

2023 Global Health and Welfare Forum in Taiwan

Health for All: Strengthen Well-being through Collaboration and Empowerment for the Attainment of New Normal

Nov. 7th-8th, 2023, Taipei, Taiwan

One Health and One Digital Health for Preventing Pandemic

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College of Public Health National Taiwan University

2023-11-07

The '3I' Justice for Safe Earth System Boundaries

1

Interspecies Justice and Earth System Stability (I1)

2

Intergenerational Justice (I2a and I2b)

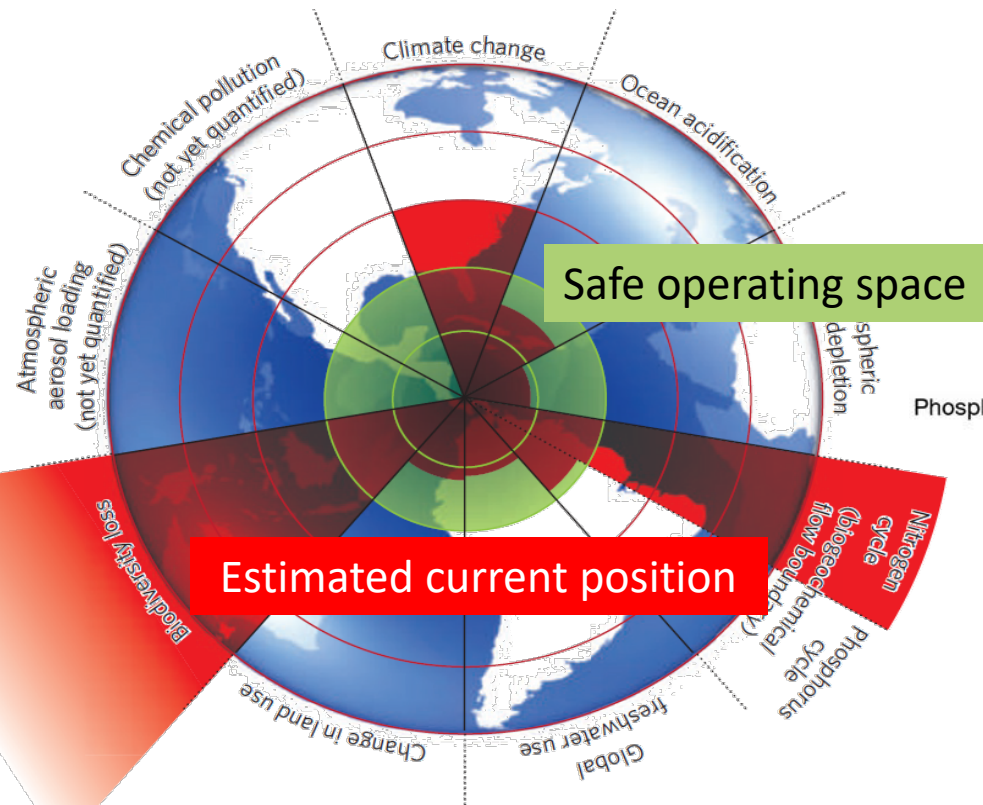
Past $\xrightarrow{\text{I2a}}$ Present $\xrightarrow{\text{I2b}}$ Future

3

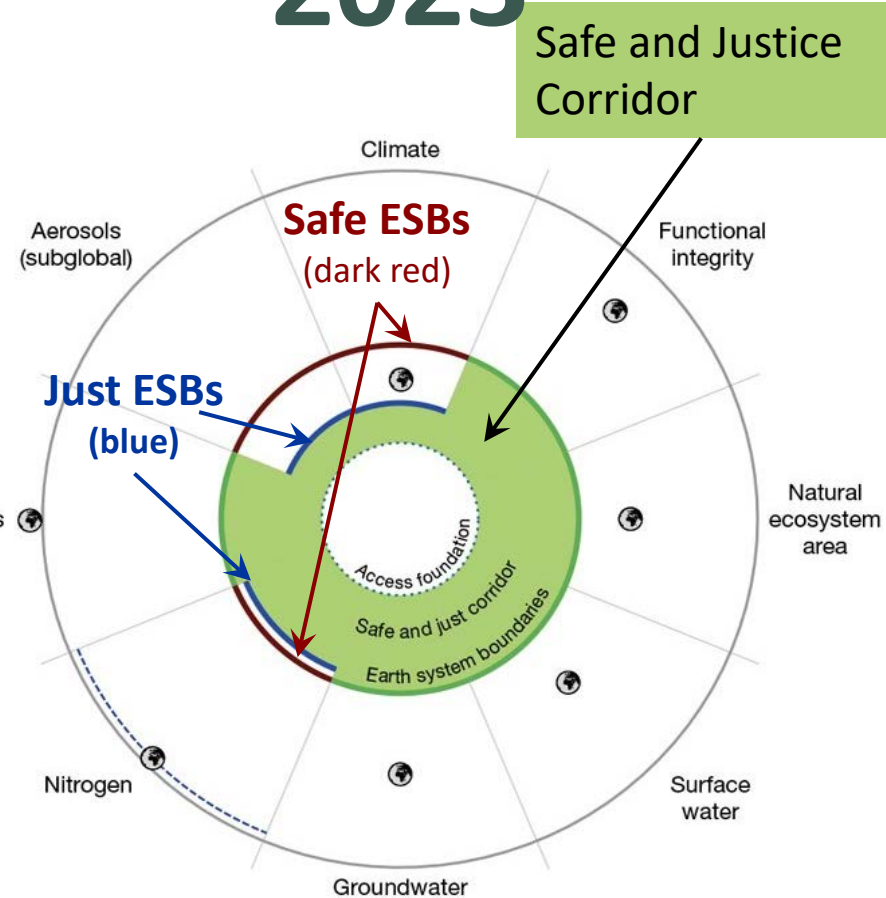
Intragenerational justice: between countries, communities and individuals (I3)

Safe and Just Earth System Boundaries (ESB)

2009



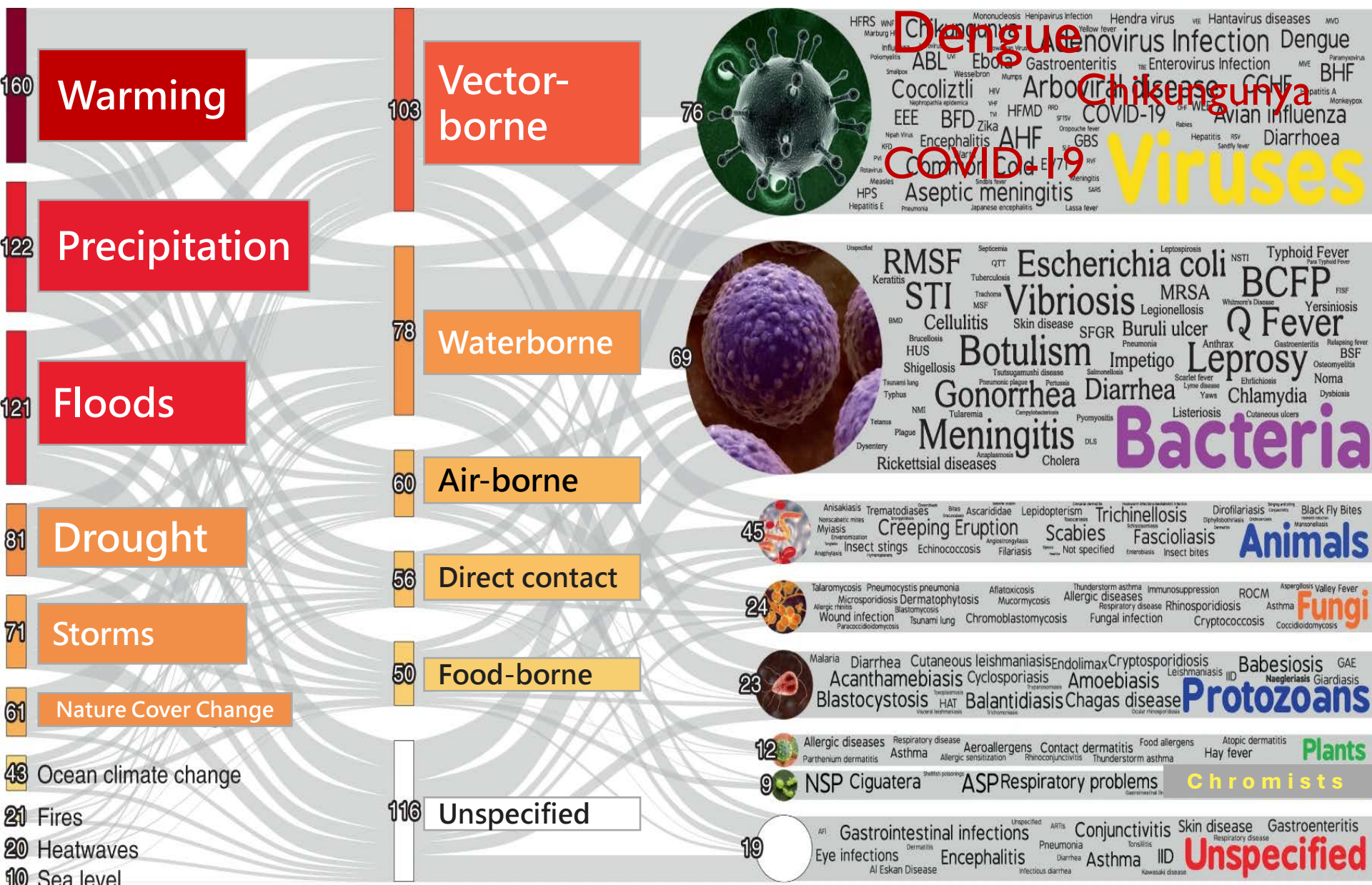
2023



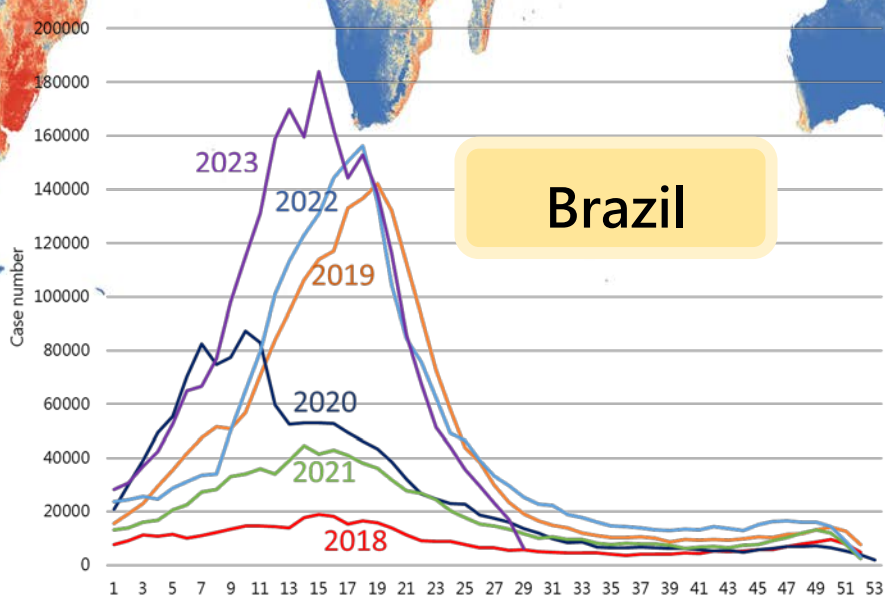
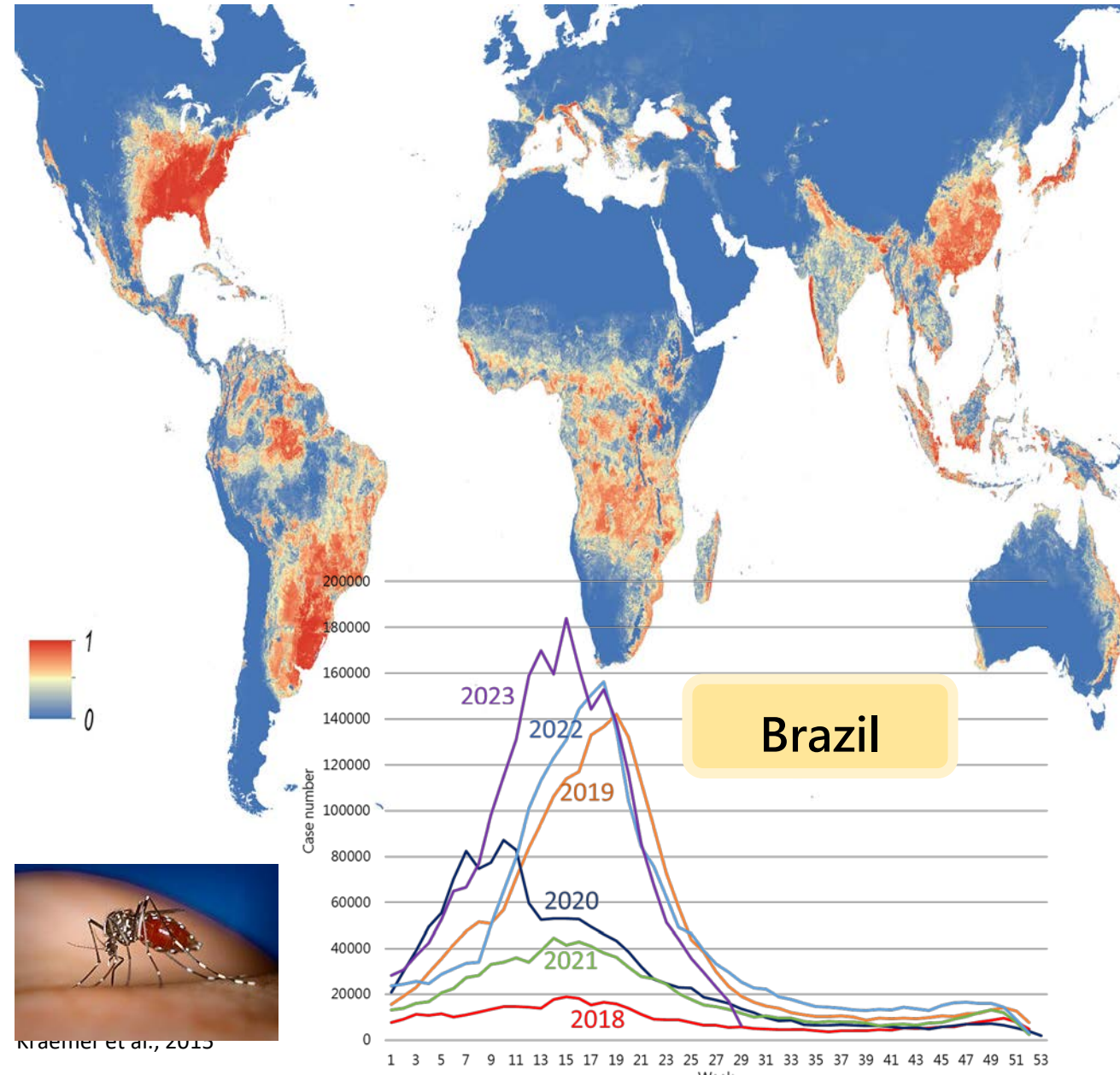
Safe and Justice Corridor

