Innovations in Early Detection and Interventions for One Health

Michael L. Tee

Associate Professor, UP Manila

Objective

- Understand IHITM 2016-17
- Propose engineering solutions with a one health perspective

One Health: Innovations in Early Detection and Interventions in Human, Animal, and Plant Health

PCARI-IHITM-2016-17

Problem we are solving

- fragmented view on health
- silos of specialists
- signal recognition
- data mining
- data management

Universal Health Care is about…

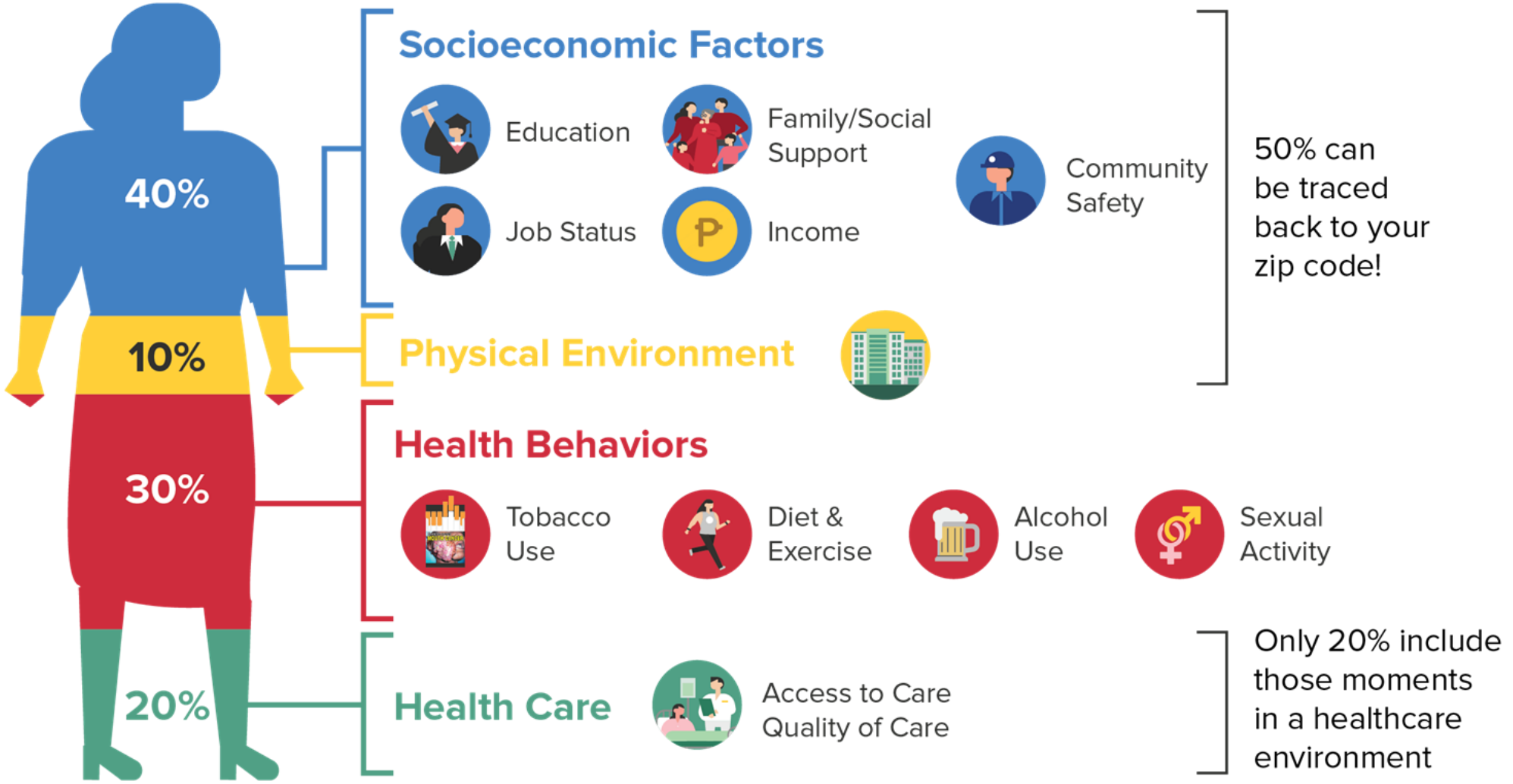
✓ healthy living, schooling & working environments

through policy, advocacy, community mobilization

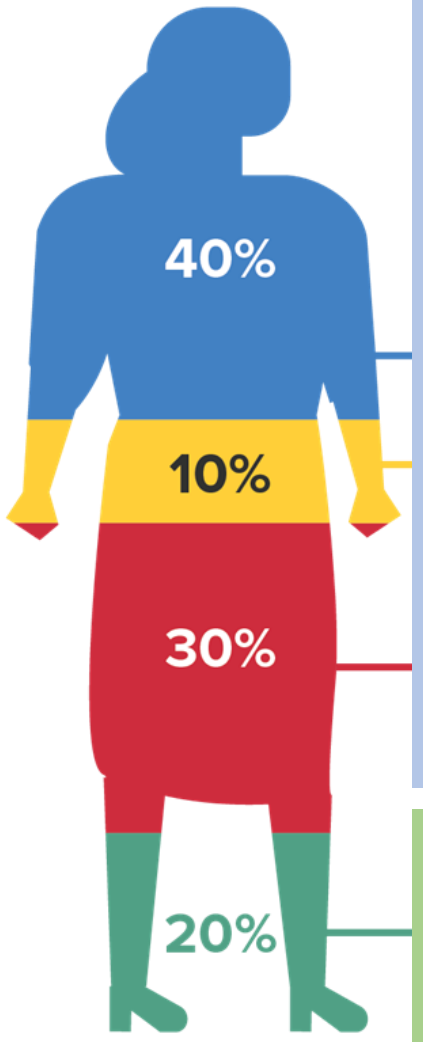
✓ primary care provider team for every family

✓ health spending is predictable, not “lahat libre”

through providers organized as INTEGRATED NETWORKS



Source: Institute for Clinical Systems Improvement, Going Beyond Clinical Walls: Solving Complete Problems (October 2014)



Keeping Filipinos *healthy & health literate*

Taking care of Filipinos *when they need it*

Source: Institute for Clinical Systems Improvement, Going Beyond Clinical Walls: Solving Complete Problems (October 2014)

Health for all: are we there yet?

PHILIPPINE SOCIETY OF PHCON PUBLIC HEALTH PHYSICIANS

THE DECLARATION OF ALMA-ATA

On 12 September 1978, at Alma-Ata in Soviet Kazakhstan, representatives of 134 nations agreed the terms of a solemn Declaration pledging urgent action by all governments, all health and development workers, and the world community to protect and promote the health of all the people of the world. The climax of a major International Conference on Primary Health Care, jointly sponsored by WHO and UNICEF, this Declaration stated:

1

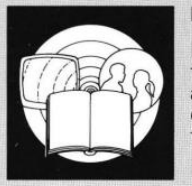
The conference strongly reaffirms that health, which is a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity, is a fundamental human right and that the attainment of the highest possible level of health is a most important world-wide social goal whose realisation requires the action of many other social and economic sectors in addition to the health sector.

2

tively in the planning and implementation of their health care.

5

Governments have a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures. A main social target of governments, international organizations and the whole world community in the coming decades should be the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and eco-



EDUCATION

Literate and informed mothers are better mothers. The same is true for fathers

FOOD AND NUTRITION

The family's food should be adequate, affordable and balanced in nutrients

WATER SANITATION

A safe water supply and clean disposal of wastes are vital

MATERNAL AND CHILD CARE

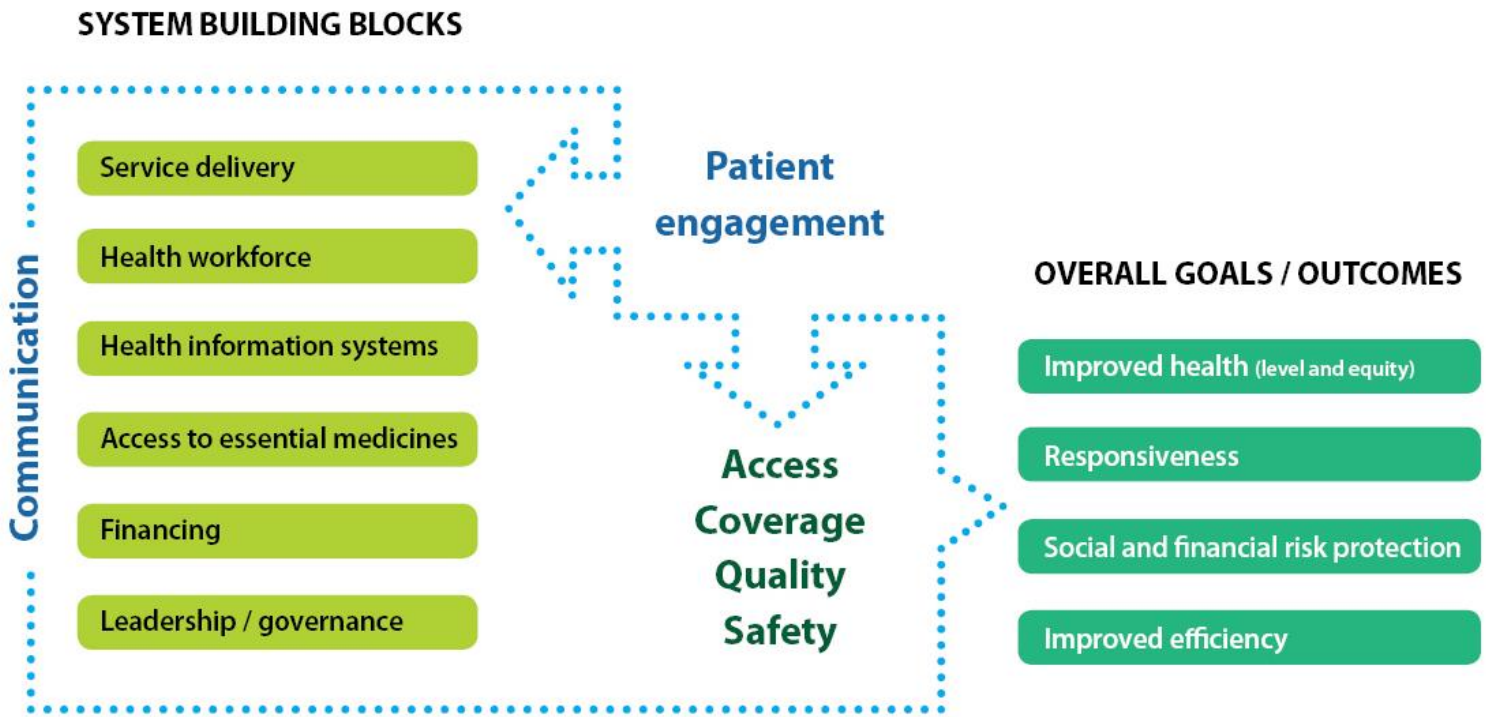
Healthy mothers are more likely to have healthy children

IMMUNIZATION

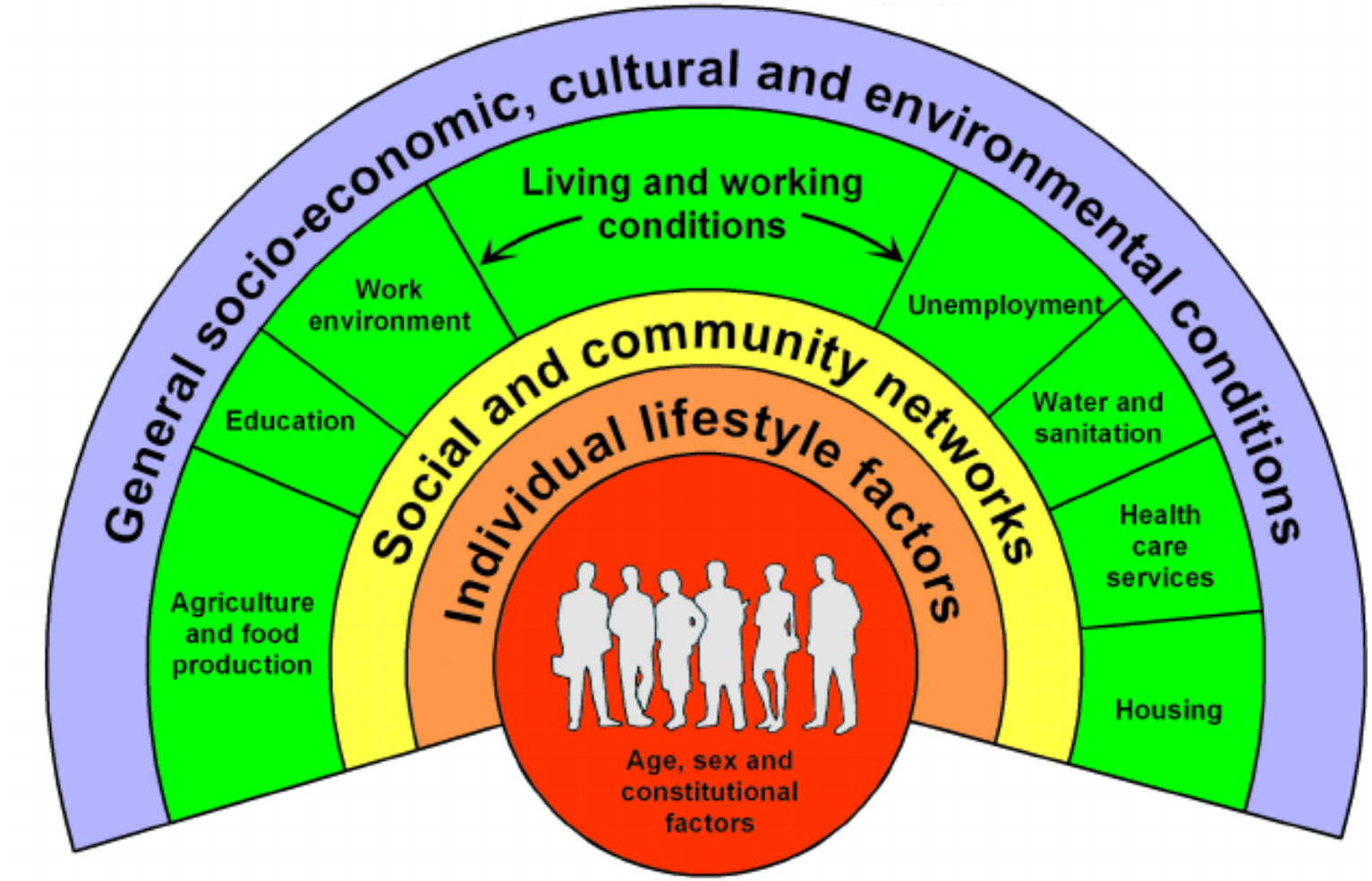
Many of the diseases that kill children by the

