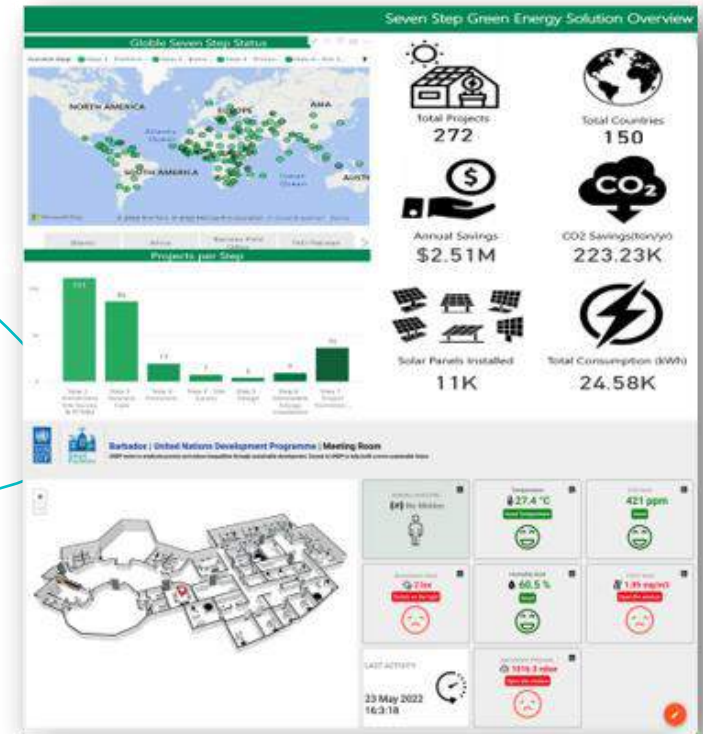
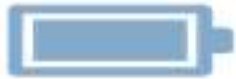# We need to have accessible, easy to manage technologies

Benefits of using the LoRaWAN Protocol

Network set up for end-users at a low cost

It covers long-range distances

Low power consumption and long battery life

Ability of a single gateway to maintain 1000s of end devices

Flexible integration of deployment and installation

LoRaWAN

6

Example of Smart facility for Health in Africa

• Smart facility in the National Reference Laboratory In Sao Tome and Principe:

- Hybrid energy system
- Backup connectivity solution
- Environmental and disaster monitoring
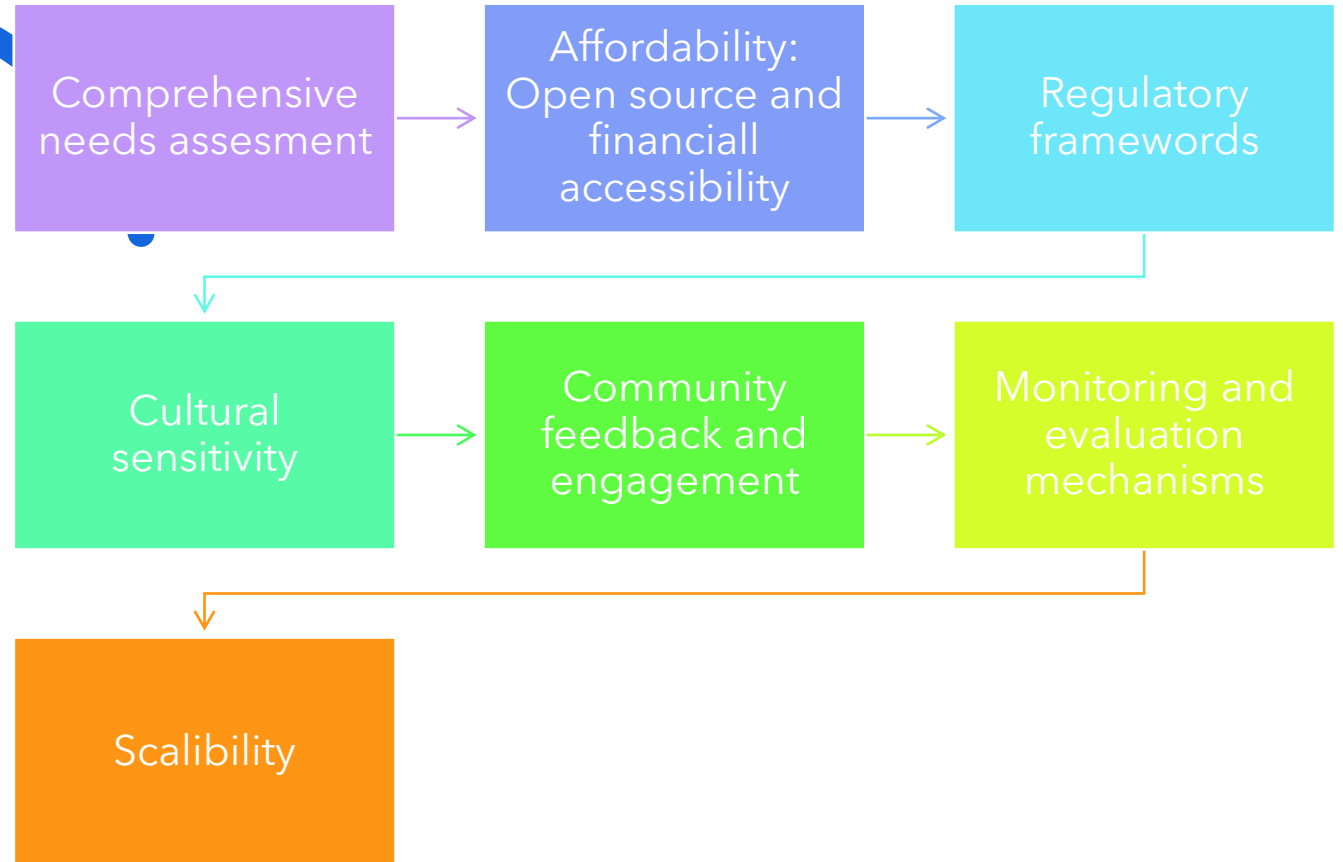- Energy efficiency monitoring
- CCTV security access

Key considerations: ensuring access to technology

RESILIENCE

SUSTAINABILITY

Comprehensive needs assesment	Affordability: Open source and financiall accessibility	Regulatory framewords

Cultural sensitivity	Community feedback and engagement	Monitoring and evaluation mechanisms

Scalibility

Building resilient health structures in climate change

World Bank, 2023C

- At COP-26 over [50 countries committed to build climate resilient and low-carbon health systems](#). These include 47 countries, representing over a third of global health care emissions. Fourteen countries have also set a target date to reach net zero carbon emissions in their health system before 2050.
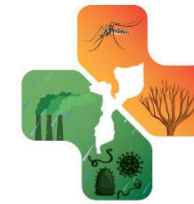
World Bank, 2023

Resilient health facilities are crucial in the climate response

- Millions of lives hang in the balance. It's time we step up and make climate action—and climate-health action—a global priority. This is our investment in planet Earth, our investment in future generations, our investment in a better world.

Sao Tome and Principe

- Obrigado!

Thank you

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