Climatic Hazards and Transmission Pathways for Diseases

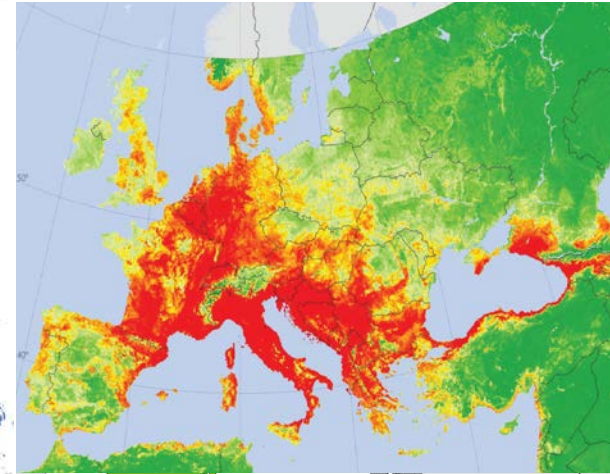
Mora et al., 2022



Global Warming and Distribution of Mosquito Vectors



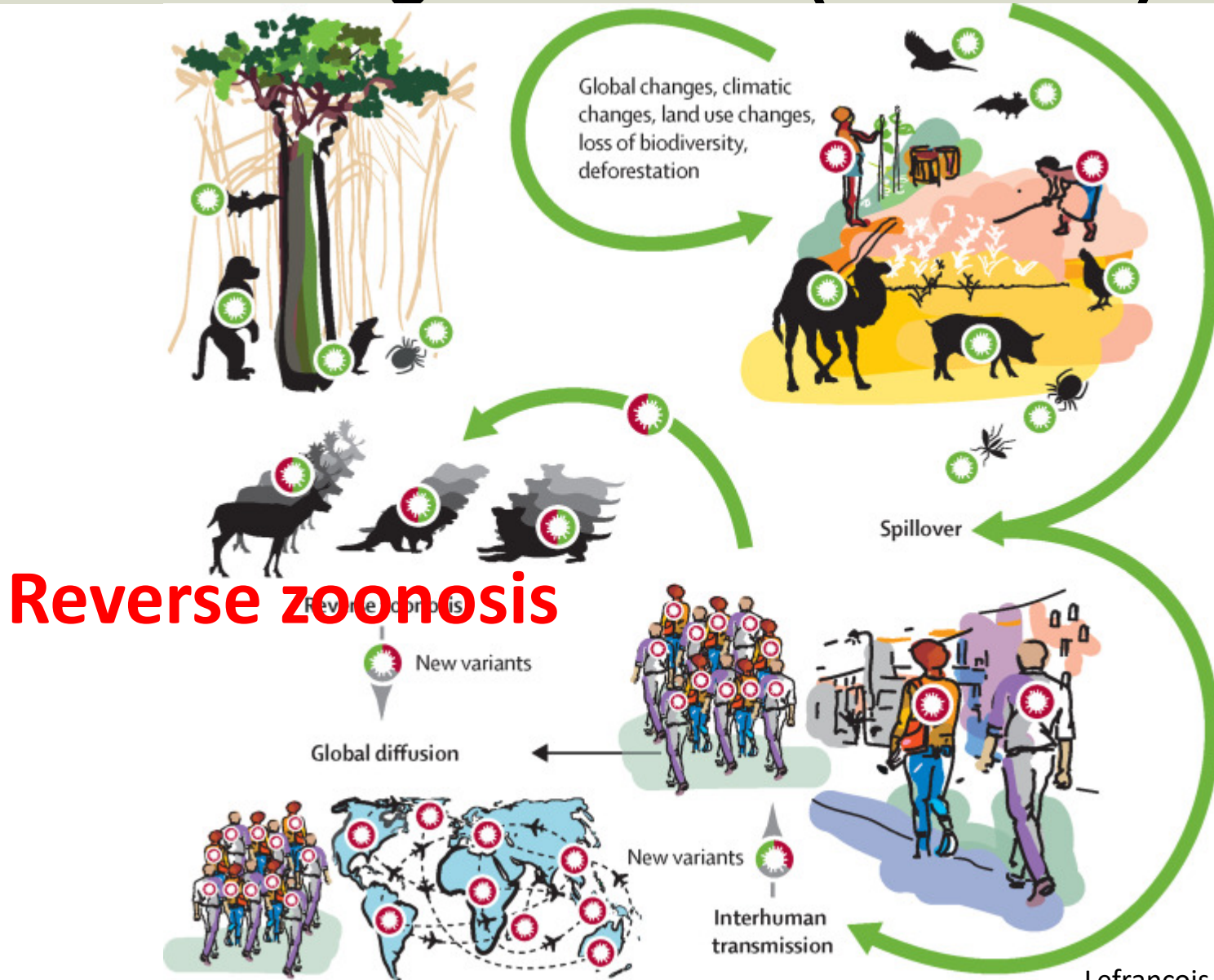
Weather fitness for Mosquito Vectors



Areas where mosquito vectors were identified in Europe



Transmission of Zoonotic Diseases: The origin Omicron (B.1.1.529) ?