WHO's health system building blocks

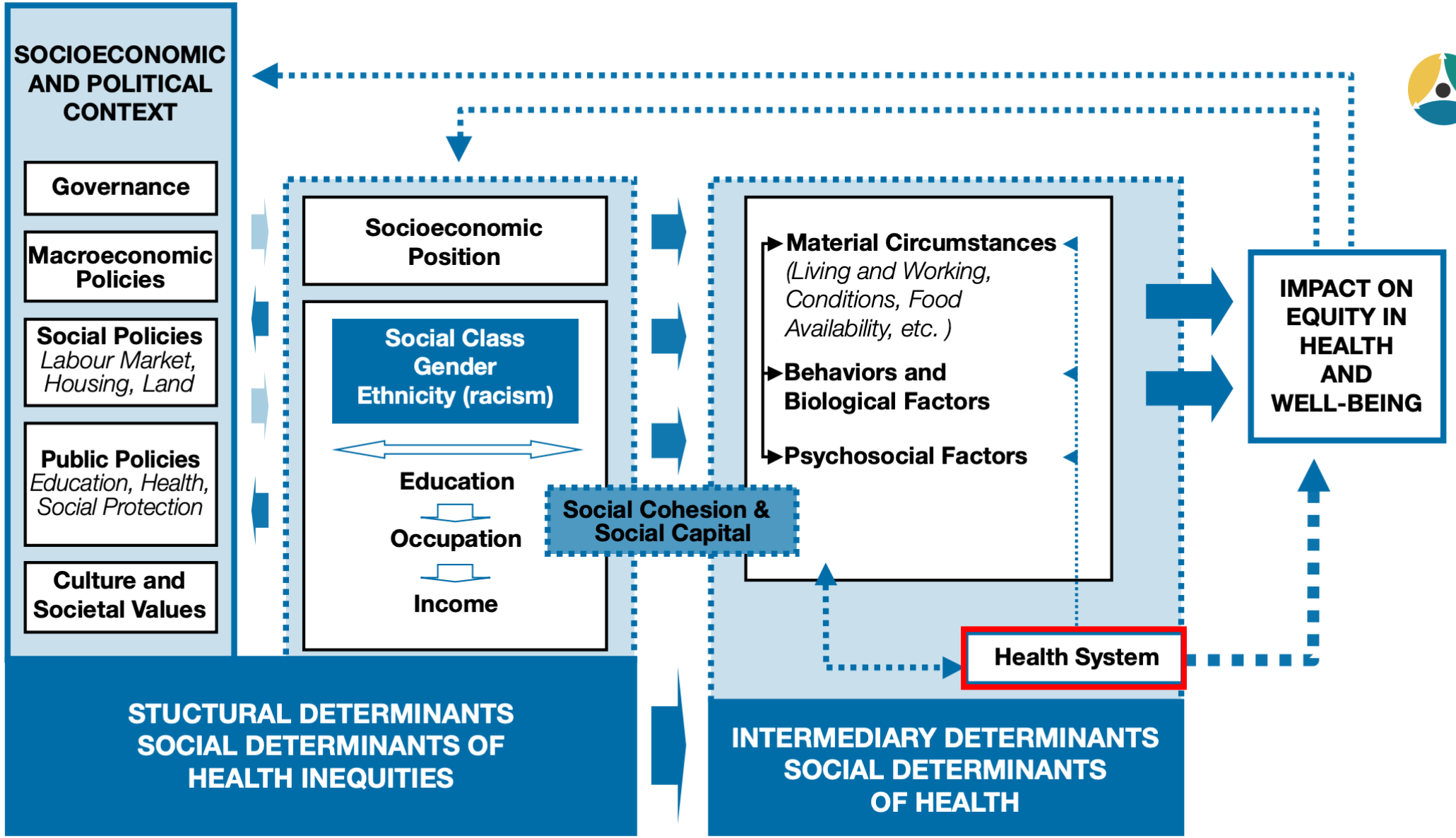
Figure 2. Proposed modified WHO Health Systems Framework



https://www.healthsystemsglobal.org/blog/9/A-new-era-for-the-WHO-health-system-building-blocks-.html
http://www.thinktankinitiative.org/file/who-health-system-framework-espng-0



Source: Dahlgren and Whitehead, 1991



Solar O, Irwin A. A conceptual framework for action on the social determinants of health. Social Determinants of Health Discussion Paper 2 (Policy and Practice).

PHILIPPINE SOCIETY OF PHCON PUBLIC HEALTH PHYSICIANS

Current situation

“ when we recognize agricultural-borne diseases and zoonotic diseases, we tend to focus only on how to cure the disease as it manifests in humans, thereby failing to address what might be the root of the problem..”

REVIEW

THE AMERICAN JOURNAL of MEDICINE®

Saturnine Gout, Redux: A Review

Sam R. Dalvi, MD,[a,b,c] Michael H. Pillinger, MD[a,b]

[a]Department of Medicine, Division of Rheumatology, NYU Hospital for Joint Diseases, New York; [b]Department of Medicine, Section of Rheumatology, New York Harbor Health Care System of the Department of Veterans Affairs, New York Campus, New York; [c]Division of Rheumatology and Immunology, Duke University Health System, Durham, NC.

Case Reports

Saturnine Gout

GEORGE E. EHRLICH, MD, AND JOHN CHOKATOS, MD, PHILADELPHIA

Summary

A middle-aged man simultaneously had lead toxicity and gout. The coincidental occurrences, as suggested in the medical literature of the past, may imply a causal relationship. Chelation was able to remove the lead stored in the body, but uricosuric therapy was ultimately required to maintain lowered serum urate levels.

Harry Heller, MD, suggested the explanation in the legend of the Figure.

Heavy Metals

Published in final edited form as:
EXS. 2012 ; 101: 133–164. doi:10.1007/978-3-7643-8340-4_6.

Heavy Metals Toxicity and the Environment

Paul B Tchounwou[*], **Clement G Yedjou**, **Anita K Patlolla**, and **Dwayne J Sutton**
NIH-RCMI Center for Environmental Health, College of Science, Engineering and Technology, Jackson State University, 1400 Lynch Street, Box 18750, Jackson, MS 39217, USA

- Arsenic, cadmium, chromium, lead, and mercury rank among the priority metals that are of public health significance.
- These metallic elements are considered systemic toxicants that are known to induce multiple organ damage, even at lower levels of exposure.

MONITORING APPLICATION FOR FARMER'S PESTICIDE USE IN THE PHILIPPINES

INTRODUCTION

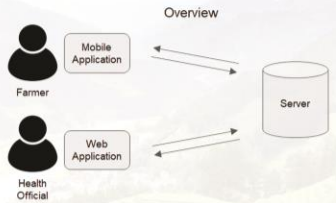
Pesticide Use and its Effect on Farmer Health

- Pesticides tend to get overused in the Philippines
- Effect of pesticides on farmers are less studied compared to its effect on the plants.
- Health risks to farmers affects productivity

Quantified Self-Tracking Applications when it comes to farmer health

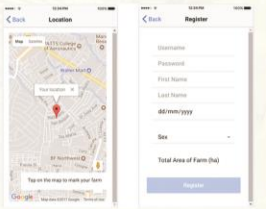
- Farmers are provided easy access to monitor information about their health, as well as track environmental data (pesticides activity) that may be affecting their health.
- Health Officials are provided data on farmers health with relation to chemical exposure proactively, warning officials of farmers with chances of having chronic chemical poisoning.

CONCEPT AND DESIGN



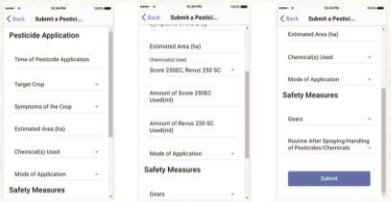
Information gathered about the farm

- Location
- Total Area
- Age
- Sex



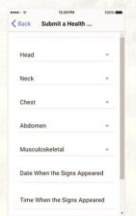
Information gathered about the Application of Pesticides

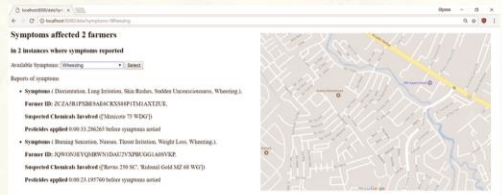
- Target crop
- Target pests or symptoms
- Chemical(s) used
- Dosage of each chemical used (in mL)



Important Information in Health Concerns

- Signs noticed
  - Head includes Eye and nose irritation, Nausea and Headaches
  - Neck includes Throat irritation and swelling, and Lymph node
  - Chest includes Skin rashes and Coughing and Difficulty breathing
  - Abdomen includes Diarrhea and Urine problems





CONCLUSION

We have designed a self-tracking application for farmers to monitor their health in relation to their application of pesticides.

Health professionals are able to access demographic data on health reports submitted by farmers through a separate web application.

Data analytics on farmer health and pesticide usage is important in tracking and monitoring effects of pesticide use and practices.

J. Caro, M. L. Tee, E. A. Aguilar, M. Y. Benedicto, J. H. Catipay, M. Garcia, K. O. Shirabe
University of the Philippines

EYERICE: A MOBILE APP THAT IDENTIFIES RICE DISEASES USING DEEP CONVOLUTIONAL NEURAL NETWORK

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Davao City, Philippines

ABSTRACT

Diseases have enormous impact to the production of rice every year. Untimely and misidentification of the disease leads to some incorrect control measurements. This study enables farmers to identify common rice disease through Eyerice application via android phones using a powerful images processing, artificial intelligence that uses deep learning called Convolutional Neural Networks. We exhibit datasets augmentation techniques and fine tuning the model by adjusting the hyperparameter to get the best result despite the many constraints in mobile vision applications.

MICROBIAL ANALYSIS OF STREET FOOD SOLD NEAR QUEZON CITY PUBLIC SCHOOLS

Frederick Samonte
Laya Dela Pena
Jarod De Luna
Bea Medina
Michael Tee Jr.
University of the Philippines Integrated School, Philippines

ABSTRACT

Street food plays an important socioeconomic role in the Philippines and in other developing countries due to its affordability and accessibility (Bernad & Fernandez, 2002). However, multiple studies and researches have shown how street food in the Philippines are sources of foodborne diseases due to unsatisfactory levels of microbial contamination and improper food handling practices of the vendors (Azanza, 2004; Barcelon et al., 2015). The present study aimed to find out if the street food sold by vendors near Quezon City public schools have safe and acceptable microbial levels. For the study, four of the most common cooked street food were chosen to be the samples: kwek-kwek, fishball, flour-based sauce, and vinegar sauce. These were then collected from two different sites within Quezon City: along Batasang Pambansa Road and inside the UP Diliman Campus. Microbial tests, specifically aerobic plate count, total coliform and Escherichia coli count, and Staphylococcus aureus! count, were all done using 3M Petrifilms. The microbial counts were then compared to microbiological guidelines for food safety and further supported by an observational food handling checklist. The results show that the samples have a negative presence of Escherichia coli and Staphylococcus aureus, which means that the food samples are safe from the effects of these specific microbes. However, the results also indicate that the samples have unsatisfactory levels of aerobic bacteria and coliforms, implying the presence of other harmful microbes. In conclusion, the street food samples collected are generally safe for consumption. More studies should be conducted to determine other types of bacteria that are able to thrive in street food, and if these microbes are also potentially harmful. Additionally, future studies are recommended to observe the food handling techniques of the vendors since these might explain why the levels of coliforms and aerobic bacteria are high. Las! tly, local government units should properly screen and test the products of street vendors before giving them business certificates.

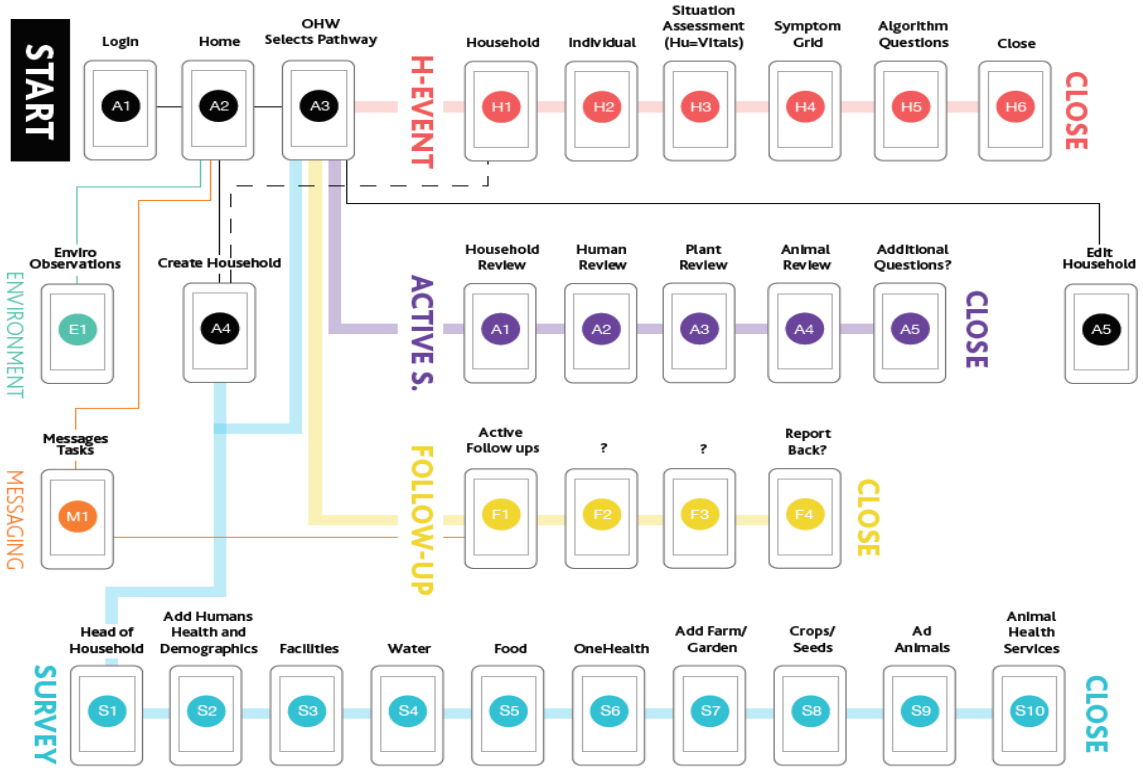
PCARI-IHITM-2016-17

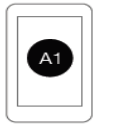
- Barangay One Health Worker (OHW)
- One Health (OH) APP tool in a smart device
- Integrate multi-sectoral health solutions across the human, animal, and environment/ plant domains.

App Snap Shot One Health Philippines

After OHW selects household they then choose a forced Path

HEALTHS EVENT • ACTIVE SURVEILLANCE • FOLLOW UP • SURVEY • EDIT HOUSEHOLD





Login Screen
Forgot Password

Home Screen

Functions include:
- Household search
- Add Household
- Access to
  - Environmental Observation Page
  - Messaging Page

OHW Selects Pathways

1. Healths Event
2. Active Surveillance
3. Follow up
4. Complete Survey
5. Edit Household

Create Household

Collect Head of household informa-tion

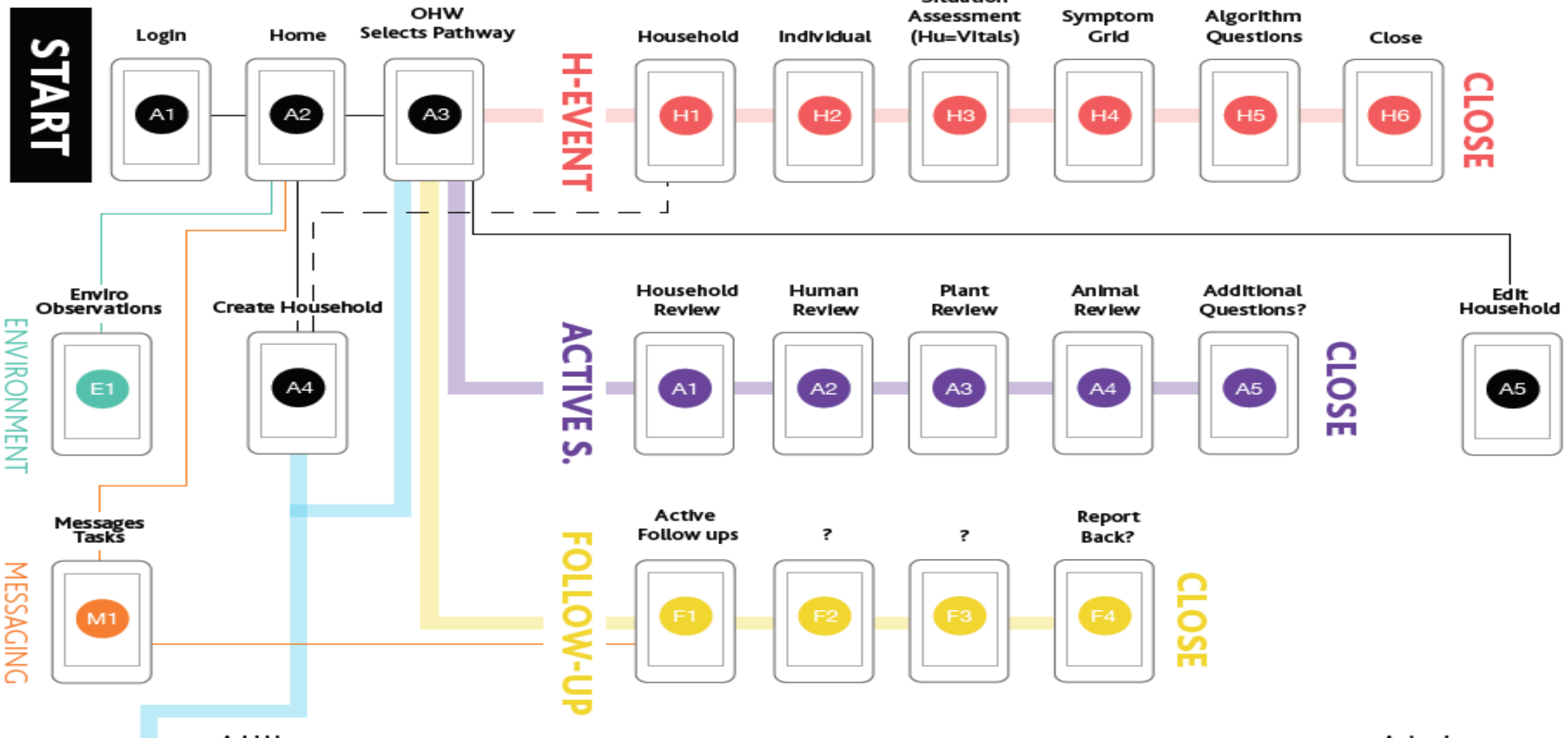
Edit Household

1. Change Address
2. Death
3. Birth

App Snap Shot One Health Philippines

After OHW selects household they then choose a forced Path

HEALTHS EVENT • ACTIVE SURVEILLANCE • FOLLOW UP • SURVEY • EDIT HOUSEHOLD



Data Visualization for One Health

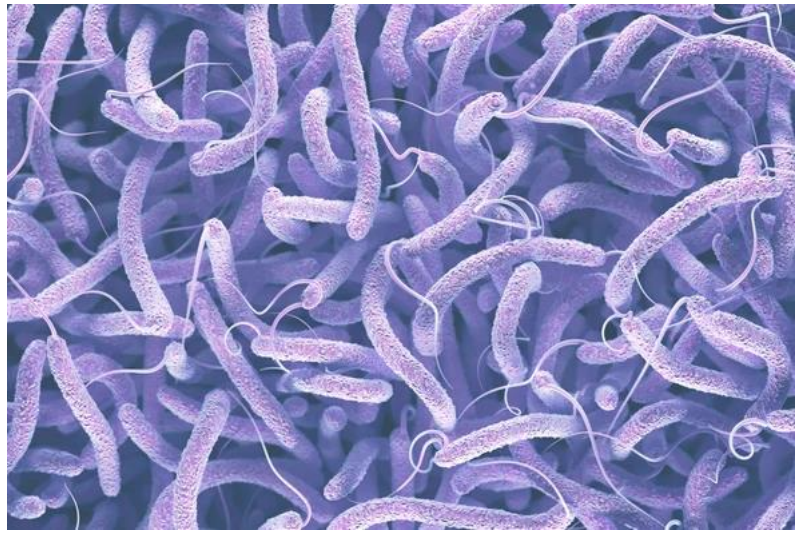
Data Management

Big Data

Data Analytics and Business Intelligence (BI)

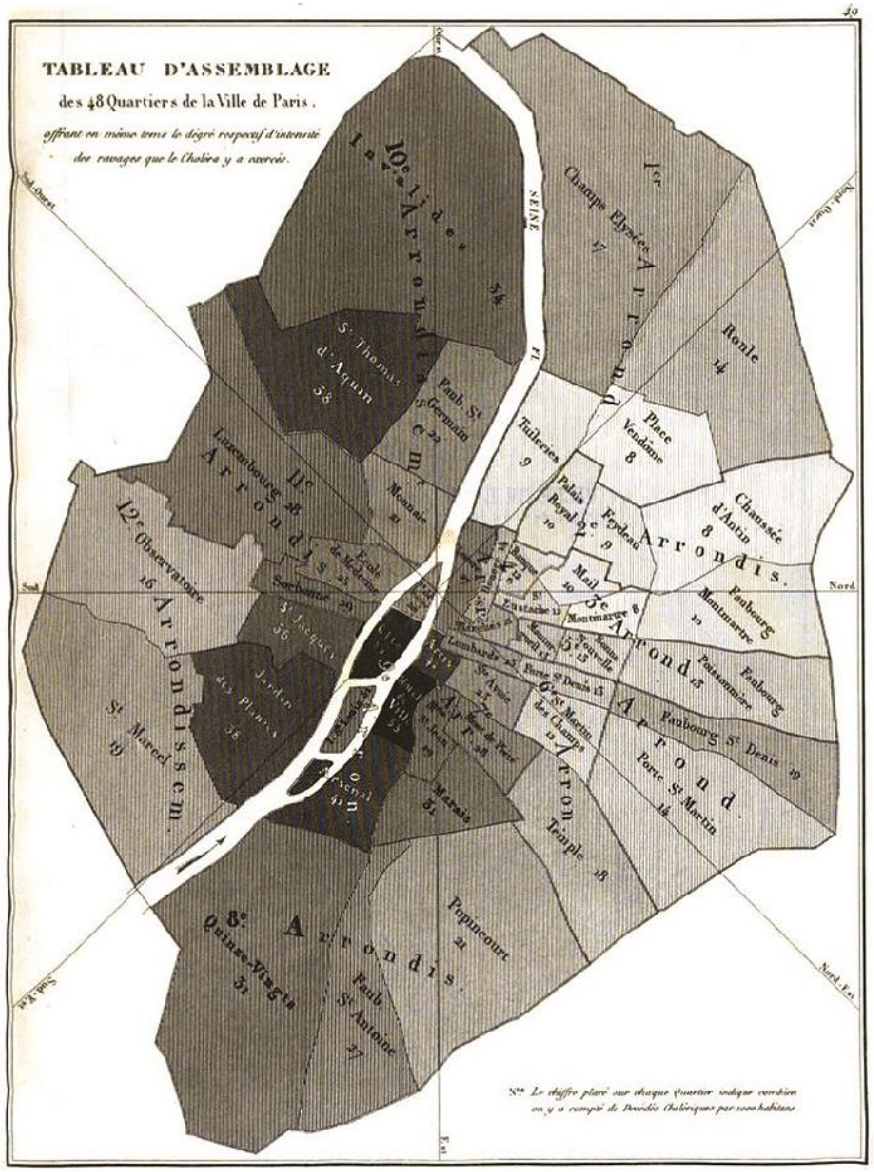
Data Visualization

Cholera in New York in the 1800s

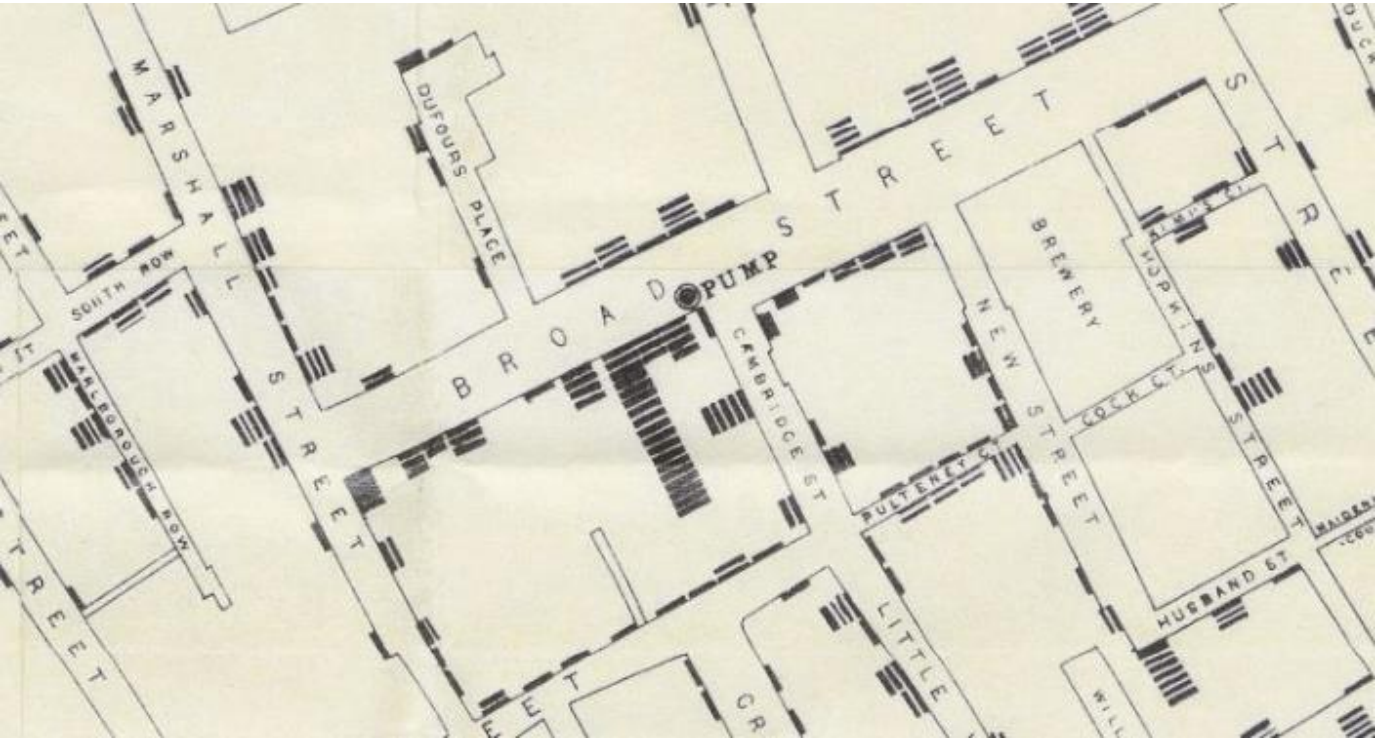


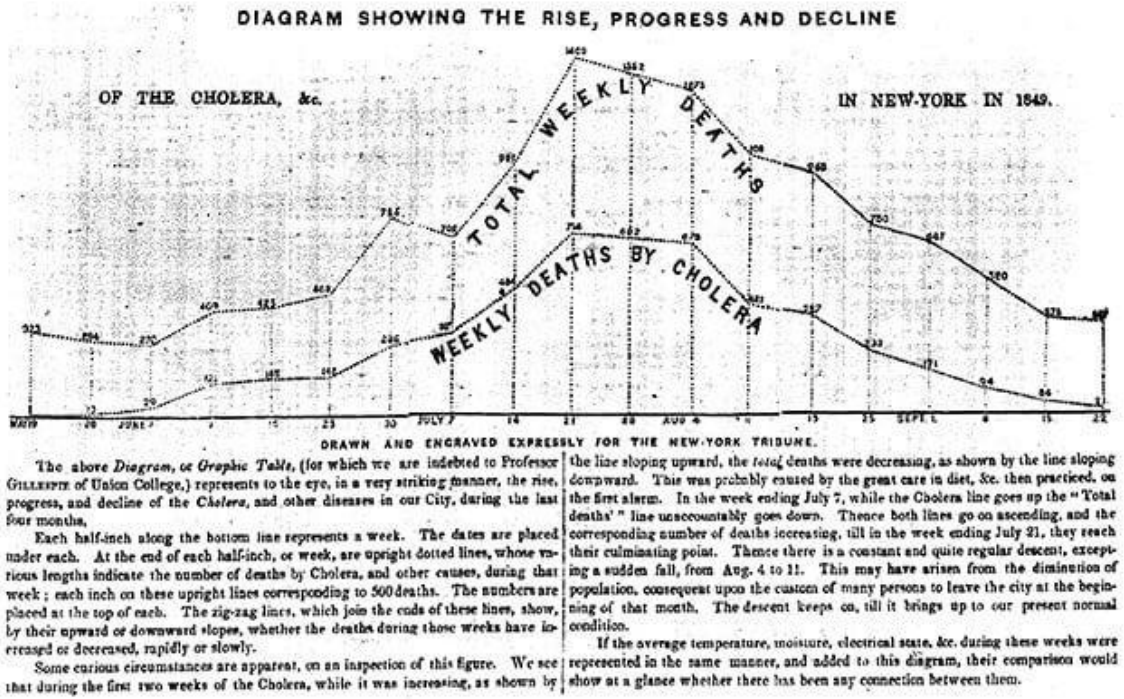
- 1800's, cholera deaths.
- disease was spreading but found it difficult to track.
- Data visualization used to know how the cholera epidemic was spreading.
- A map of the area was combined with data of the locations of cholera outbreaks.