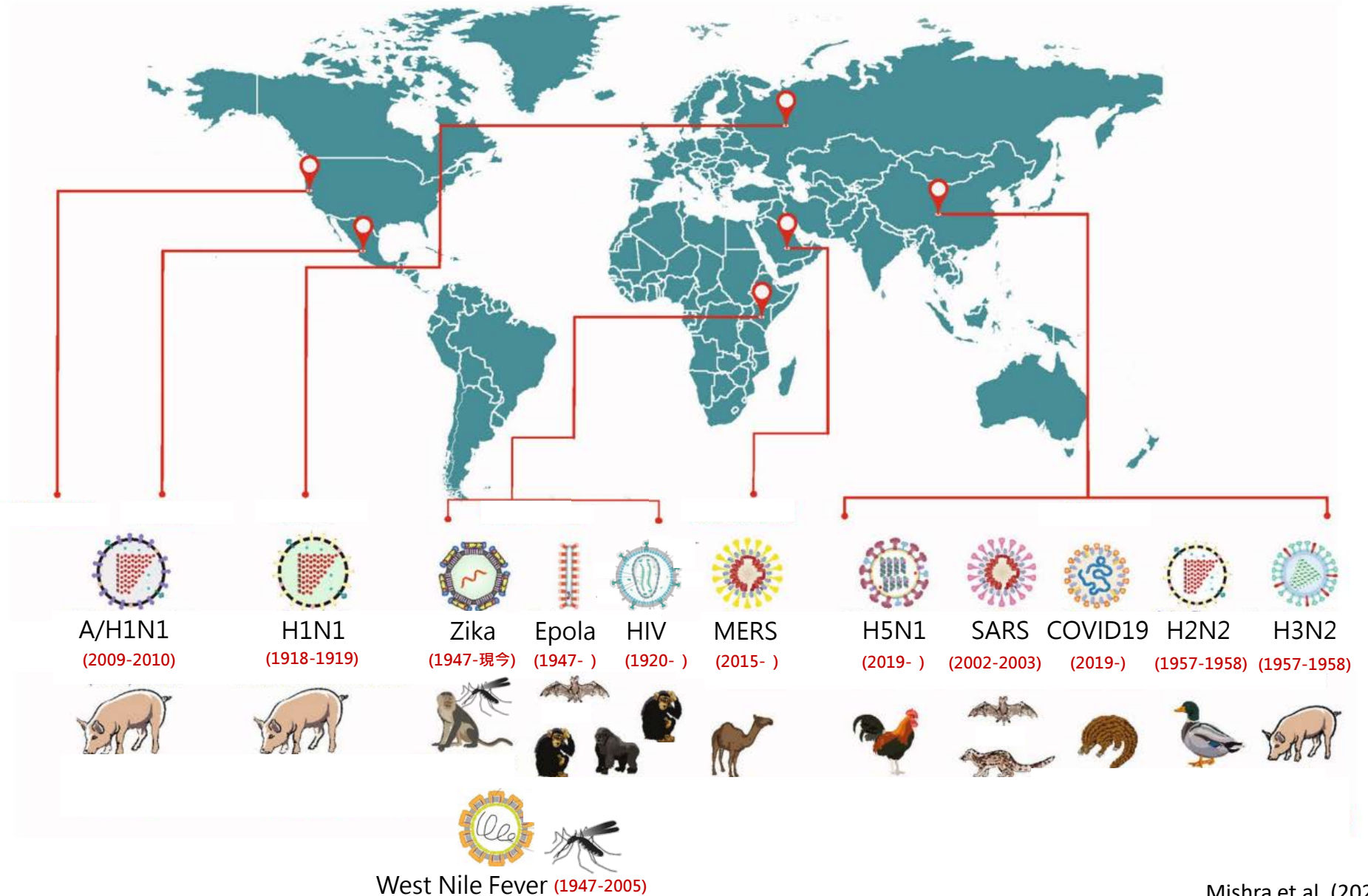


Bird flu outbreak at Spanish Mink Farm

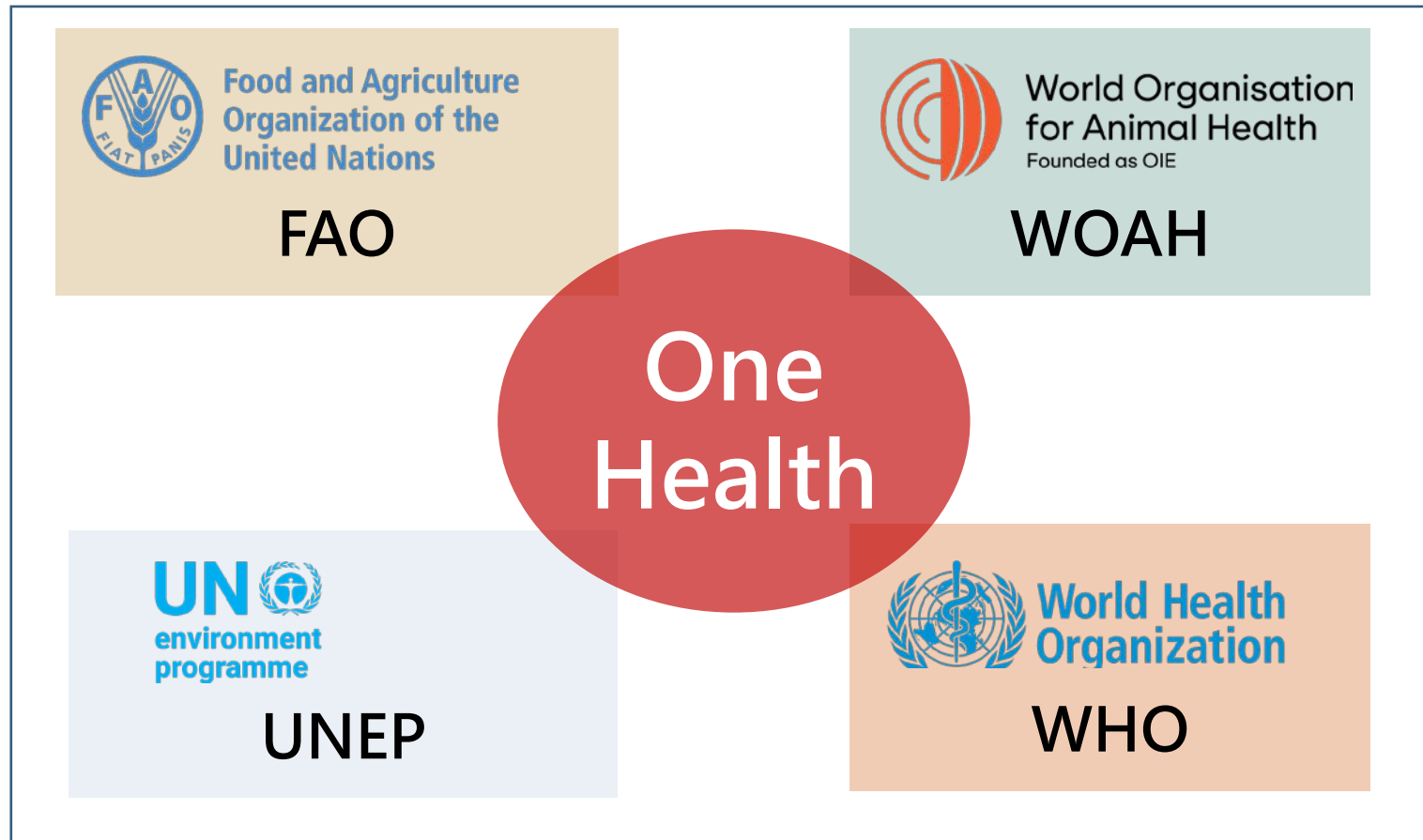


- Highly pathogenic avian influenza A(H5N1) virus infection in farmed minks, Spain, October 2022
- RT-PCR test positive for both SARS- CoV-2 and H5N1

Global Pandemic Spread: History of Epidemics



Quadripartite One Health Intelligence



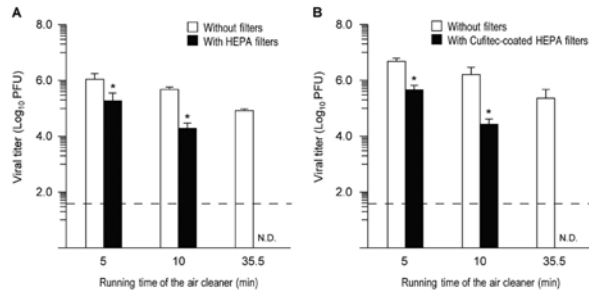
OHHLEP

The One Health High-Level Expert Panel

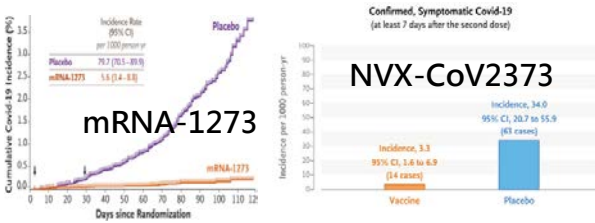
From Evidence-based Medicine to Metaverse Health Care

RCT

HEPA Filters

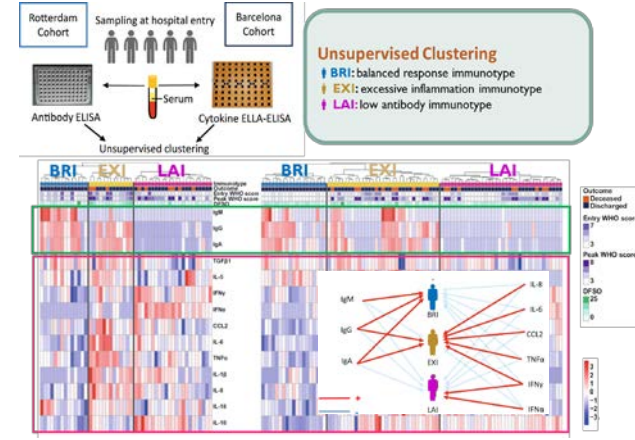


Vaccine

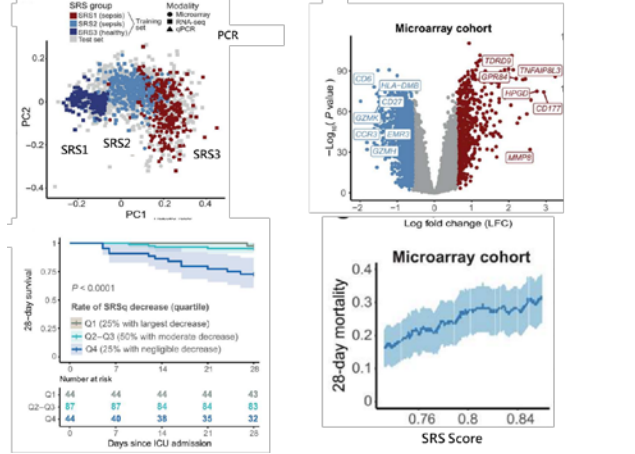


Precision Medicine

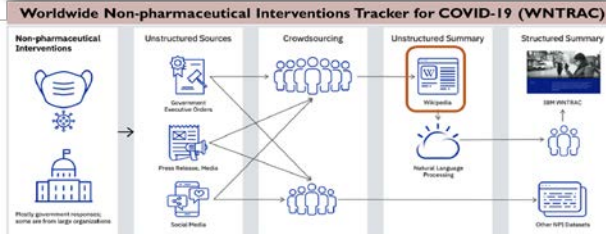
Machine learning for categorizing hospitalized Covid-19 patients' immune phenotypes



Quantitative Sepsis Response Signature Score for Predicting COVID-19 Death



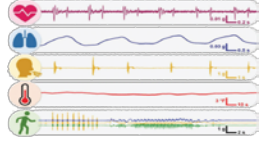
Io Health Care Things (IoBCT)



Contact tracing app



Wearable Devices



Bluetooth



GPS



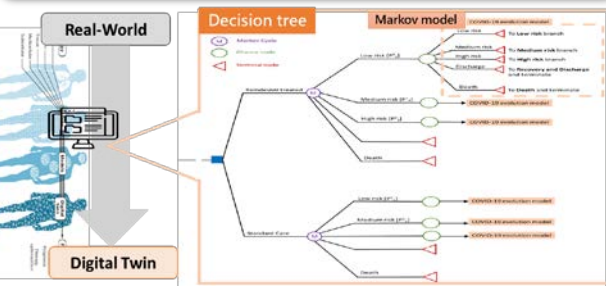
Ultrasonic system



Health Passport



Digital Twin Design



Evidence-based Medicine
1970~ 1990

Precision Medicine
1990-2015

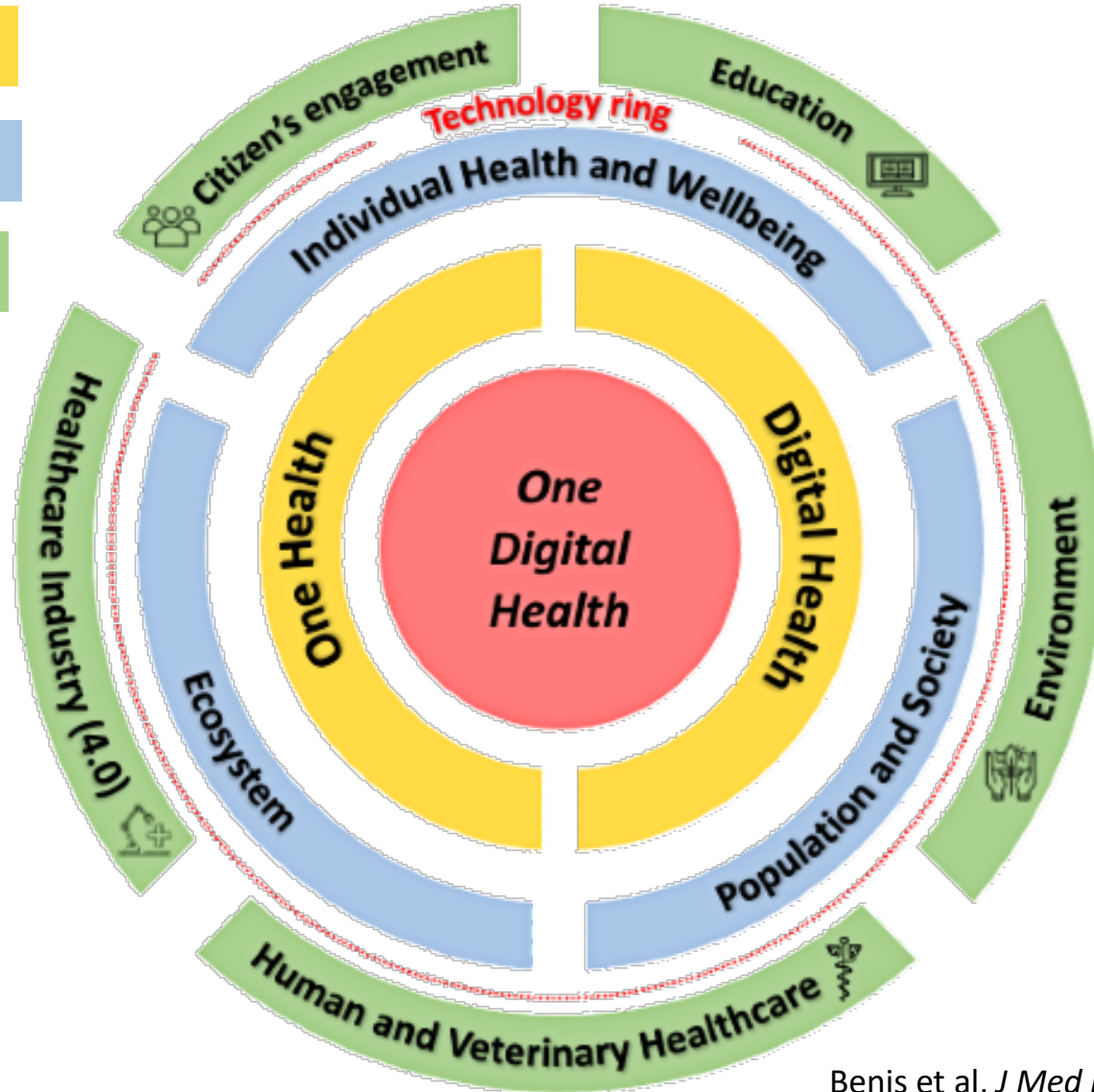
Metaverse Health Care
2015~

One Digital Health (ODH)