Cholera Heat Map of Paris in 1830s



Data Visualization of Cholera in New York in the 1840s



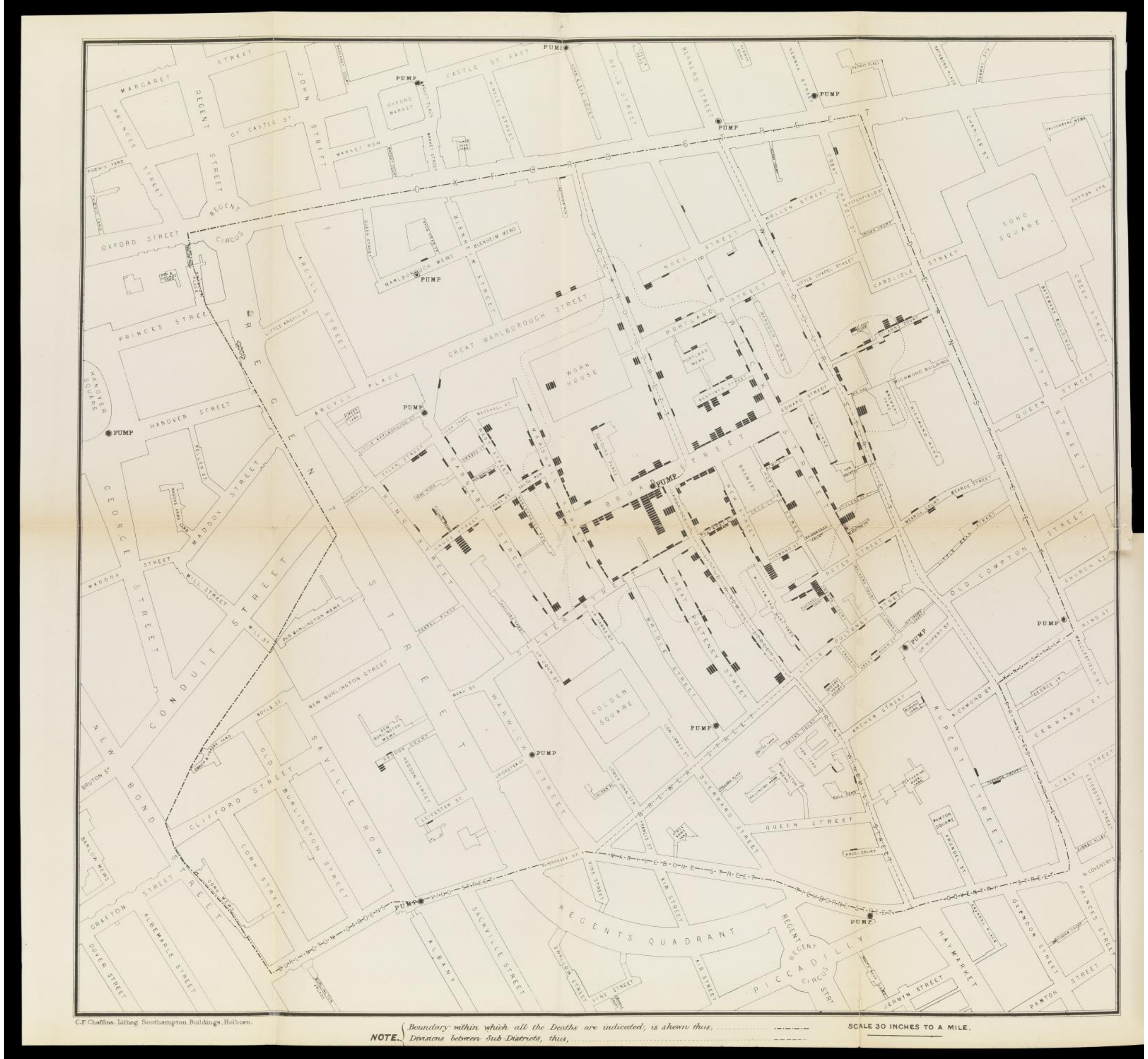


The above *Diagram*, or *Graphic Table*, (for which we are indebted to Professor GILLESPIE of Union College,) represents to the eye, in a very striking manner, the rise, progress, and decline of the *Cholera*, and other diseases in our City, during the last four months.

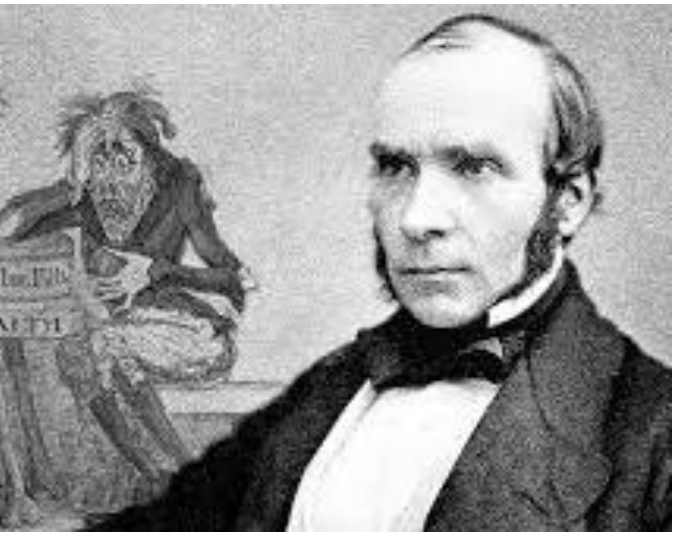
Each half-inch along the bottom line represents a week. The dates are placed under each. At the end of each half-inch, or week, are upright dotted lines, whose various lengths indicate the number of deaths by Cholera, and other causes, during that week; each inch on these upright lines corresponding to 500 deaths. The numbers are placed at the top of each. The zig-zag lines, which join the ends of these lines, show, by their upward or downward slopes, whether the deaths during those weeks have increased or decreased, rapidly or slowly.

Some curious circumstances are apparent, on an inspection of this figure. We see that during the first two weeks of the Cholera, while it was increasing, as shown by the line sloping upward, the *total* deaths were decreasing, as shown by the line sloping downward. This was probably caused by the great care in diet, &c. then practiced, on the first alarm. In the week ending July 7, while the Cholera line goes up the "Total deaths'" line unaccountably goes down. Thence both lines go on ascending, and the corresponding number of deaths increasing, till in the week ending July 21, they reach their culminating point. Thence there is a constant and quite regular descent, excepting a sudden fall, from Aug. 4 to 11. This may have arisen from the diminution of population, consequent upon the custom of many persons to leave the city at the beginning of that month. The descent keeps on, till it brings up to our present normal condition.

If the average temperature, moisture, electrical state, &c. during these weeks were represented in the same manner, and added to this diagram, their comparison would show at a glance whether there has been any connection between them.


OXFORD STREET
REGENT CIRCUS
PRINCES STREET
HANOVER SQUARE
HANOVER STREET
GEORGE STREET
MADDOX STREET
CONDUIT STREET
NEW BOND STREET
BRUTON ST.
REGENT STREET
GREAT MARLBOROUGH STREET
ARGYLL STREET
ARGYLL PLACE
MARLBOROUGH MEWS
WORK HOUSE
BROAD STREET
PORTLAND MEWS
BERWICK STREET
NOEL STREET
WARDOUR STREET
SOHO SQUARE
FRITH STREET
GREEK STREET
DEAN STREET
OLD COMPTON STREET
CHURCH STREET
QUEEN STREET
GERRARD STREET
RUPERT STREET
PRINCES STREET
GOLDEN SQUARE
WARWICK STREET
SAVILLE ROW
OLD BURLINGTON STREET
NEW BURLINGTON STREET
CLIFFORD STREET
CORK STREET
KING STREET
SILVER STREET
BREWER STREET
GREAT PULTENEY STREET
BRIDLE STREET
LITTLE PULTENEY STREET
ARCHER STREET
WINDMILL STREET
QUEEN STREET
SHERRARD STREET
REGENTS QUADRANT
PICCADILLY
REGENT CIRCUS
HAYMARKET
JERMYN STREET
SACKVILLE STREET
ALBANY
AIR STREET
VINE STREET
SWALLOW STREET
ALBEMARLE STREET
DOVER STREET
GRAFTON STREET
PANTON SQUARE
PANTON STREET
OXENDON STREET
COVENTRY STREET
CASTLE ST. EAST
MARGARET STREET
JOHN STREET
OXFORD MARKET
CARLISLE STREET
RICHMOND BUILDINGS
PUMP
C.F. Cheffins, Lithog. Southampton Buildings, Holborn.
NOTE. Boundary within which all the Deaths are indicated, is shown thus,
Divisions between Sub Districts, thus,
SCALE 30 INCHES TO A MILE.

Data Visualization in the 1800s

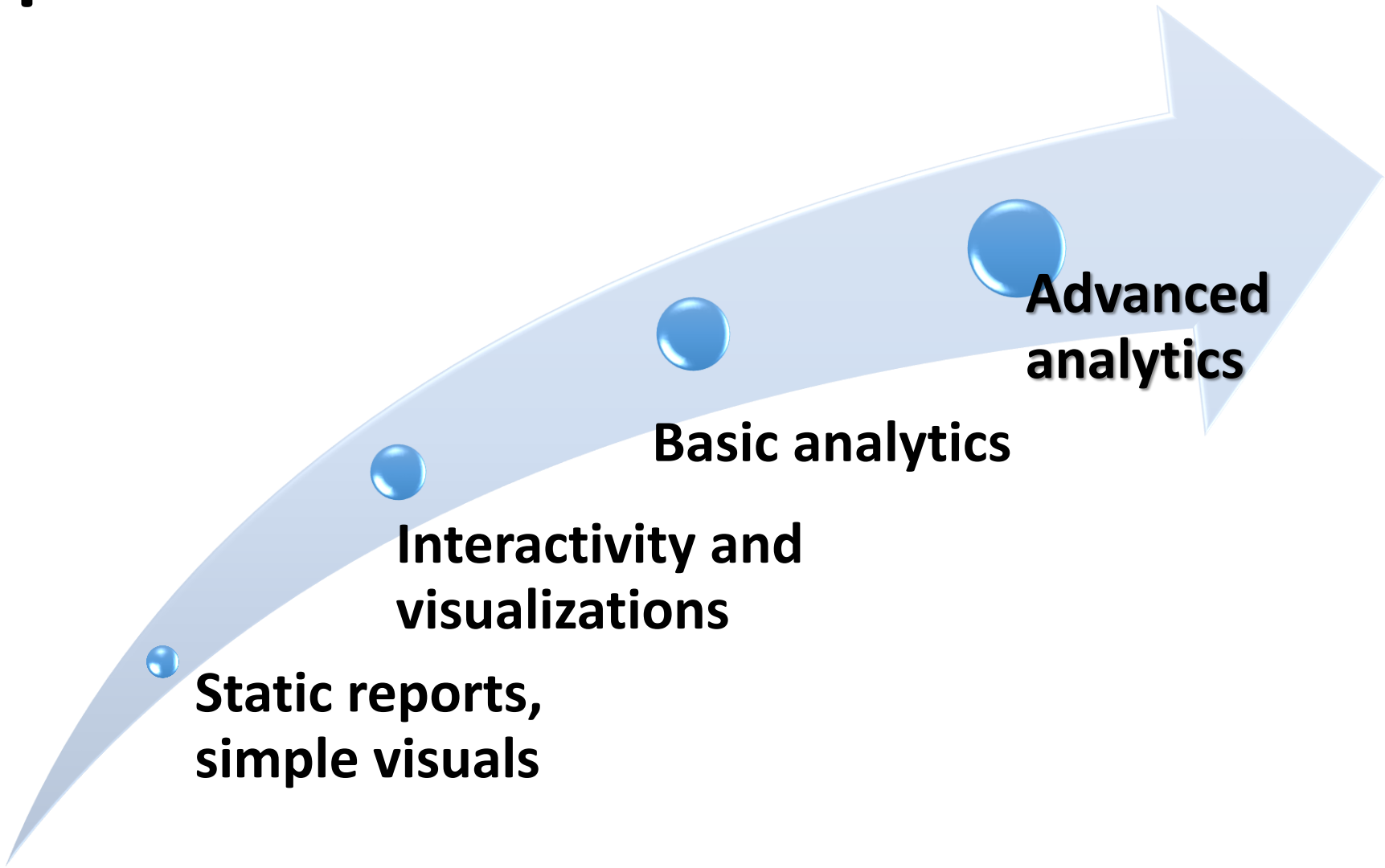


- Outbreaks were clustered around water sources, and the public informed.
- Not only were they able to convey the gravity of the death toll, but they accurately identified how cholera spread: via water.
- It was the game changer they needed and we still use it today.

https://yorkcivictrust.co.uk/event/famous-people-of-north-street-and-skeldergate/

Data Management

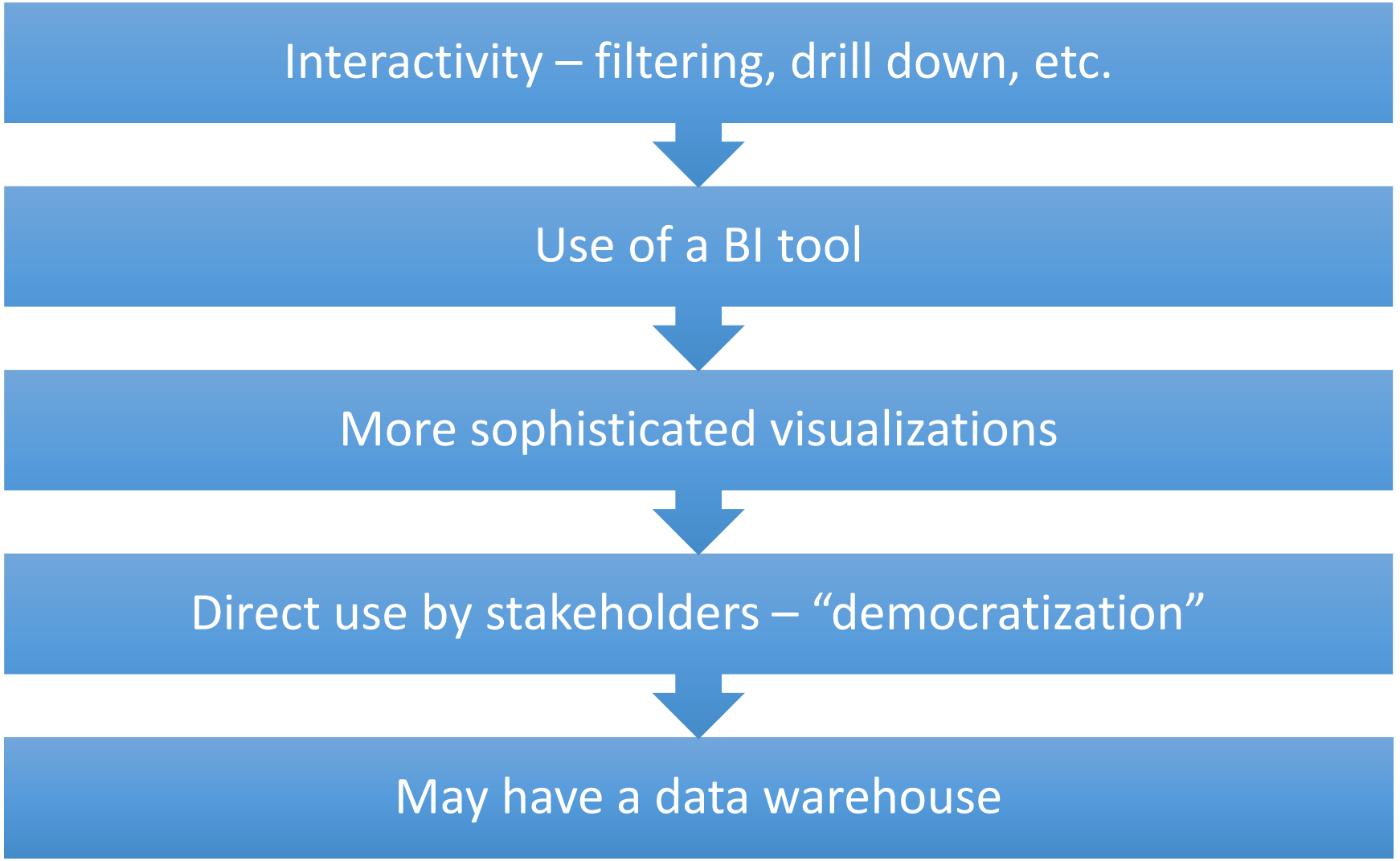
BI Spectrum


Advanced analytics
Basic analytics
Interactivity and visualizations
Static reports, simple visuals

Static Reports

- Printed reports or spreadsheets
- Heavy reliance on IT staff
- Often minimal policies and standards
- May have a centralized reporting office
- No data warehouse

Interactivity

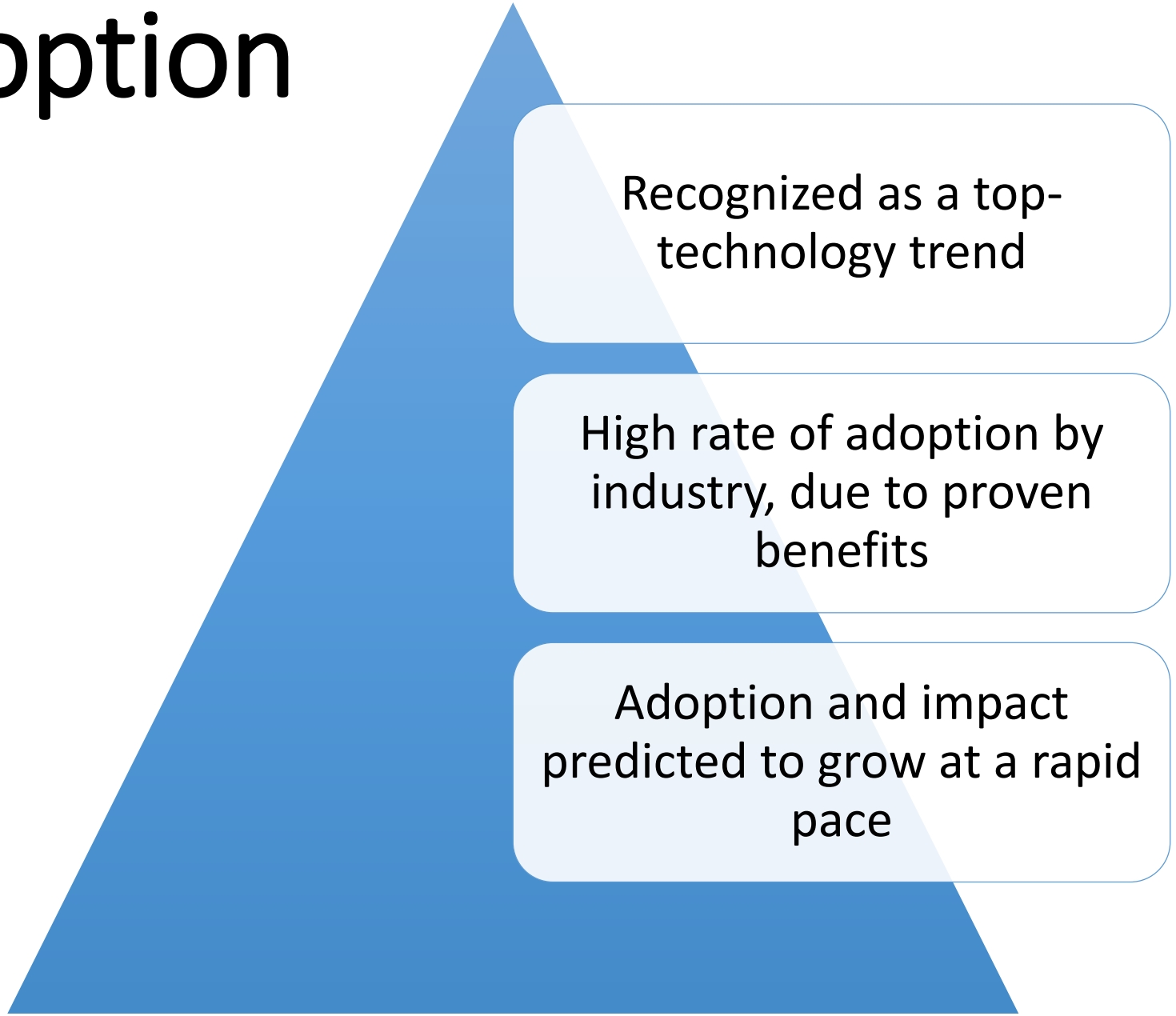


Basic Analytics

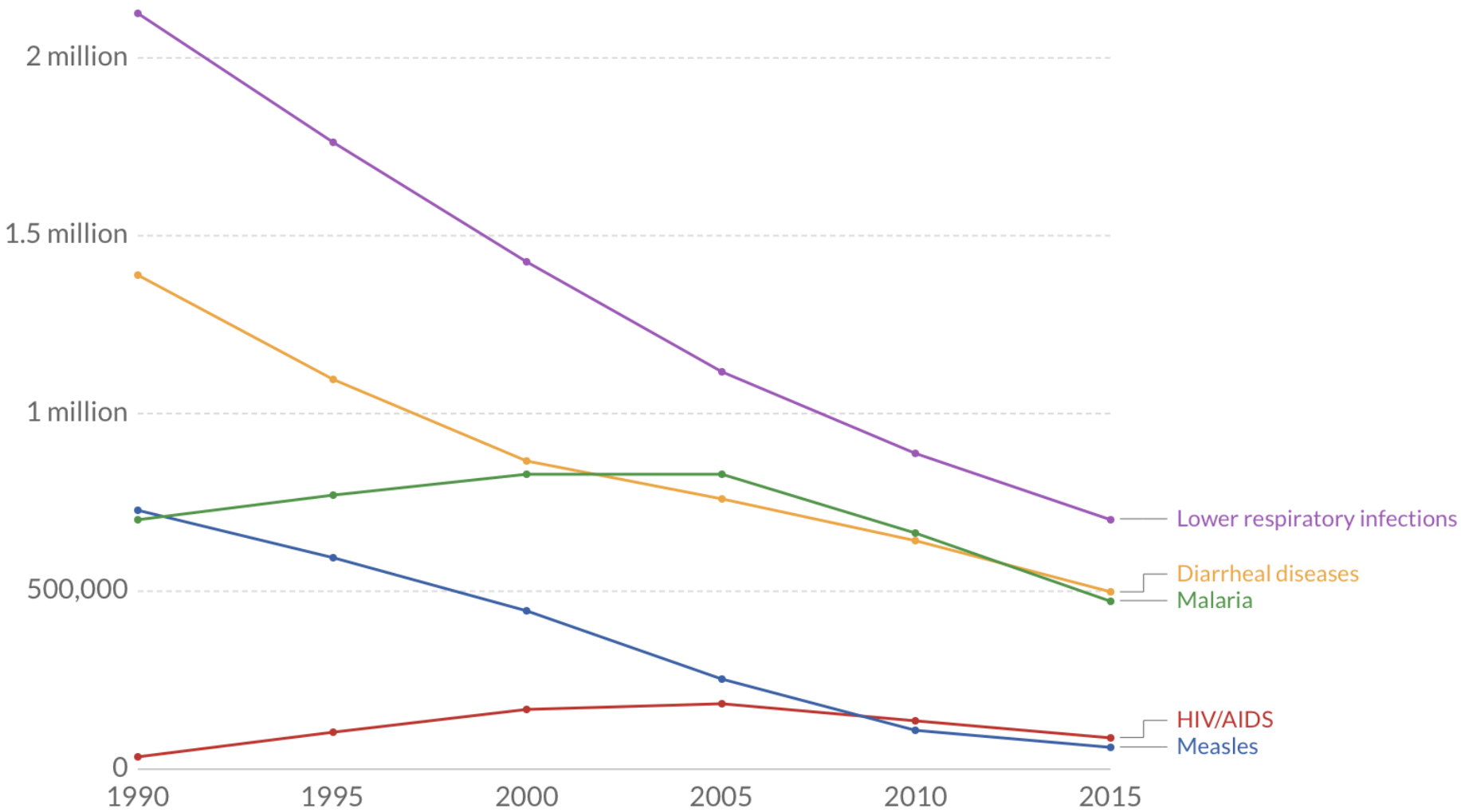
Advanced Analytics

- VVV- Volume, Variety, Velocity
- Big data
- Structured and unstructured data
- Real-time data
- Predictive, prescriptive analytics
- Mobile

BI Adoption

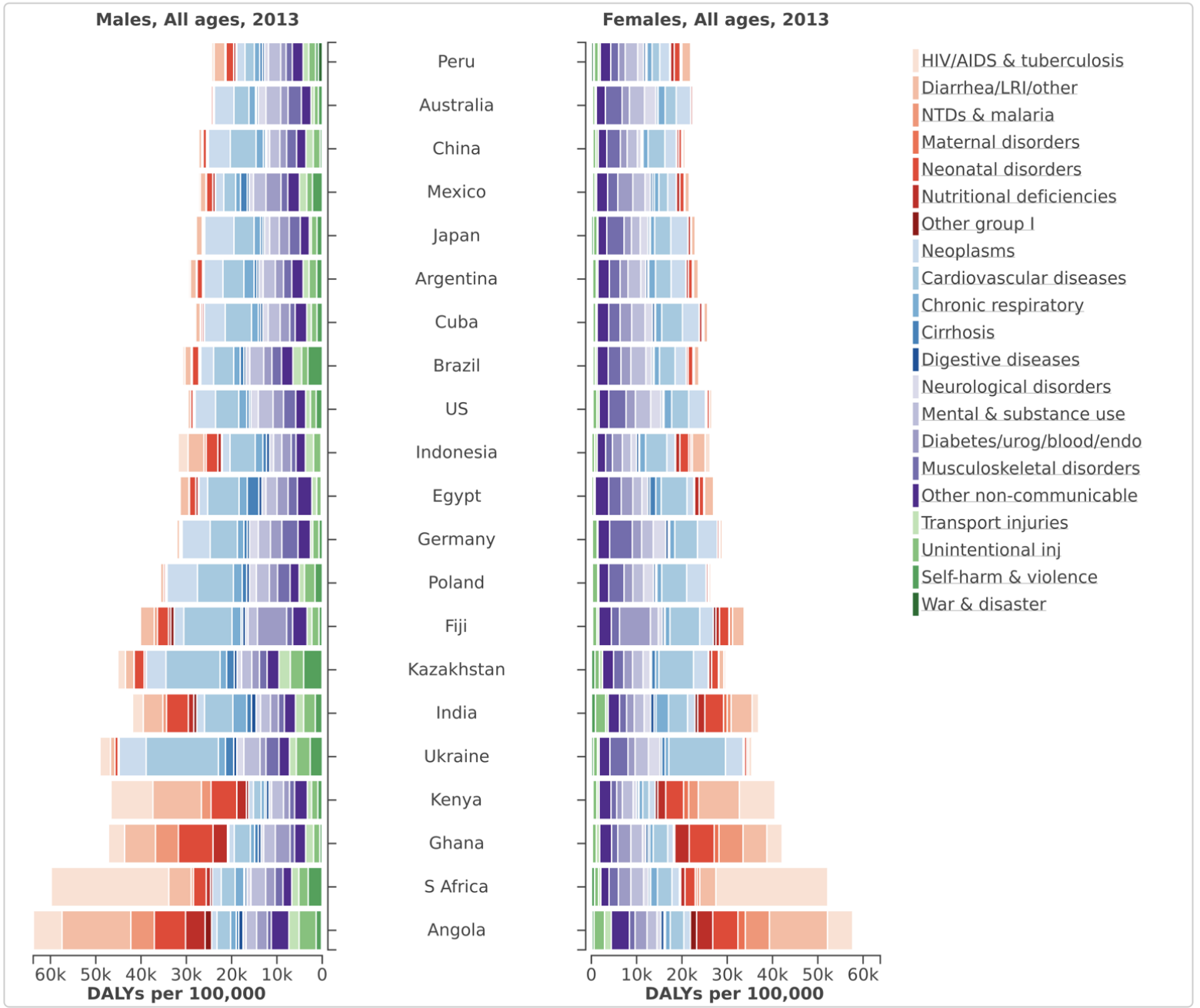

Recognized as a top-technology trend
High rate of adoption by industry, due to proven benefits
Adoption and impact predicted to grow at a rapid pace

Childhood deaths from the five most lethal infectious diseases worldwide

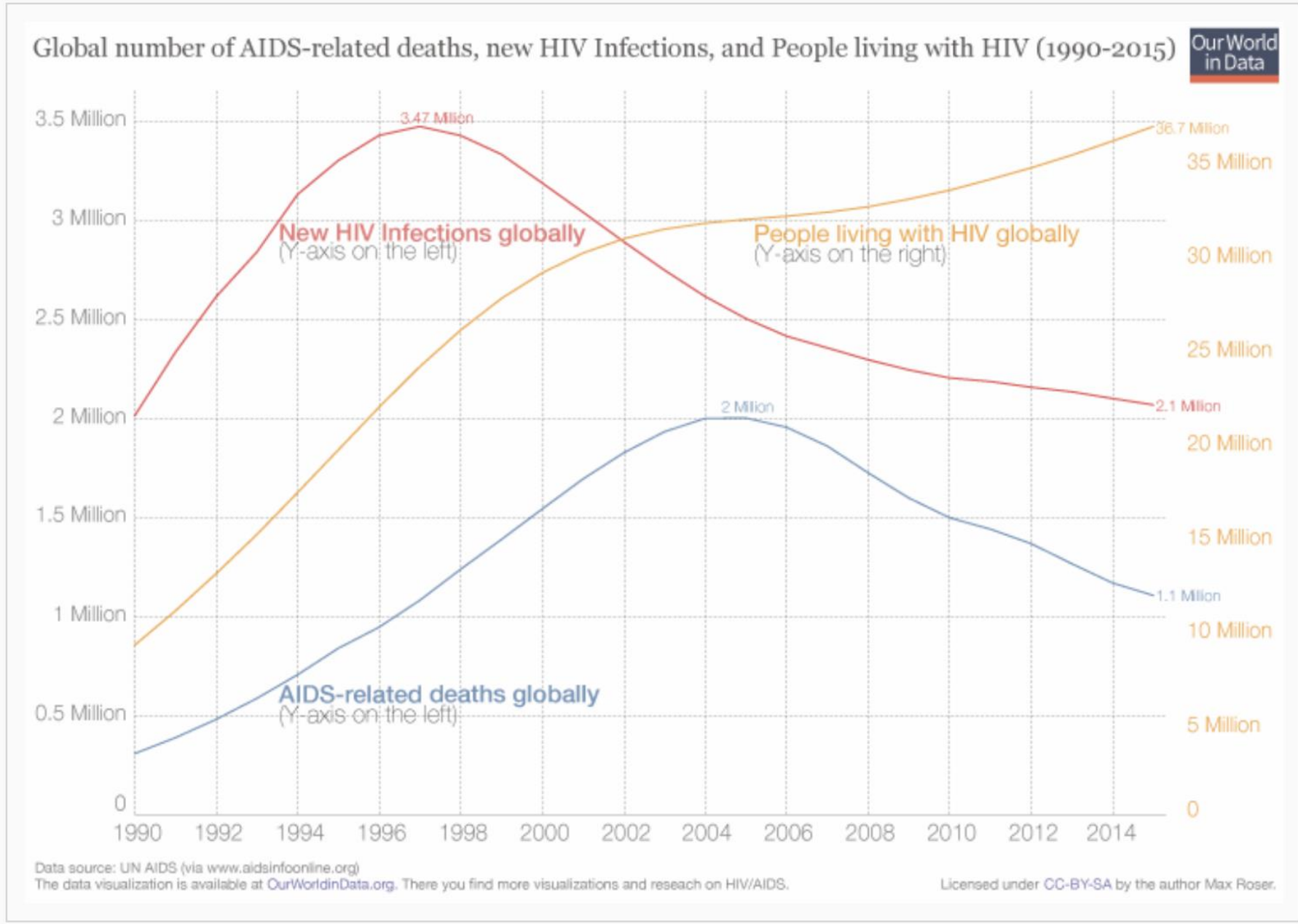


Source: IHME Global Burden of Disease (child deaths by disease) (2017)