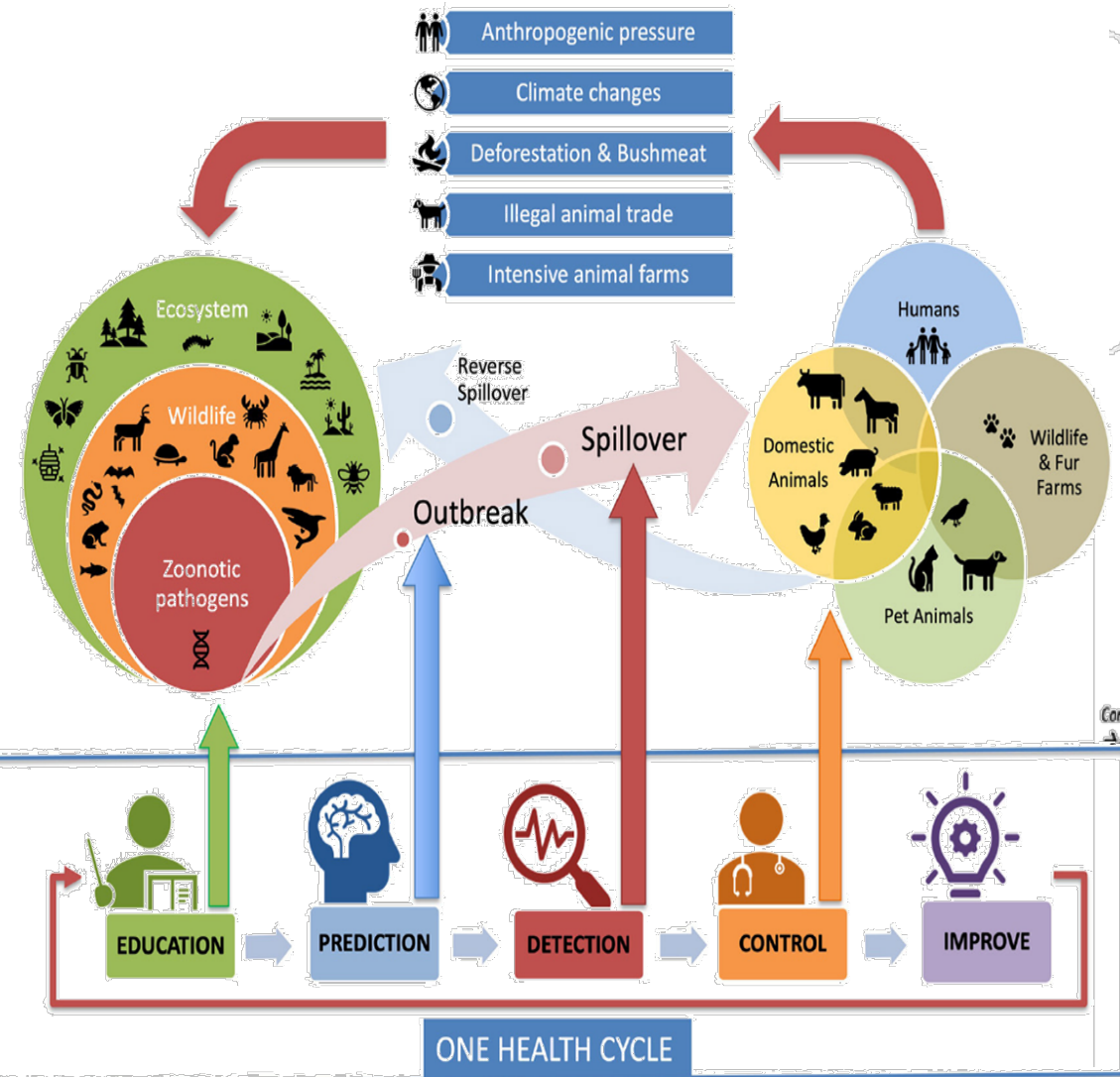
Two Enabling Keys

Three Perspectives

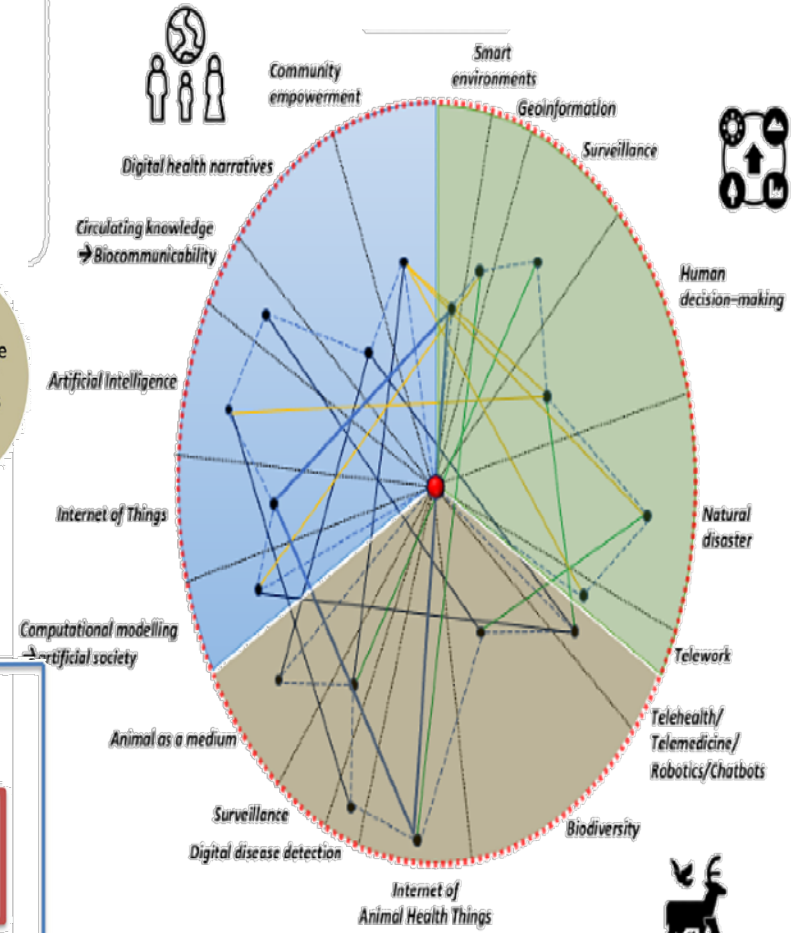
Five Dimensions



Environmental Disturbances and Zoonotic Spillover



Technology Ring



Citizen Engagement ODH Model in Crisis

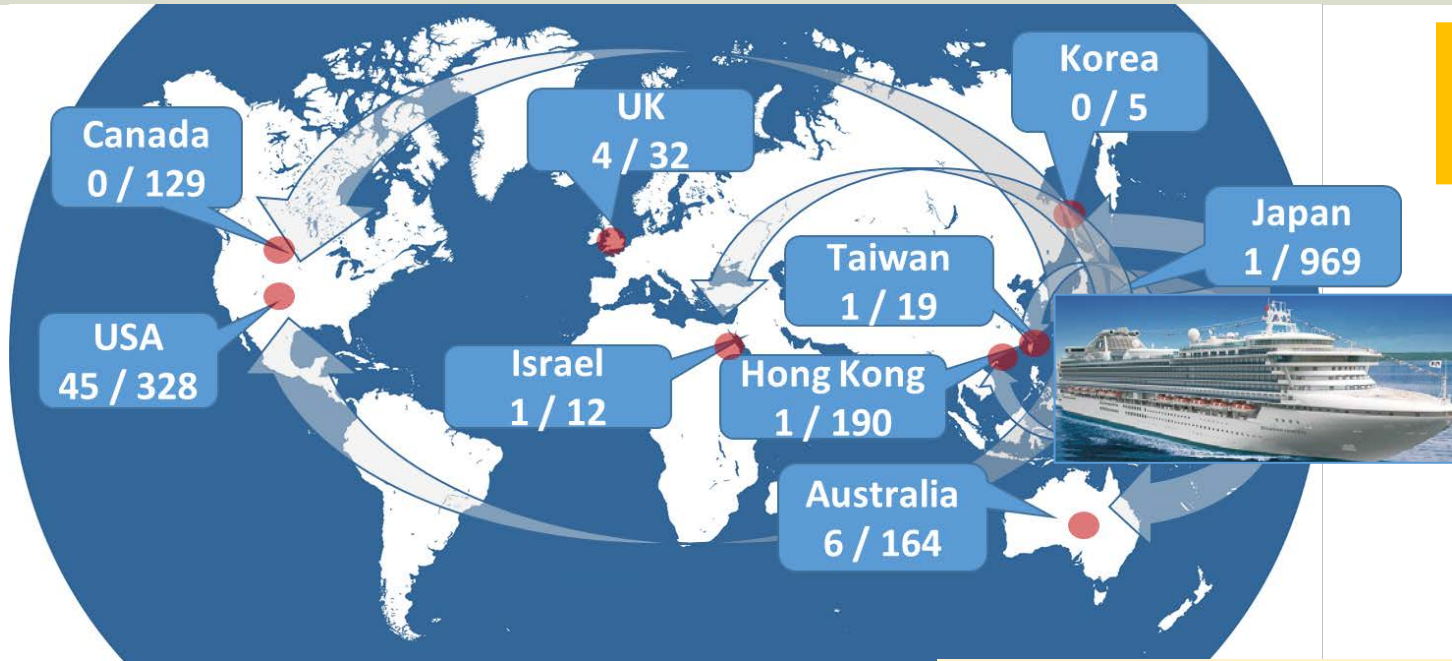
Automated Alert Messaging System

Illustrated with Covid-19 Epidemic on

Diamond Princess

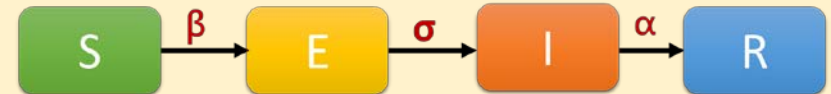
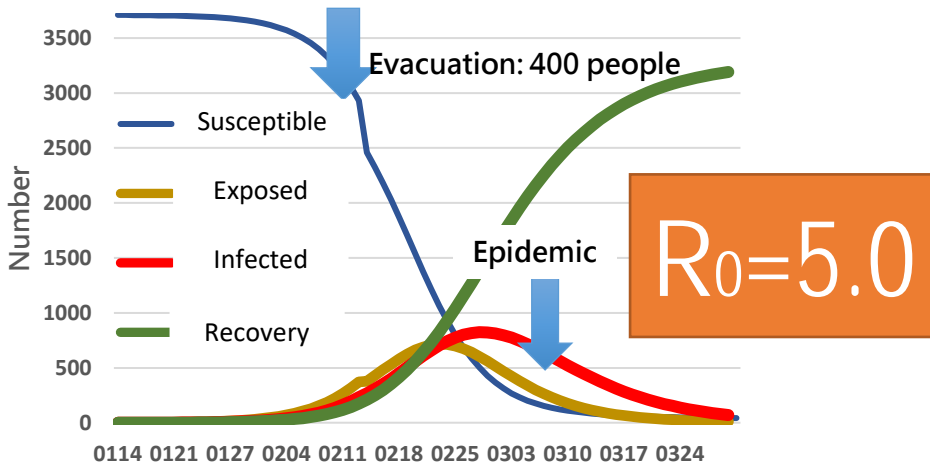


Big Data Analysis with Differential Equation Model for COVID-19 transmission on Diamond Princess



706/3711
(~3/5 10:00)

Dynamic Prediction



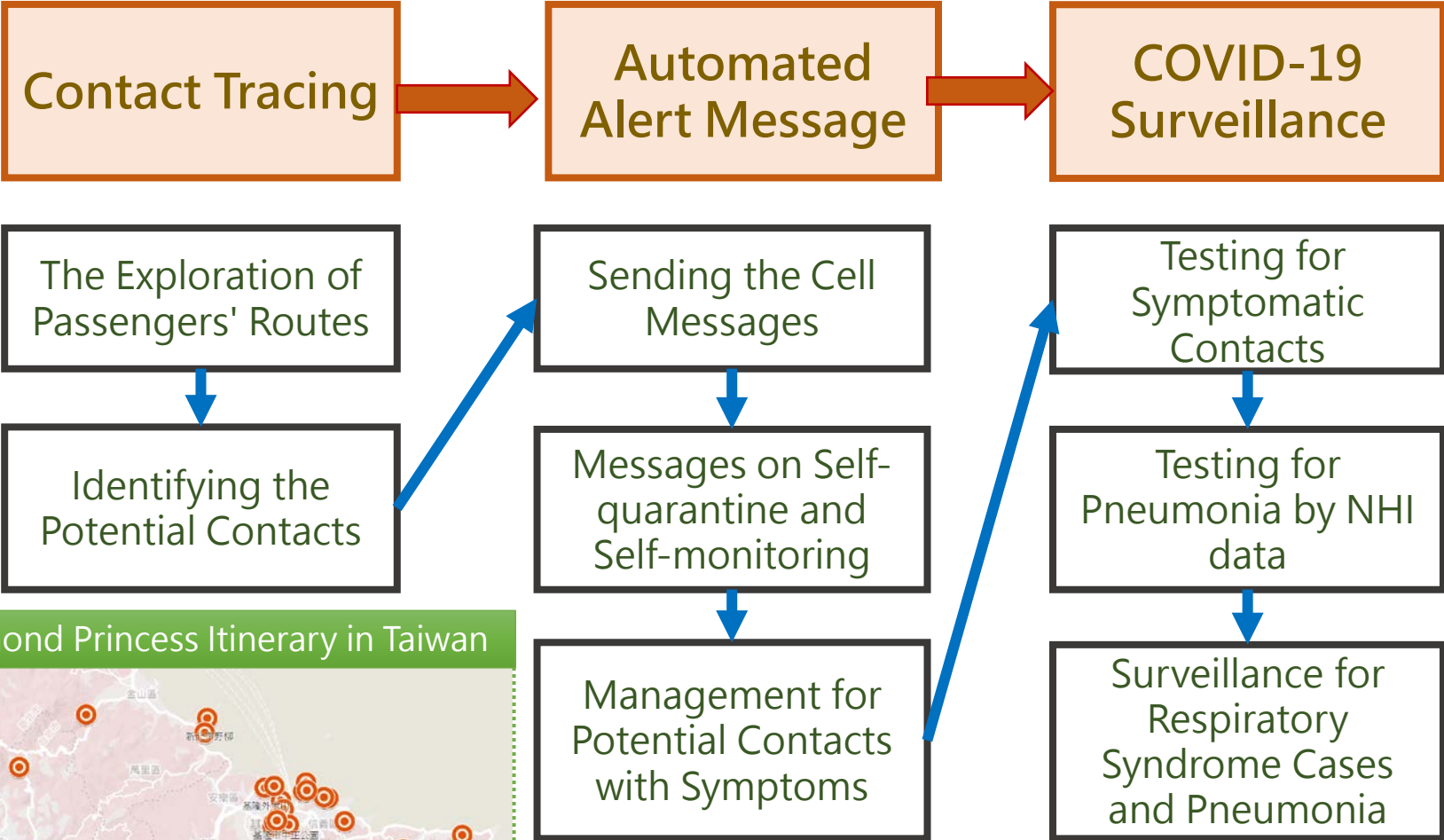
$$\frac{ds(t)}{dt} = -\beta \cdot s(t) \cdot i(t)$$