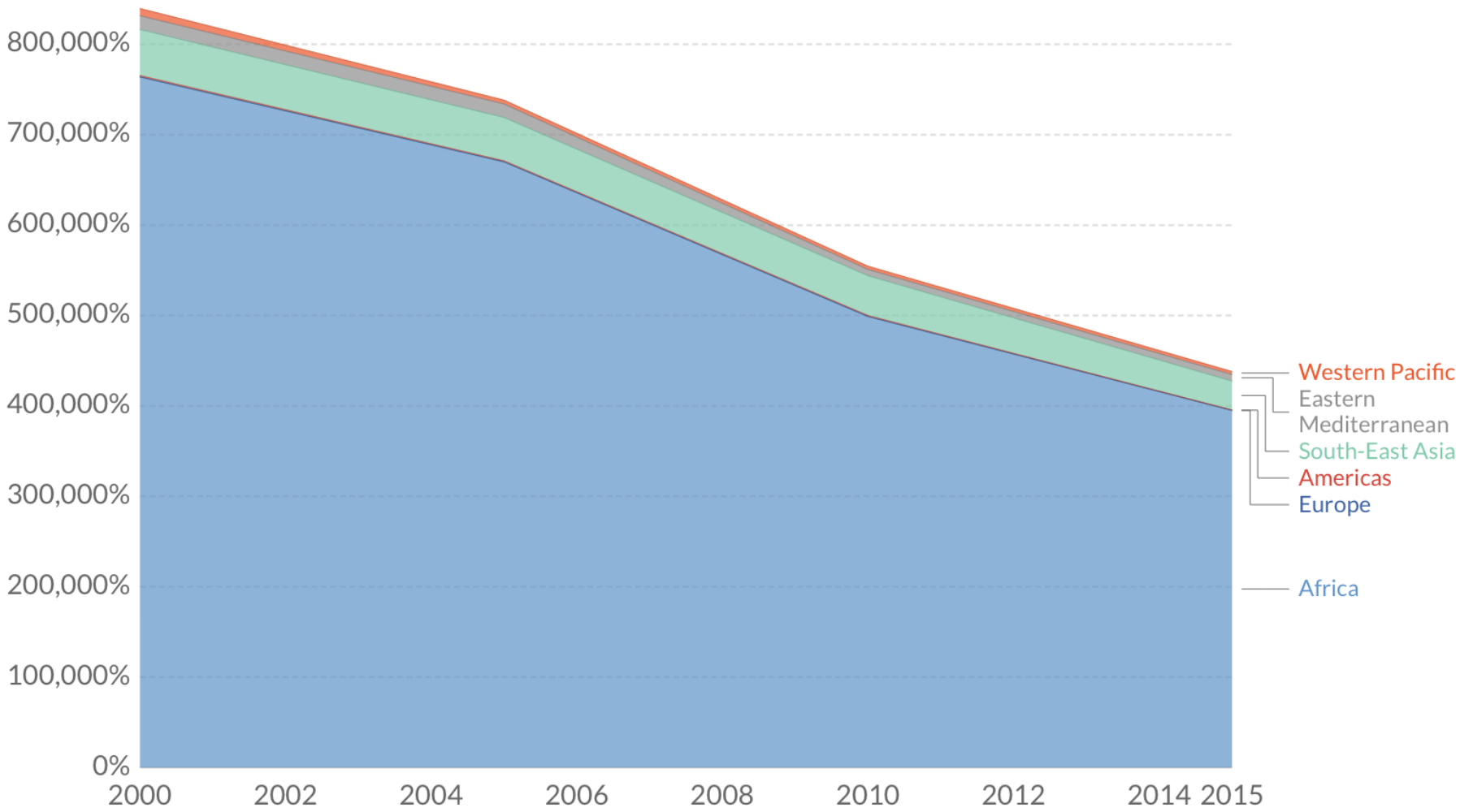
Burden of disease by cause, country, and gender (2013 estimates) – produced by IHME Viz Hub



Global number of AIDS-related deaths, new HIV Infections, and People living with HIV (1990-2015)[4]



Global malaria deaths by world region

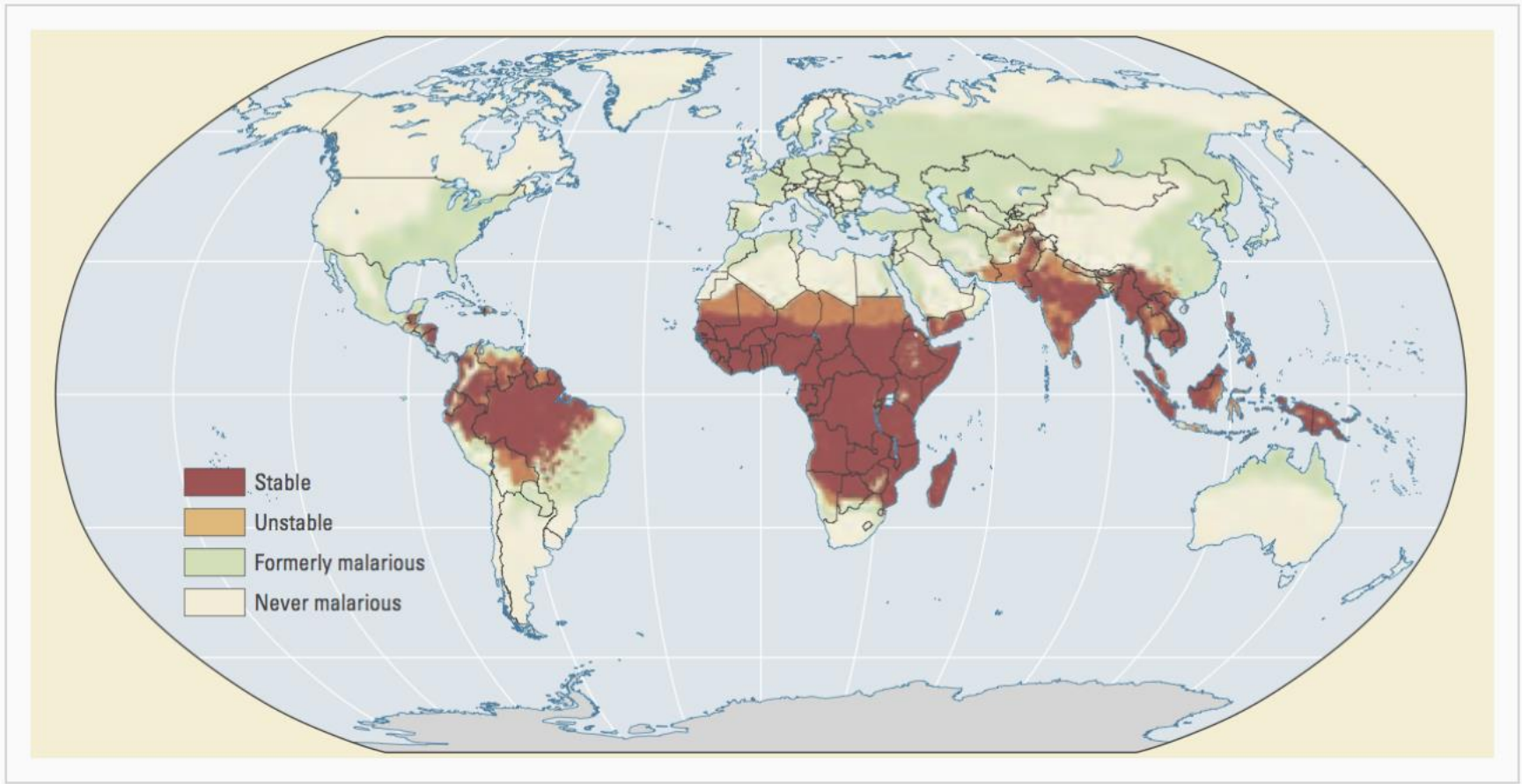


Source: Deaths by World Region - WHO (2016)

Relative

CHART DATA SOURCES

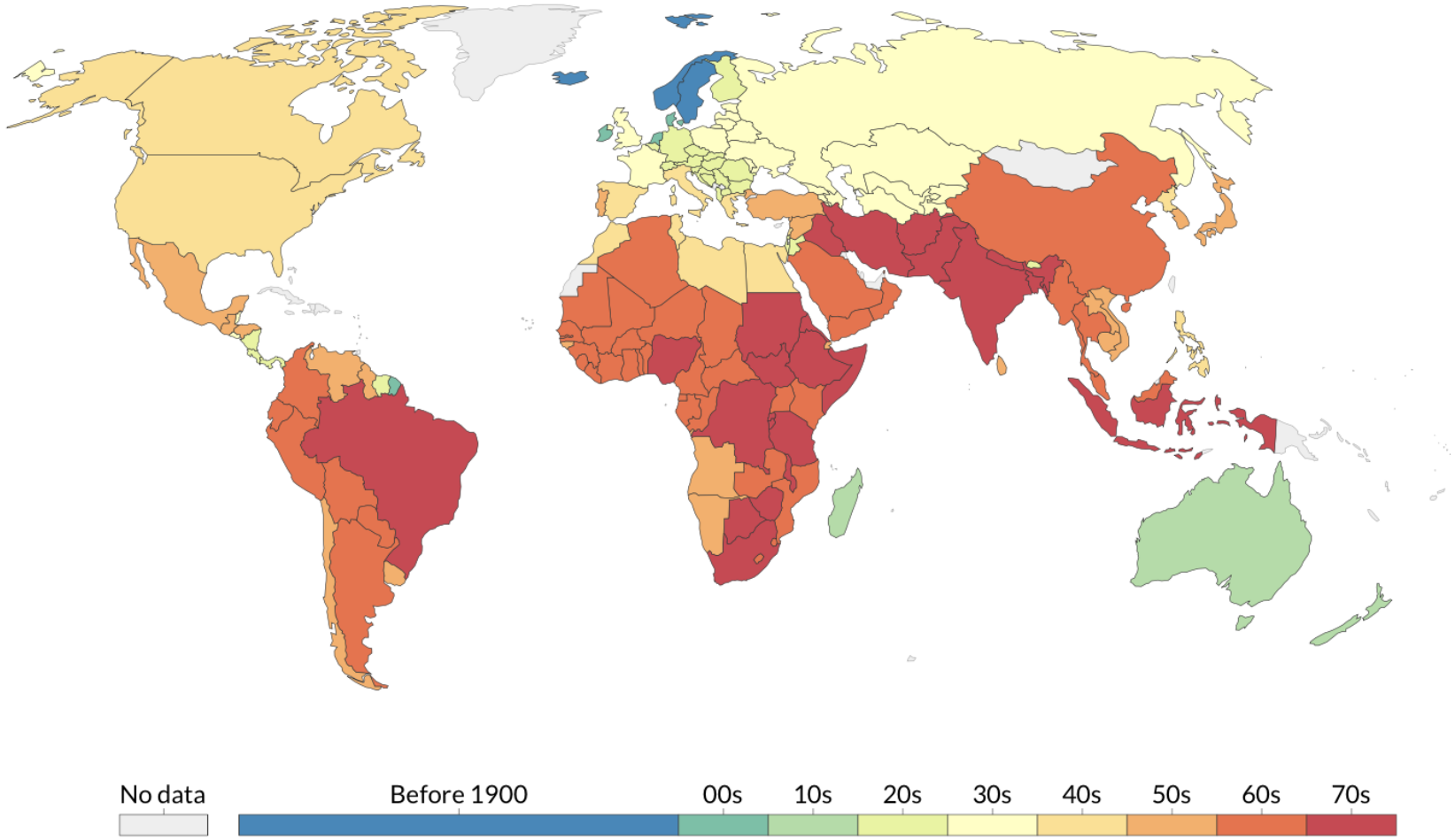
World map of past and current malaria prevalence – World Development Report (2009)[5]



Decade in which smallpox ceased to be endemic by country

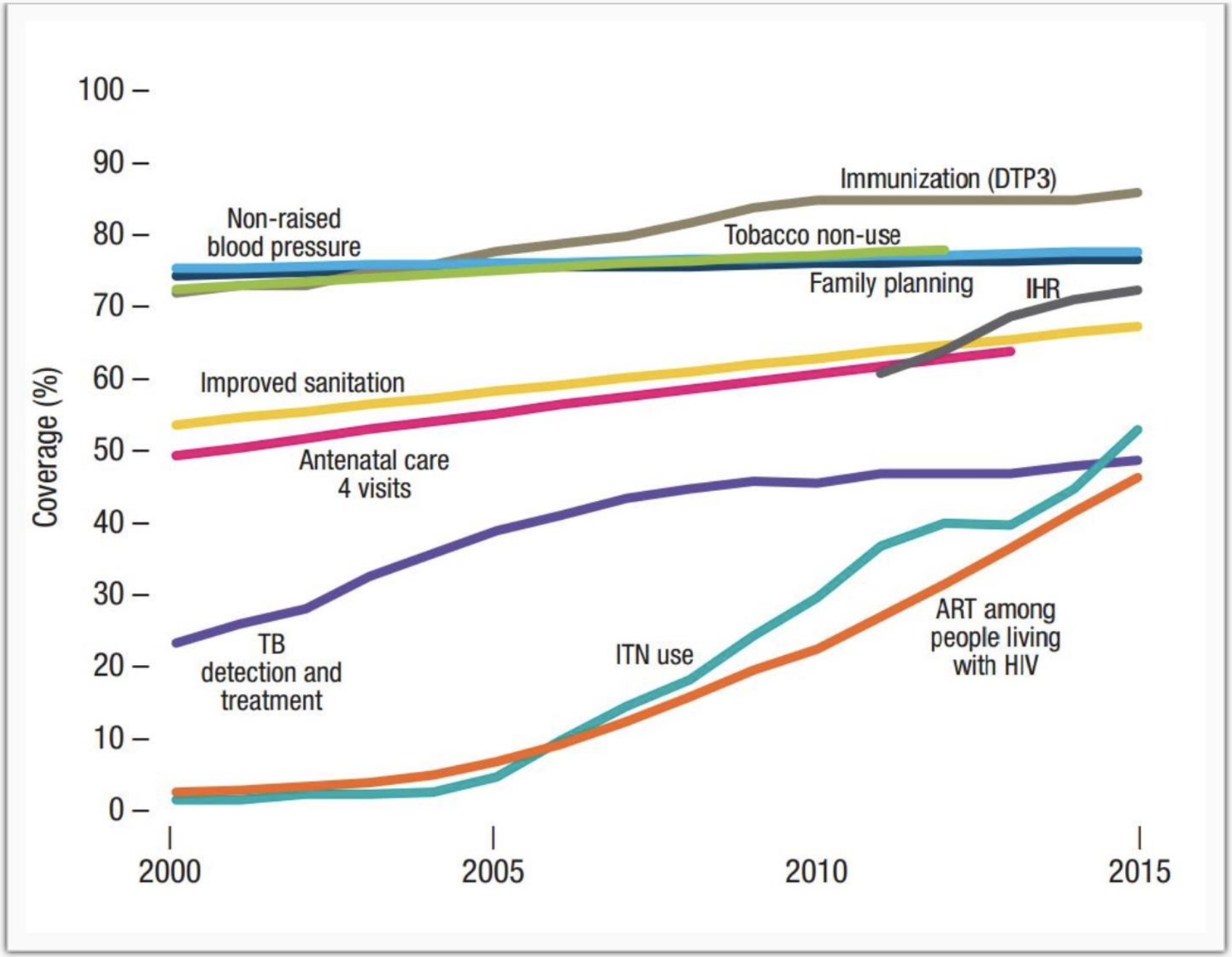
The decade in which smallpox was eliminated by country. Smallpox was globally eradicated in 1977.