$$\frac{de(t)}{dt} = \beta \cdot s(t) \cdot i(t) - \sigma \cdot e(t)$$

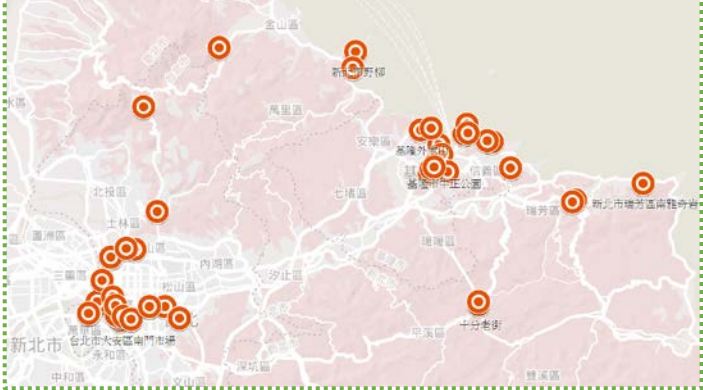
$$\frac{di(t)}{dt} = \sigma \cdot e(t) - \alpha \cdot i(t)$$

$$\frac{dr(t)}{dt} = \alpha \cdot i(t)$$

Big Data Analytics for Containing the spread of SARS-COV-2: Diamond Princess Disembarking at Keelung

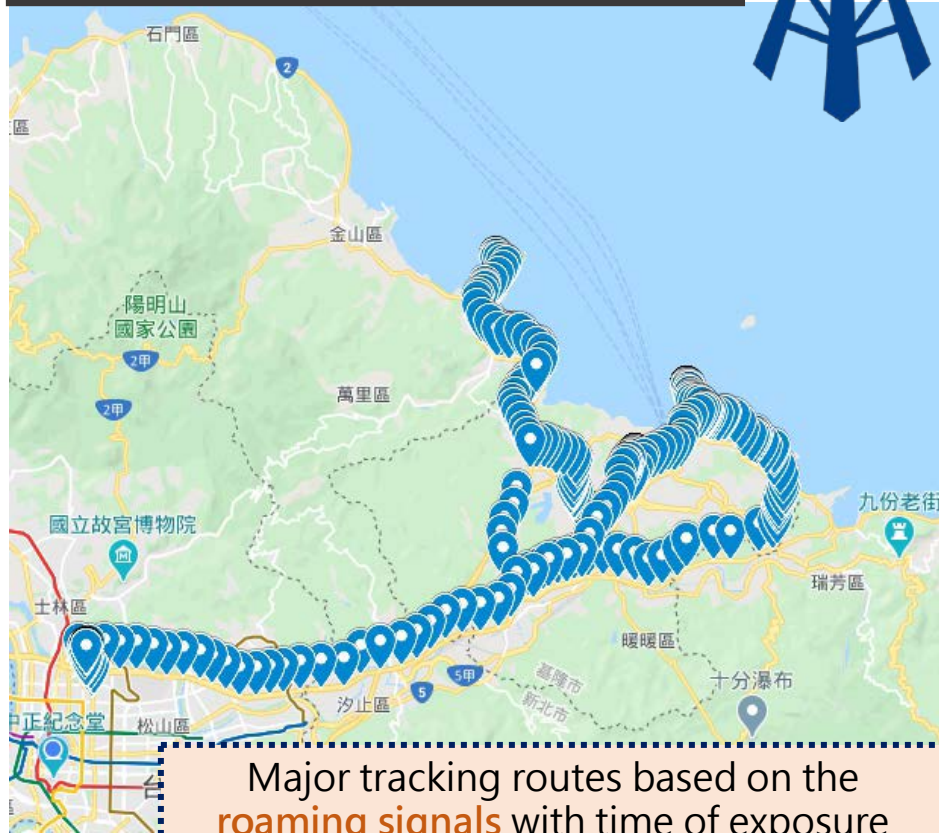


Diamond Princess Itinerary in Taiwan



① Digital Contact Tracing


Big Sensor Data –
The Exploration of **Passengers'**
Routes

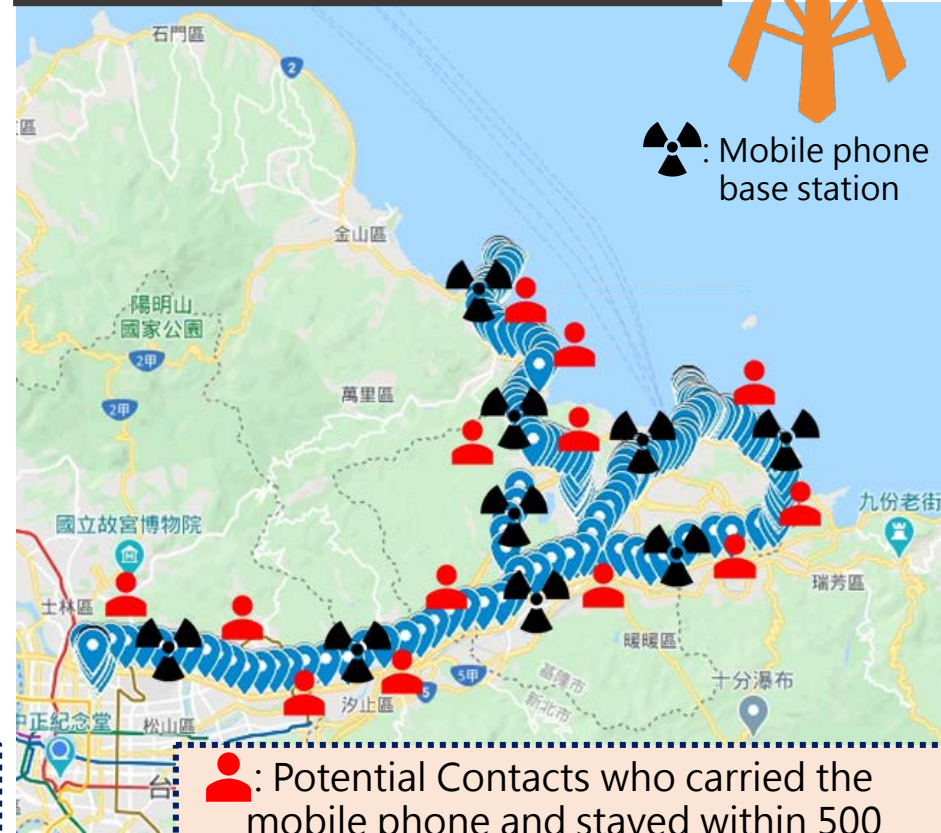



Major tracking routes based on the **roaming signals** with time of exposure over 30 minutes

Mobile Sensor Data-
Identifying the **Potential**
Contacts



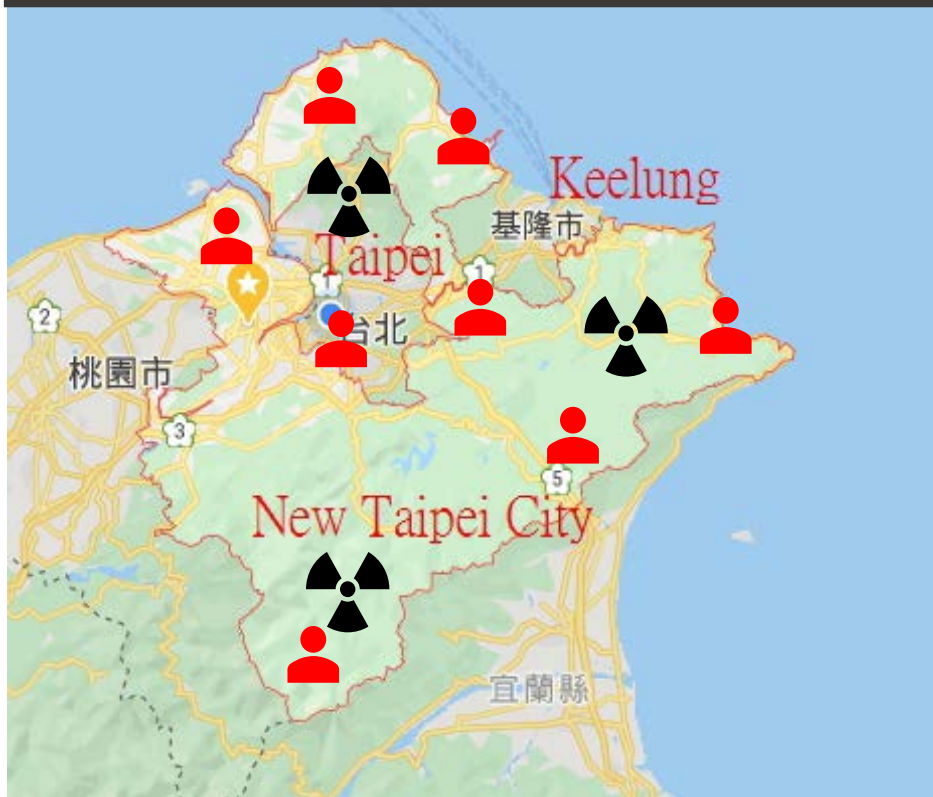
: Mobile phone base station



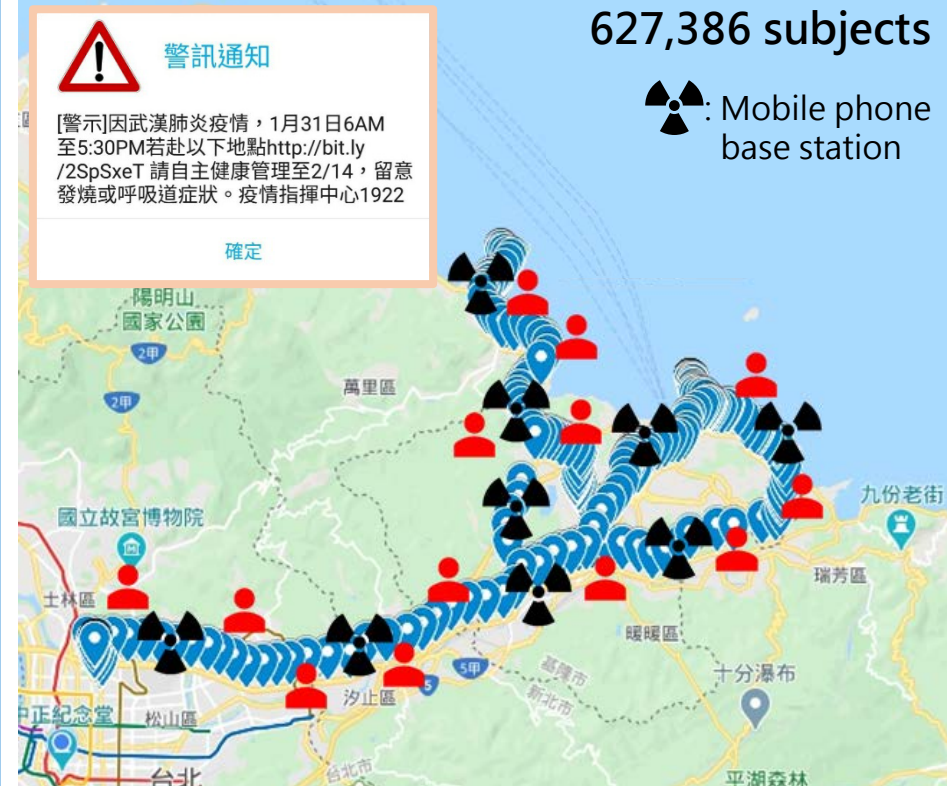
: Potential Contacts who carried the mobile phone and stayed within 500 meter of marked locations over 5 minutes