Our World in Data



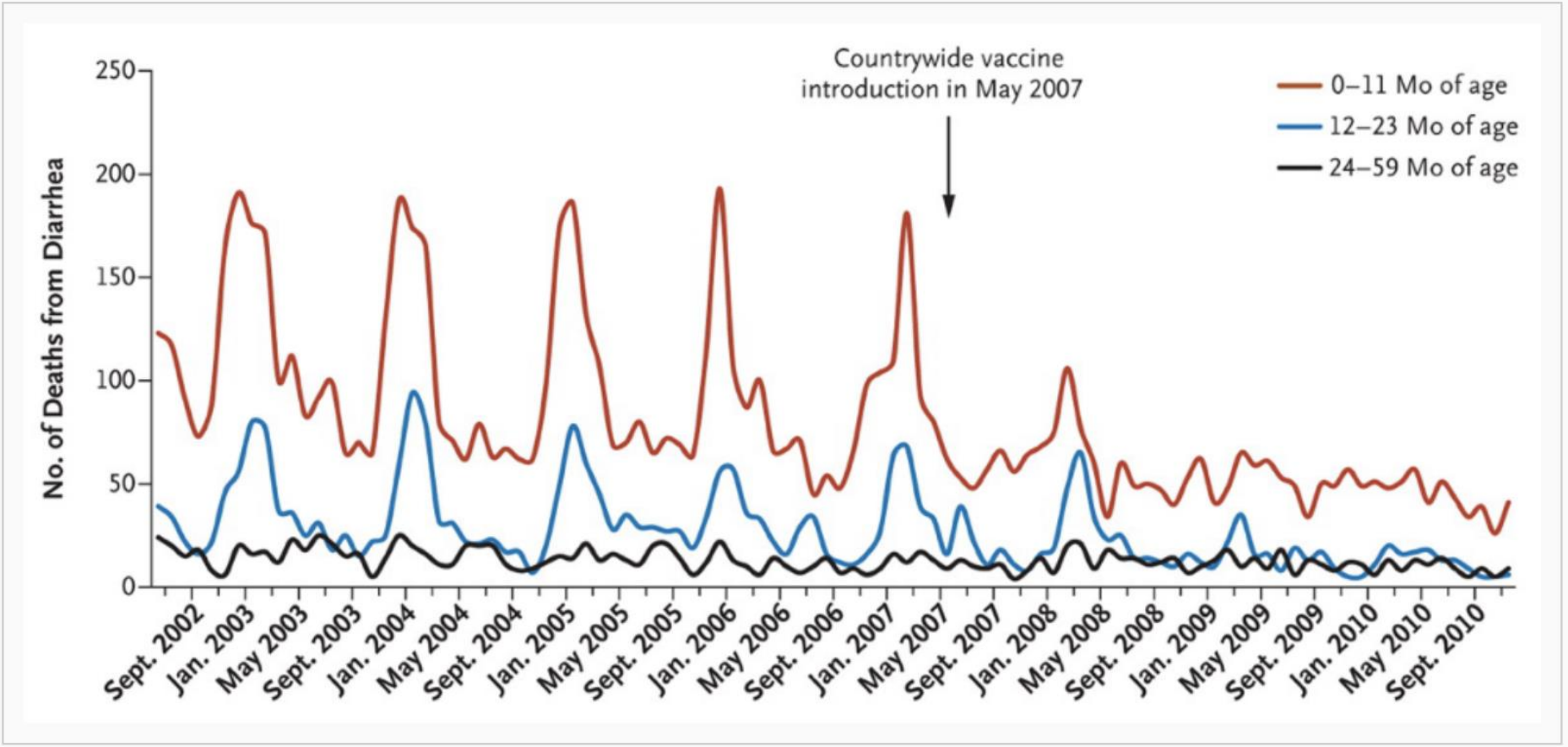
Source: Fenner et al. (1988)

Trends in global coverage of tracer indicators of essential health services, 2000–2015.[20]

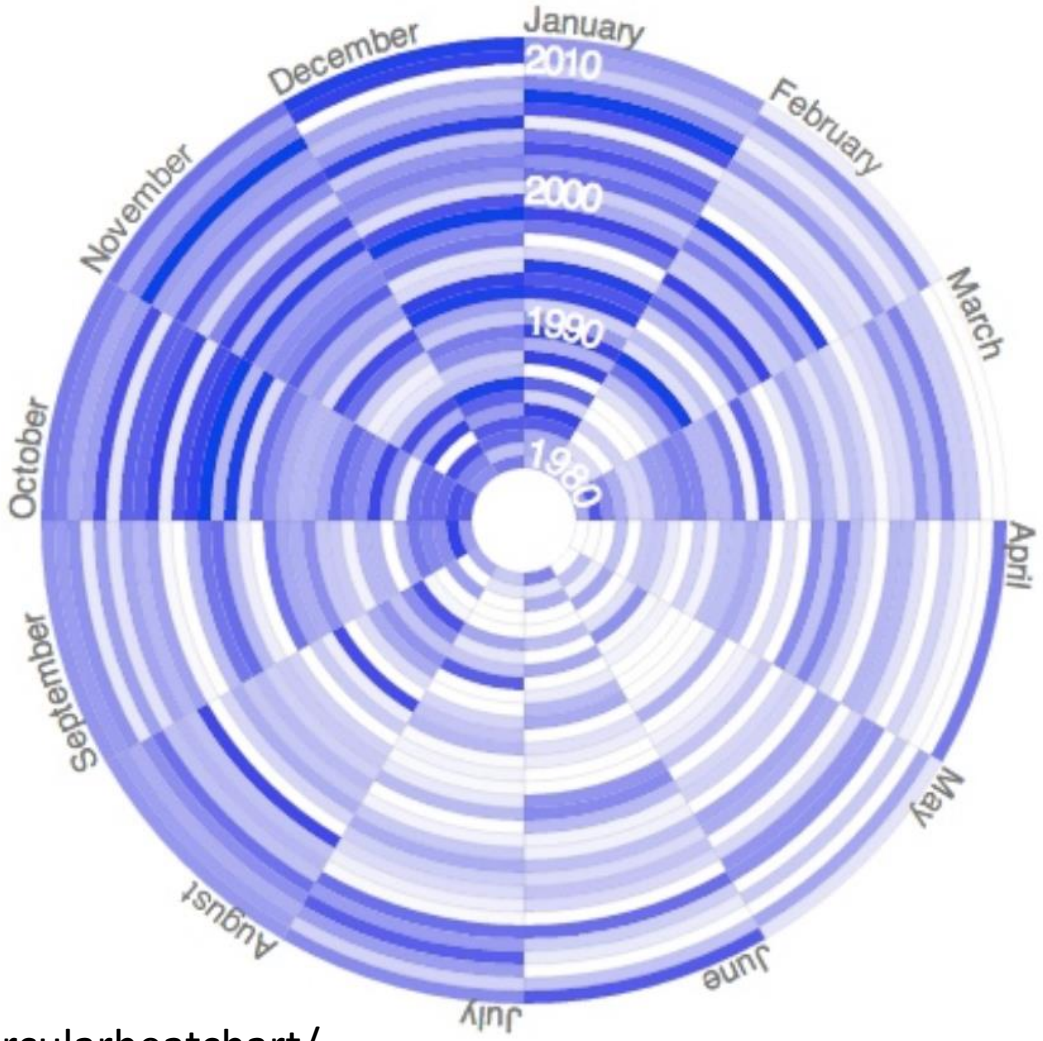


Diarrhea among children

Number of diarrhea-related deaths among children 59 months of age or younger in Mexico by age group, July 2002 to December 2010 – Richardson, Parashar, and Patel (2011)[16]