② Automated Alert Messaging System

Sending the **Cell Message** for residents in Taipei, New Taipei, and Keelung



Sending the **Alert Messages** for Potential Contacts



Health Care Industry 4.0 with FAIR Principle in ODH

**Findable, Accessible, Interoperable,
Reusable**

FAIR

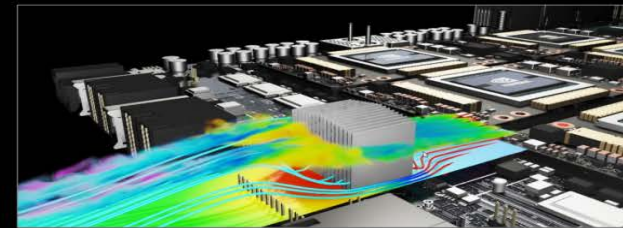
NVIDIA: Earth-2



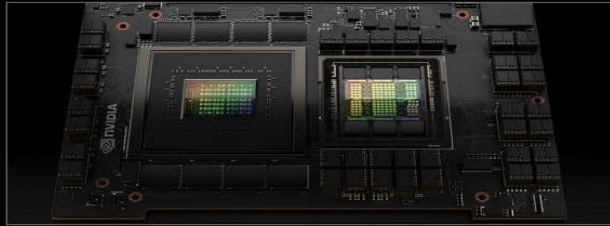
OMNIVERSE
USER EXPERIENCE



NUCLEUS
INTEROPERABILITY



MODULUS
PHYSICS -NFORMED



GRACE - HOPPER SUPERCHIP
ACCELERATED COMPUTING



OVX - SUPERPOD
LARGE AI MODELS



Earth-2 Mission #1

Interacting with Climate
Predictions at Low Latency.



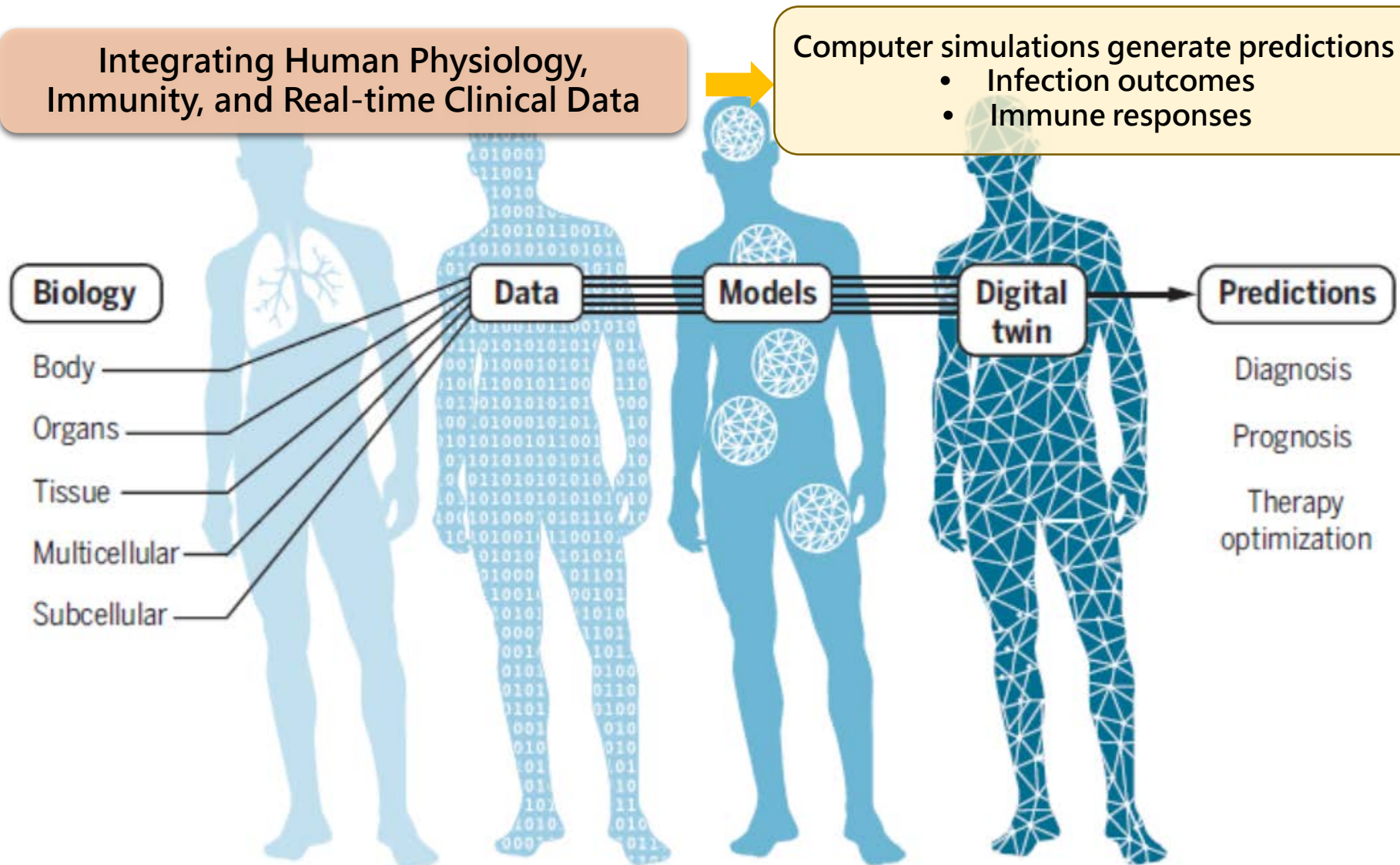
Digital Twins for Managing Infectious Diseases

AI Computer Simulation-More Effective Treatment Strategies

Integrating Human Physiology, Immunity, and Real-time Clinical Data

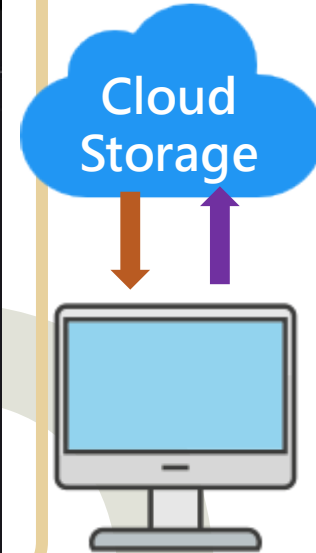
Computer simulations generate predictions :

- Infection outcomes
- Immune responses



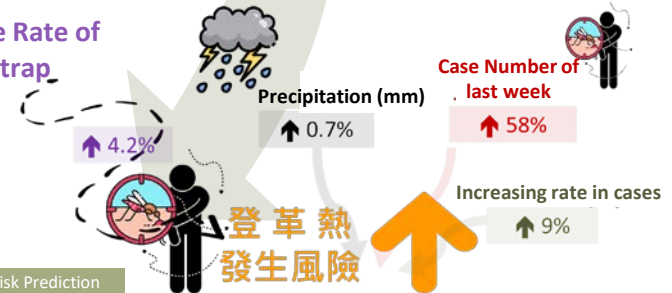
IoT for Dengue Fever Risk Prediction

IoT
Weather
Information



Big Data with
ML

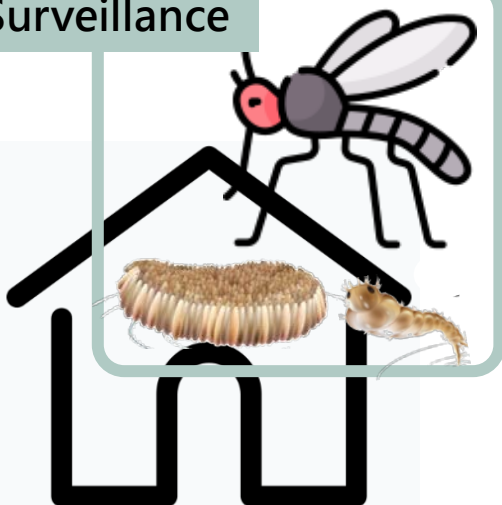
Positive Rate of
Ovitrap



Risk Prediction
Model

$$\text{Log}(\text{Case number}) = \log(\text{population}) - 9.76 + 0.42 \times [\text{Positive rate of Ovitrap}] + 0.07 \times [\text{PPTw}] + 0.58 \times [\text{case number of last week}] + 0.09 \times [\text{increasing rate in cases}]$$

Ovitrap
Surveillance

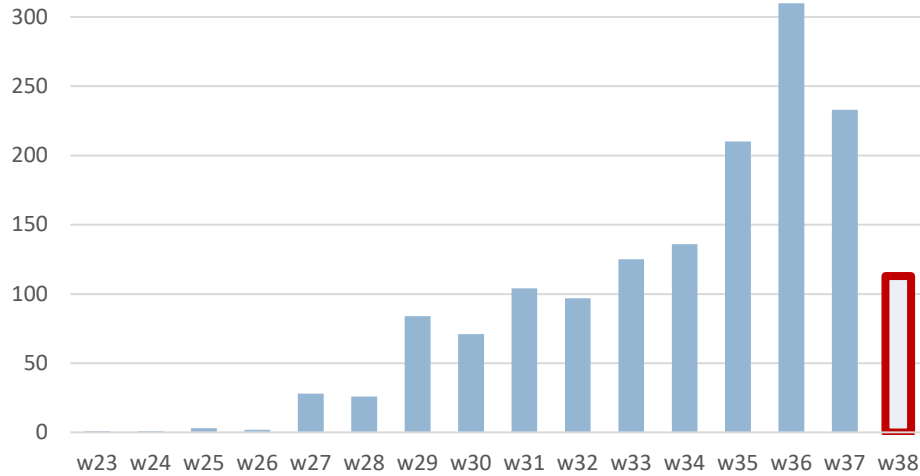


Trend of
Outbreak



Precision Risk Prediction of Dengue Fever in Tainan Township, Taiwan

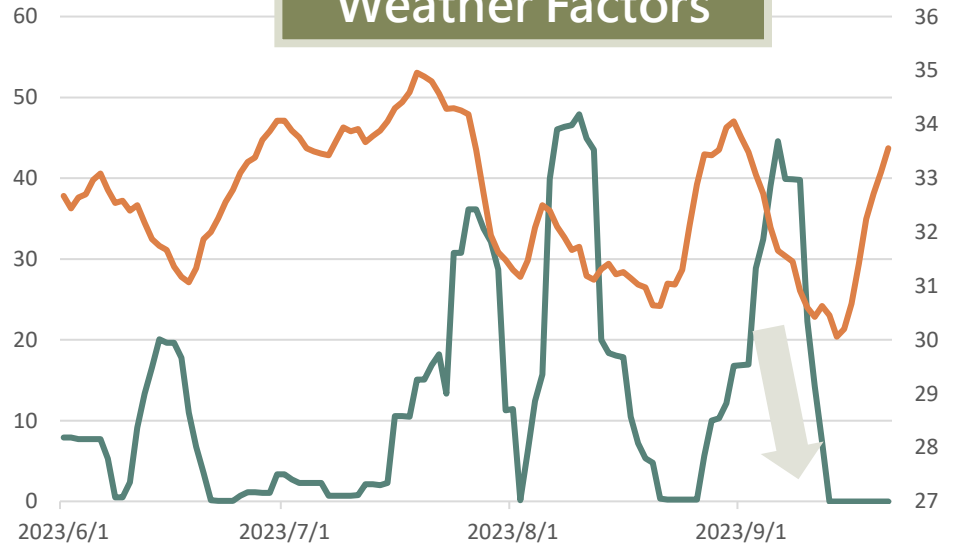
Weekly Case Number



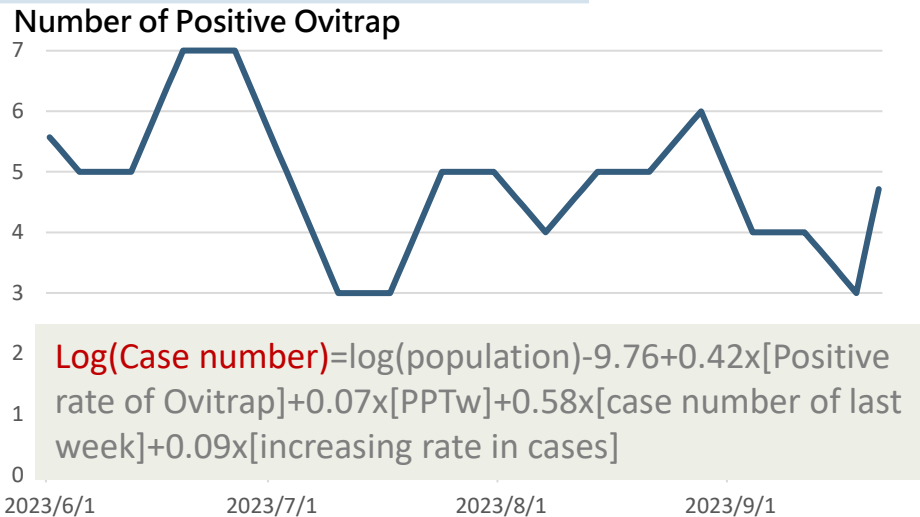
PPT (mm)

Weather Factors

Temp(°C)



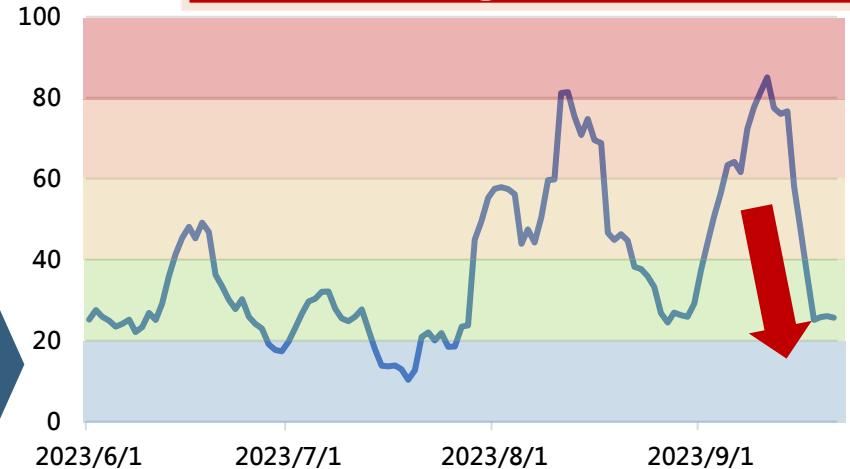
Positive rate of Ovitrap



$$\text{Log}(\text{Case number}) = \log(\text{population}) - 9.76 + 0.42 \times [\text{Positive rate of Ovitrap}] + 0.07 \times [\text{PPTw}] + 0.58 \times [\text{case number of last week}] + 0.09 \times [\text{increasing rate in cases}]$$

Risk Score

Predicted Risk of Dengue Fever



Bayesian Dynamic Geospatial Surveillance Model for Dengue Fever, Tainan Township, Taiwan

7/3-7/9



7/10-7/16



7/17-7/23



7/24-7/30



7/31-8/6



8/7-8/13



8/14-8/20



8/21-8/27



8/28-9/3



9/4-9/10



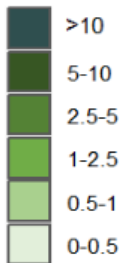
9/11-9/17



9/18-9/24



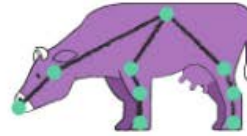
RR



Artificial Intelligence for Precision Livestock Farming



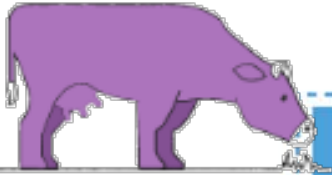
Monitoring
Drinking and Feeding
Behaviors



Activity Patterns,
Movement and Posture
Analysis



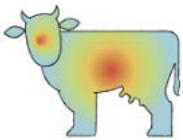
Feeces
Identification



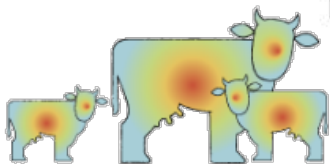
AI-Based Animal Welfare Monitoring
and Identifying Diseased
Individual Animals



Identification



Monitoring for Heat
Stress with
Temperature Analysis

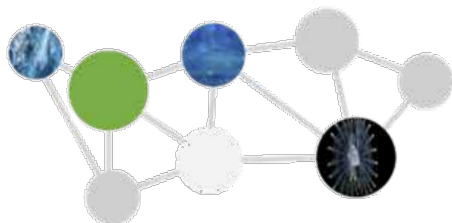


Monitoring Livestock
Vocalizations

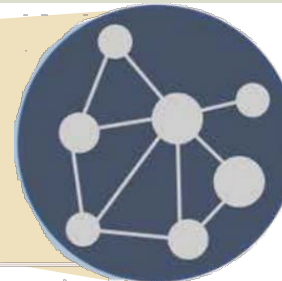


Digital Twin Approach for Ocean Life

Ocean Ecosystem



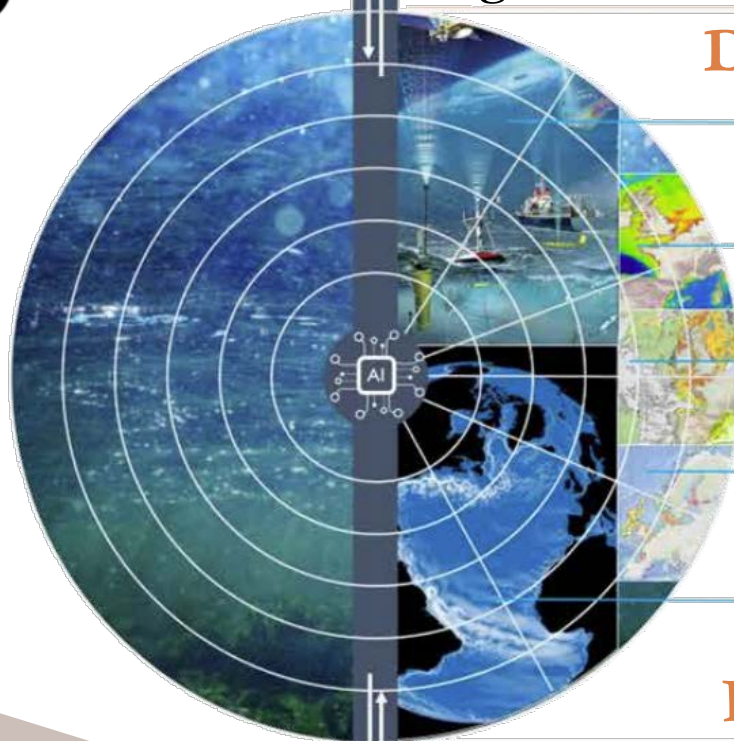
Data Sources



Public/
Private

Ocean

Digital Twin



Data Analytics

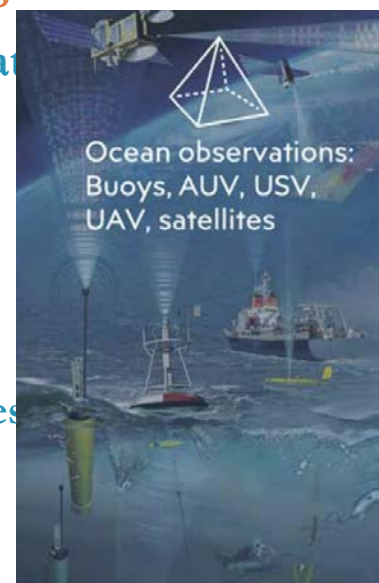
Ocean Observations

Bathymetry

Biodiversity &
Geology

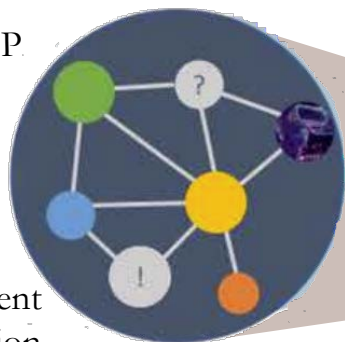
Human Activities

Ocean Models



What if?

MSP



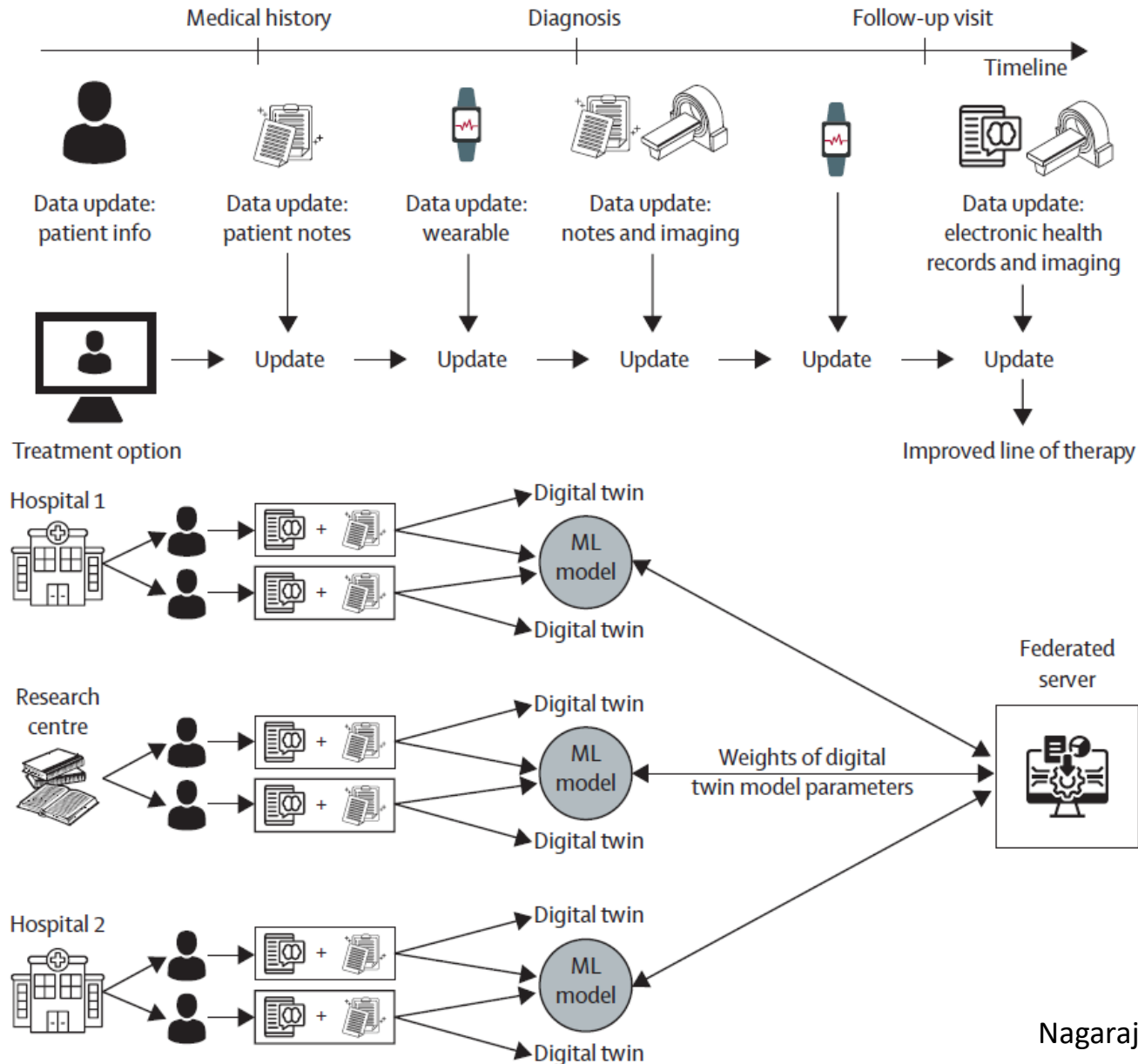
Event
Detection

Data Access



Predictions

Augmenting Digital Twins with Federated Learning in Medicine

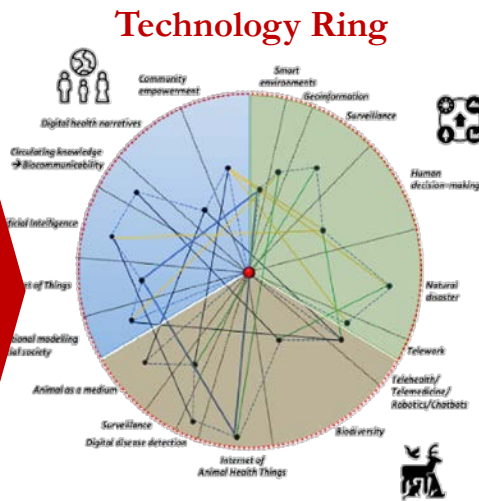


Digital Twin Approach to One Health

Physical World

Computational World

**Virtual World
(Primary/ Secondary/ Tertiary)**



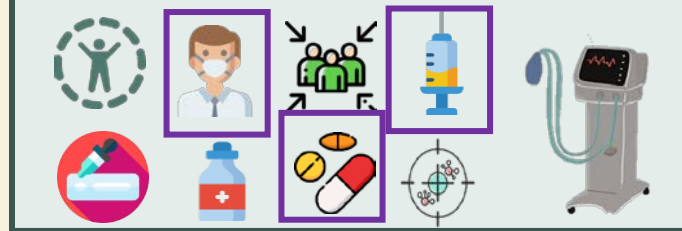
Ecosystem Prevention



Animal Prevention

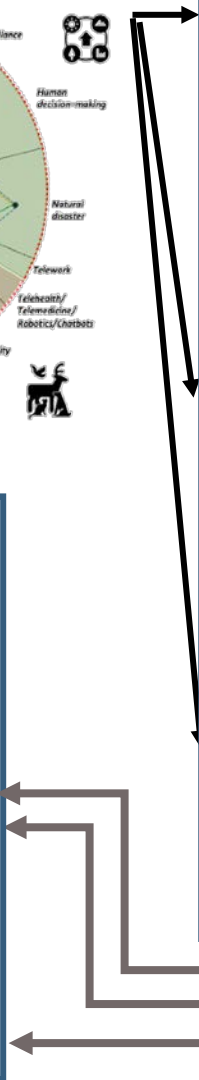


Human Prevention



One Health

Healthy Ecosystem



Health Care Industry 4.0 with FAIRER Principle in ODH

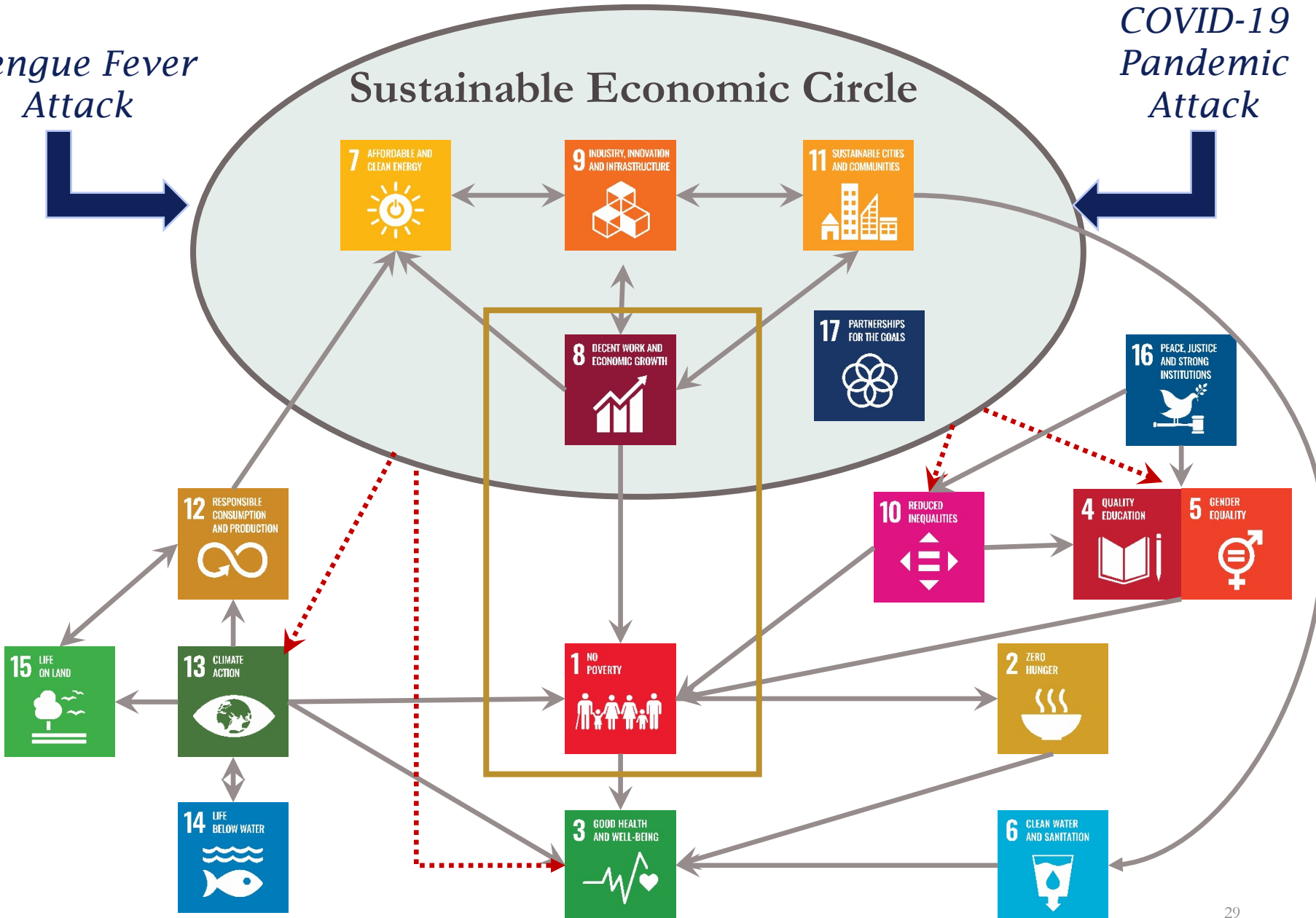
Findable, Accessible, Interoperable,
Reusable, **Ethical**, and **Revisable**

FAIRER

SDG Network Analysis for 「 Medical Poverty Trap 」 on Two Scenarios

Dengue Fever Attack

COVID-19 Pandemic Attack

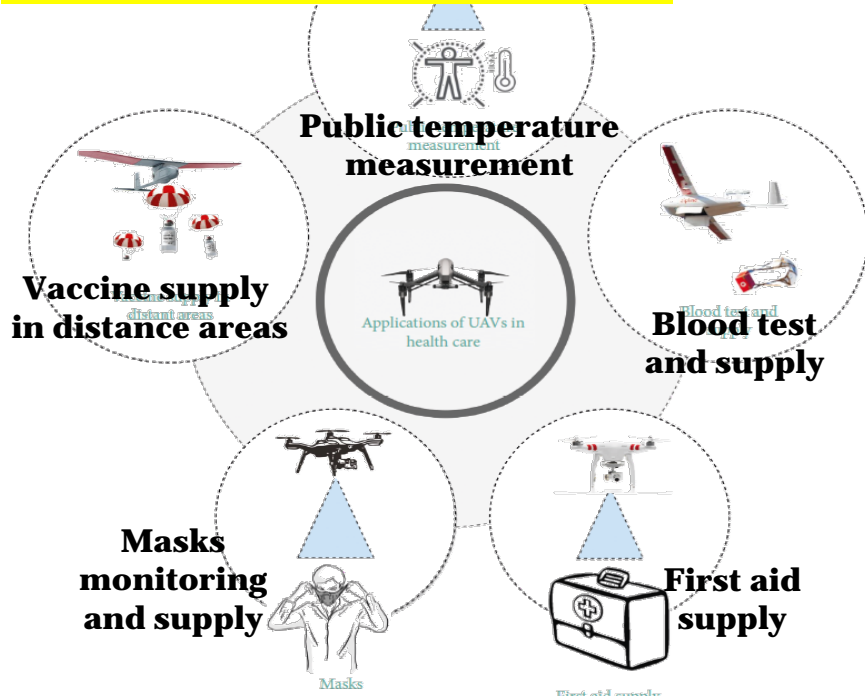


AI Drones: Health Care as Opposed to Military

Enhance Accessibility to Healthcare



Niger's Smart Vaccine Delivery



Threats to Personal Safety

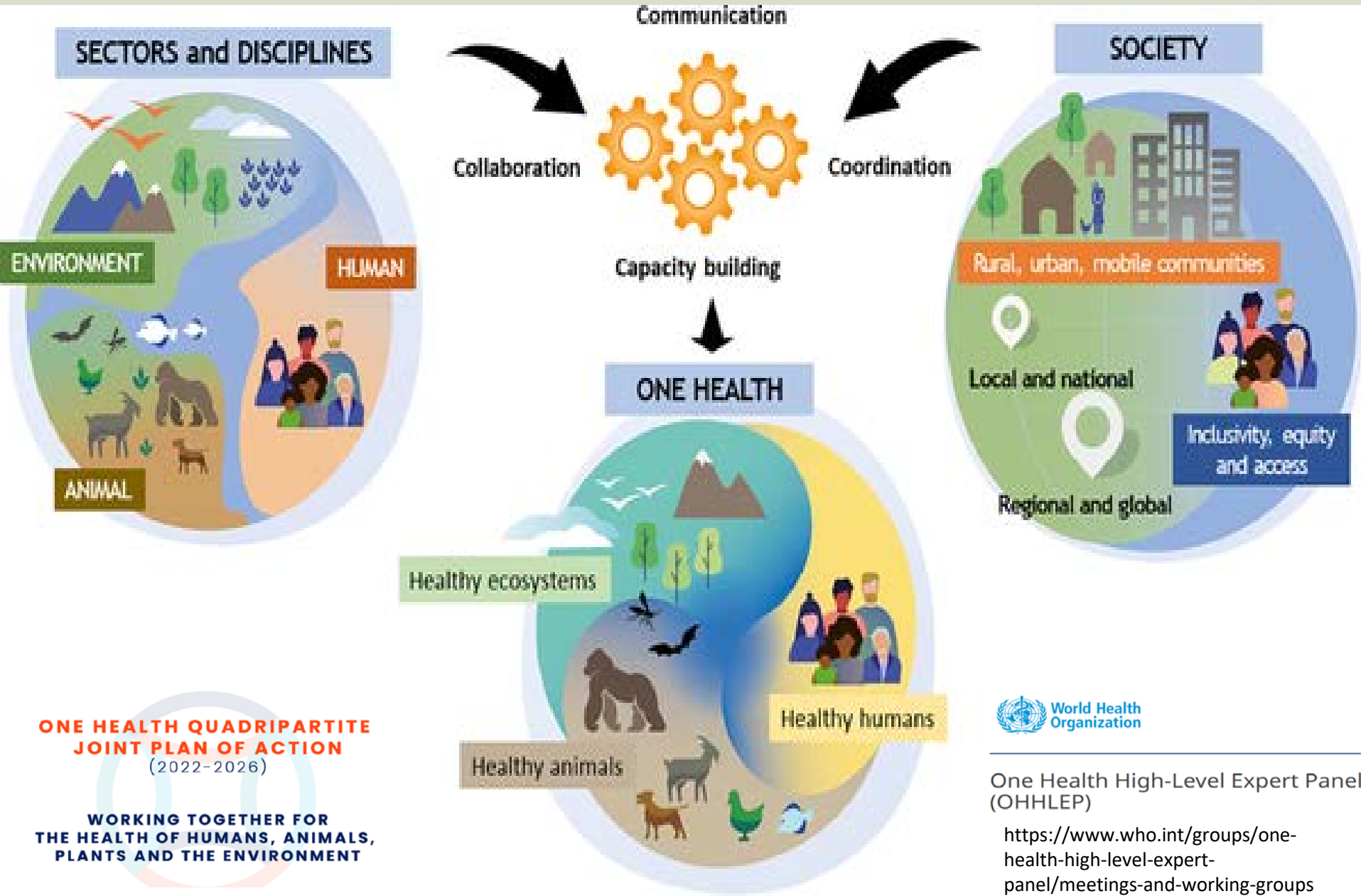


One Health Governance Index

Li et al., 2023



One Health Toward a Sustainable Healthy Future



1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



4 QUALITY EDUCATION



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



7 AFFORDABLE AND CLEAN ENERGY



8 DECENT WORK AND ECONOMIC GROWTH



9 INDUSTRY, INNOVATION AND INFRASTRUCTURE



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



14 LIFE BELOW WATER



15 LIFE ON LAND



16 PEACE, JUSTICE AND STRONG INSTITUTIONS



17 PARTNERSHIPS FOR THE GOALS



智慧健康生活圈

<https://www.realscience.top/6>



星球永續健康

<https://www.realscience.top/7>



Youtube影片

<https://reurl.cc/kaZLVd>

漢聲廣播電台生活掃描

<https://www.realscience.top/podcast>