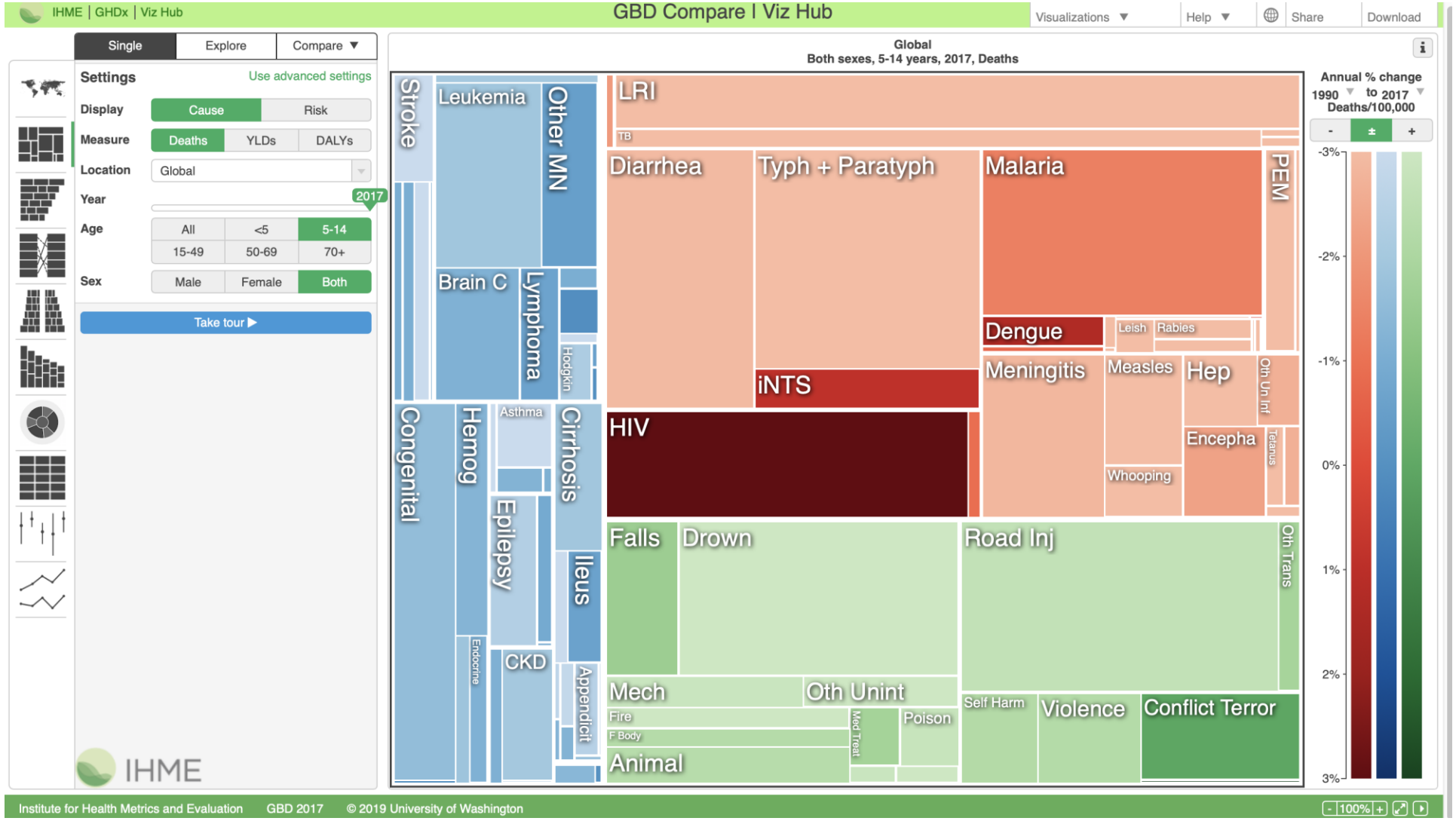


Circular Heat Chart: Rainfall Data



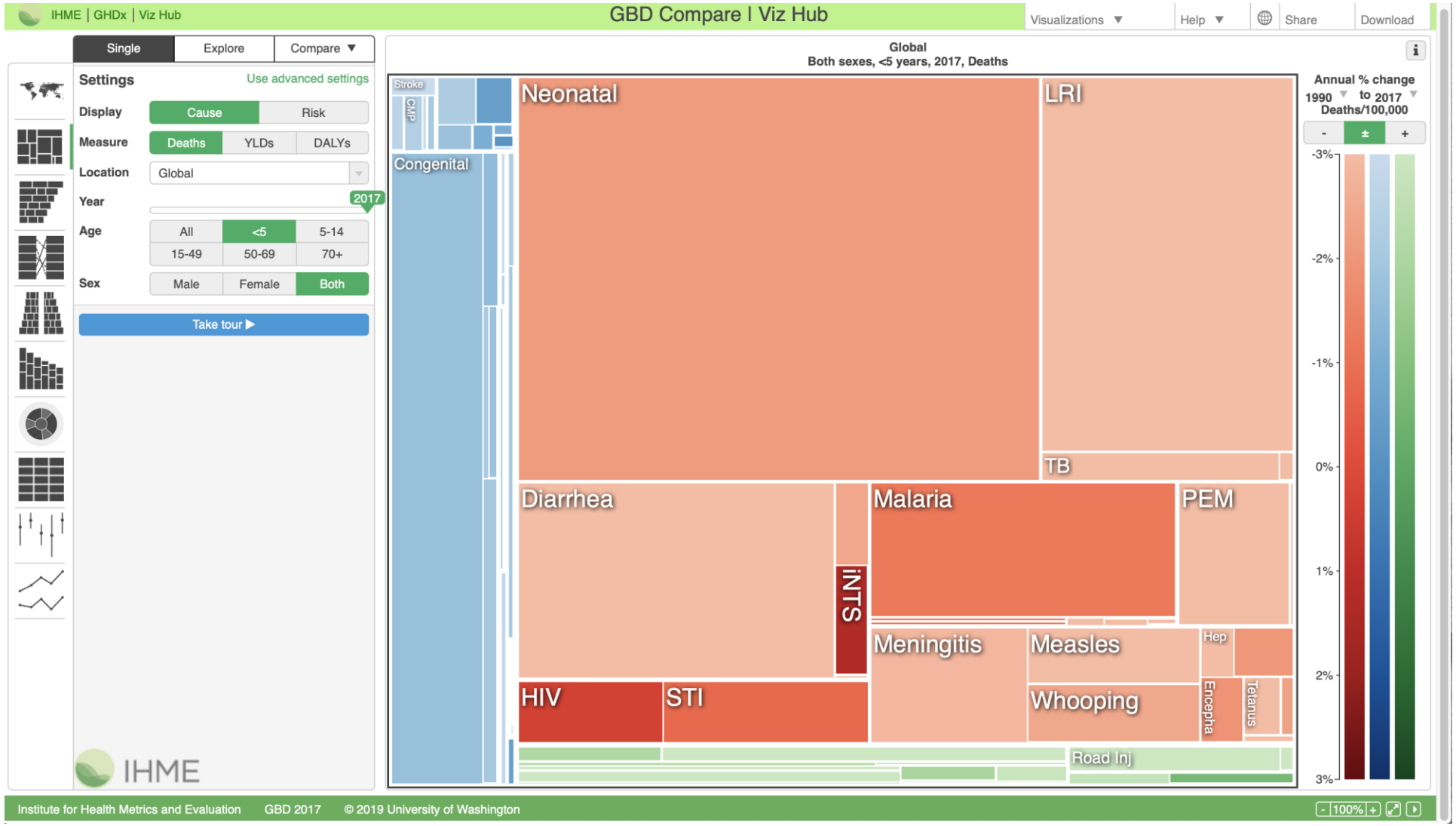
http://prcweb.co.uk/circularheatchart/

Treemap (Causes of Death for Children 5-14)



https://vizhub.healthdata.org/gbd-compare/

Treemap (Causes of Death for Children <5)



https://vizhub.healthdata.org/gbd-compare/

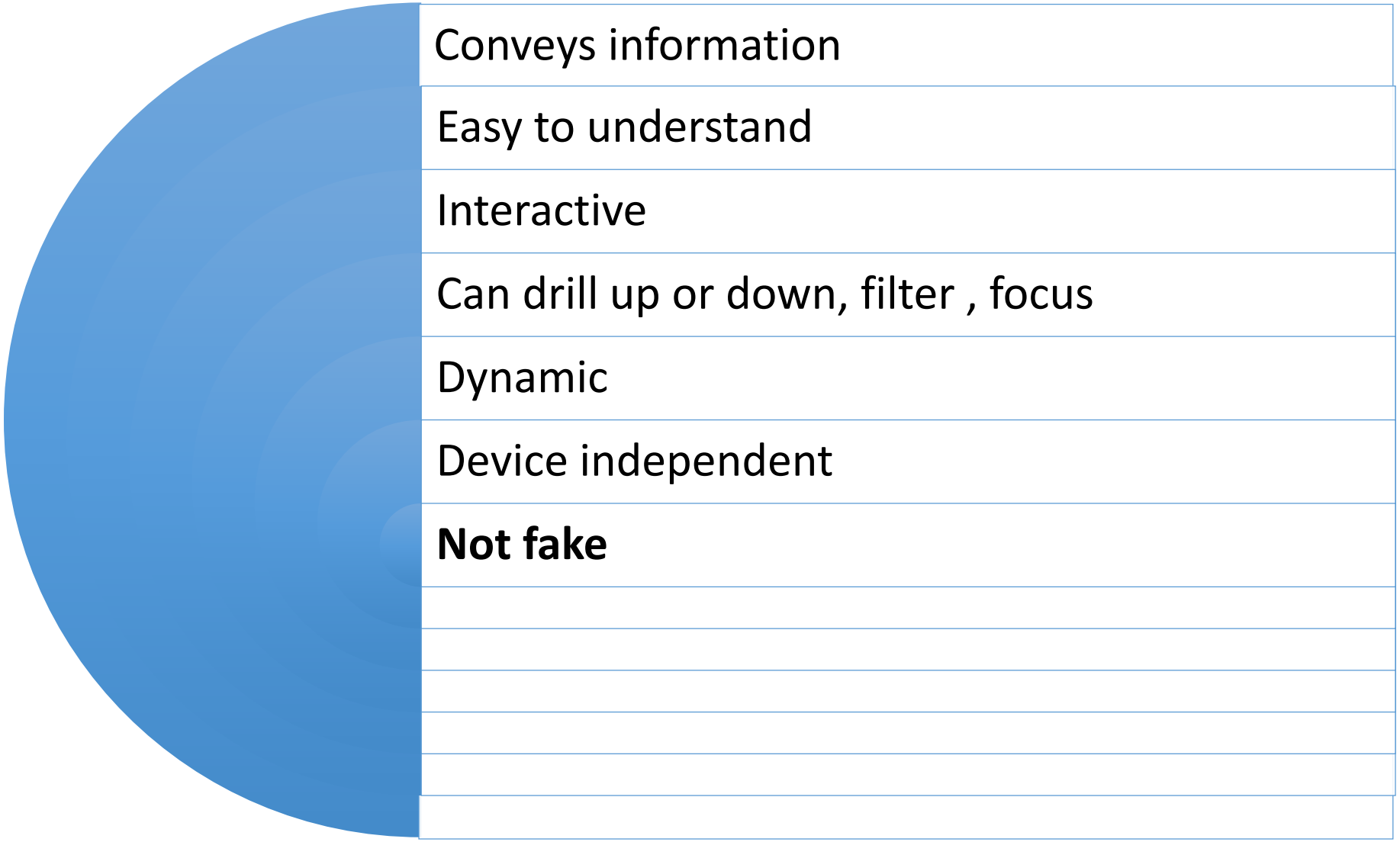
Types of Vizzes

http://helpcentral.componentone.com/

Also:

- Choropleth maps
- Heat maps
- Sparklines
- Spider Charts
- Many more

What's a Good Viz?



- Conveys information
- Easy to understand
- Interactive
- Can drill up or down, filter , focus
- Dynamic
- Device independent
- **Not fake**

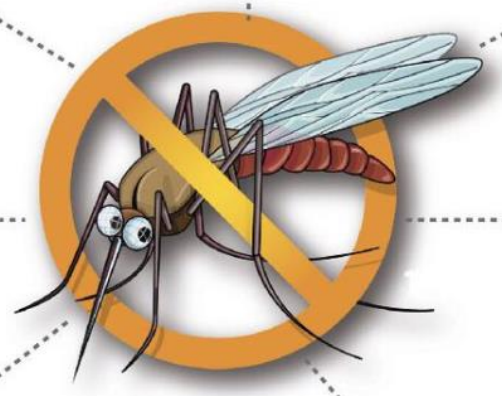
DENGUE IS PREVENTABLE

Steps to prevent mosquitoes from breeding

Dispose of empty cans, coconut shells, bottles, old tyres etc.

Clear blocked drains if any

Clear bushes around your home



Do not drop waste into drains

Dengue mosquitoes breed in clean water, so check flush tanks and unfrequented bathrooms

Sweep your surroundings and clear dry leaves

Ensure no water is stagnant in pots

/DelhiJalBoard | www.delhijalboard.nic.in | /delhijalboardofficial

Public Information Office - Dagupan City

Aggressive campaign pays off: City posts lower number of dengue cases

OCTOBER 22, 2019 · PUBLIC

DAGUPAN CITY – The city government is winning its fight against the dreaded dengue-carrying mosquitoes, significantly reducing the number of dengue cases in the city this month.

As of October 14, only nine cases were recorded for the month, down from the 59 cases listed in September, according to Dr. Lydwina Balingit-Bernardo, focal person of the city's Anti-Dengue Task Force.

Last month, Mayor Lim created the Anti-Dengue Task Force headed by Bernardo after noting that the number of dengue cases in the city usually increased in the months of August, September and October and early November.

As part of the task force's campaign, misting operations were conducted in the different villages, schools and offices in the city.

To destroy possible breeding places of dengue-carrying mosquitoes, the task force also conducted clean up drives and removed all tires in rooftops, where water could accumulate and serve as mosquito breeding places.

According to the World Health Organization (WHO), dengue is spread through the bite of the female mosquito. The mosquito becomes infected when it takes the blood of a person infected with the virus.

After about one week, the mosquito can then transmit the virus while biting a healthy person. The mosquito can fly up to 400 meters looking for water-filled containers to lay their eggs but usually remains close to the human habitation.

Forecasting and Data Visualization of Dengue spread in the Philippine Visayas Island group

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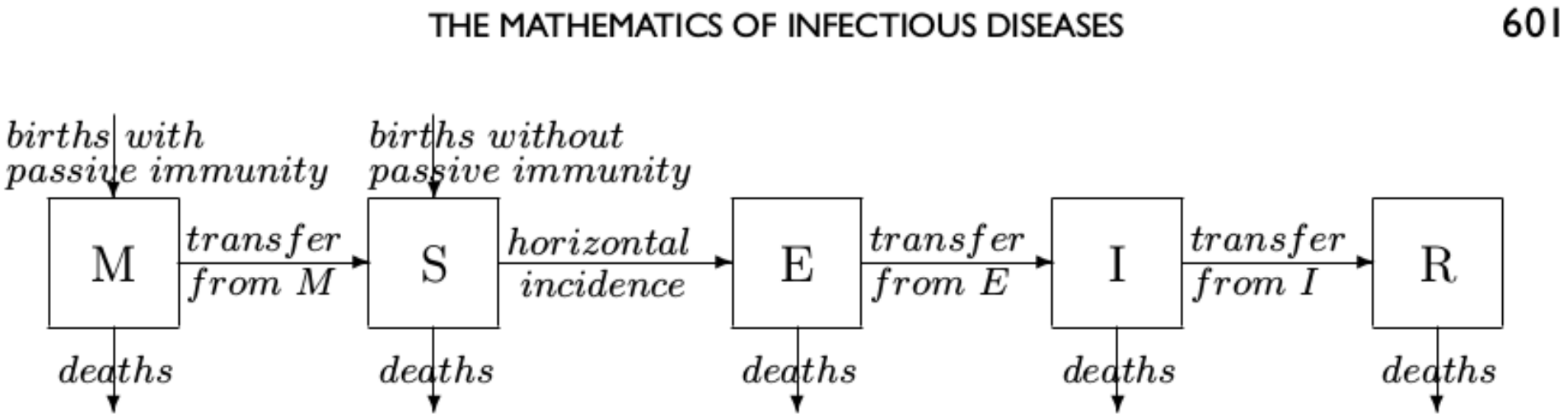
- Dengue ~ 50 million cases annually, worldwide
- In the Philippines, 585,342 cases, with a fatality rate of 0.55%, were reported from 2008 to 2012.
- Dengue continues to be a tremendous health issue that is challenging to tackle in the Philippine setting.

Objectives

- Accurately forecast future dengue cases.
- Develop a system for visualization and documentation of dengue data.

MSEIRS is a commonly used mathematical model that takes into account the number of vector and hosts in a disease system.



Due to the diculty in collecting mosquito vector data, a model that could forecast dengue cases without the use of a vector parameter was selected.

Model

- Artificial Neural Network (ANN) that takes in dengue incidence and weather data as parameters to forecast dengue cases.
- The neural network model is based on [Jani M. Aburas, B. Gultekin Cetiner, and Murat Sari, ”Dengue confirmed-cases prediction: A neural network model”]

Data

- Monthly records of weather data and dengue data cover a five year period from January 2010 to December 2015.
- Weather Data for each station consists of:
  - Total Rainfall (mm)
  - Average Temperature (C)
  - Percentage Relative Humidity

Data

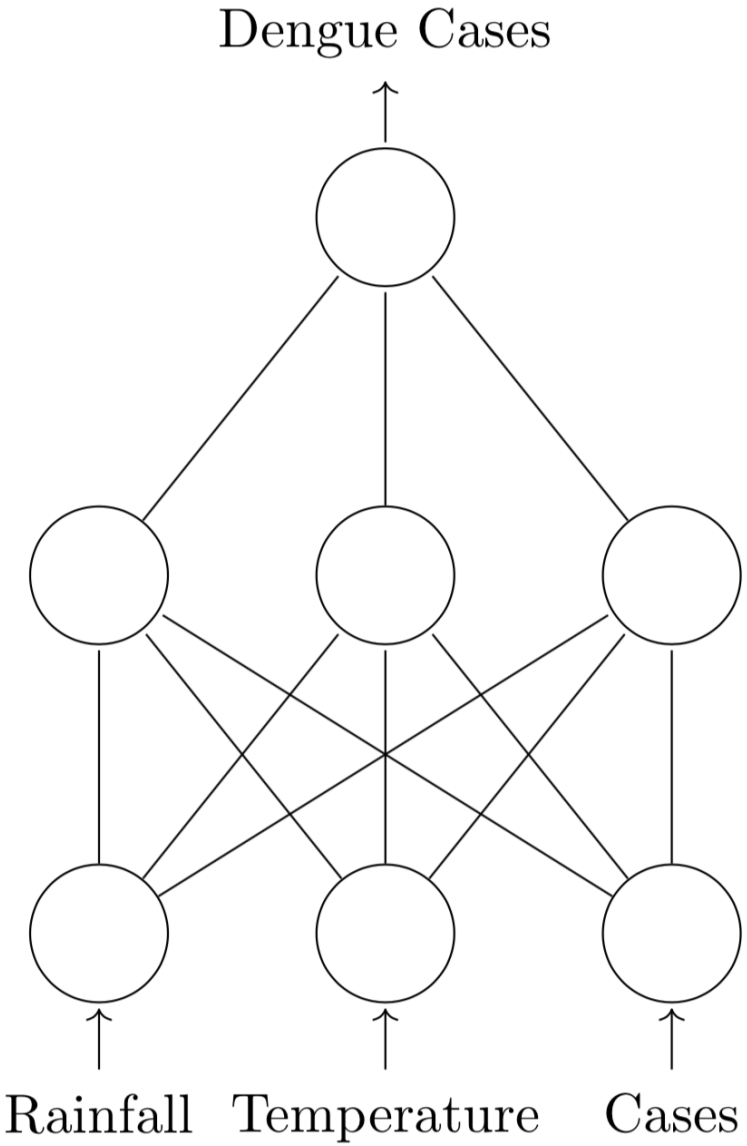
- Dengue data consists of total cases per city
- missing weather data over the study period was interpolated by averaging the available weather data
- Data was acquired from the PAGASA and National Epidemiology Bureau (NEB) under the DOH.

ANN Models

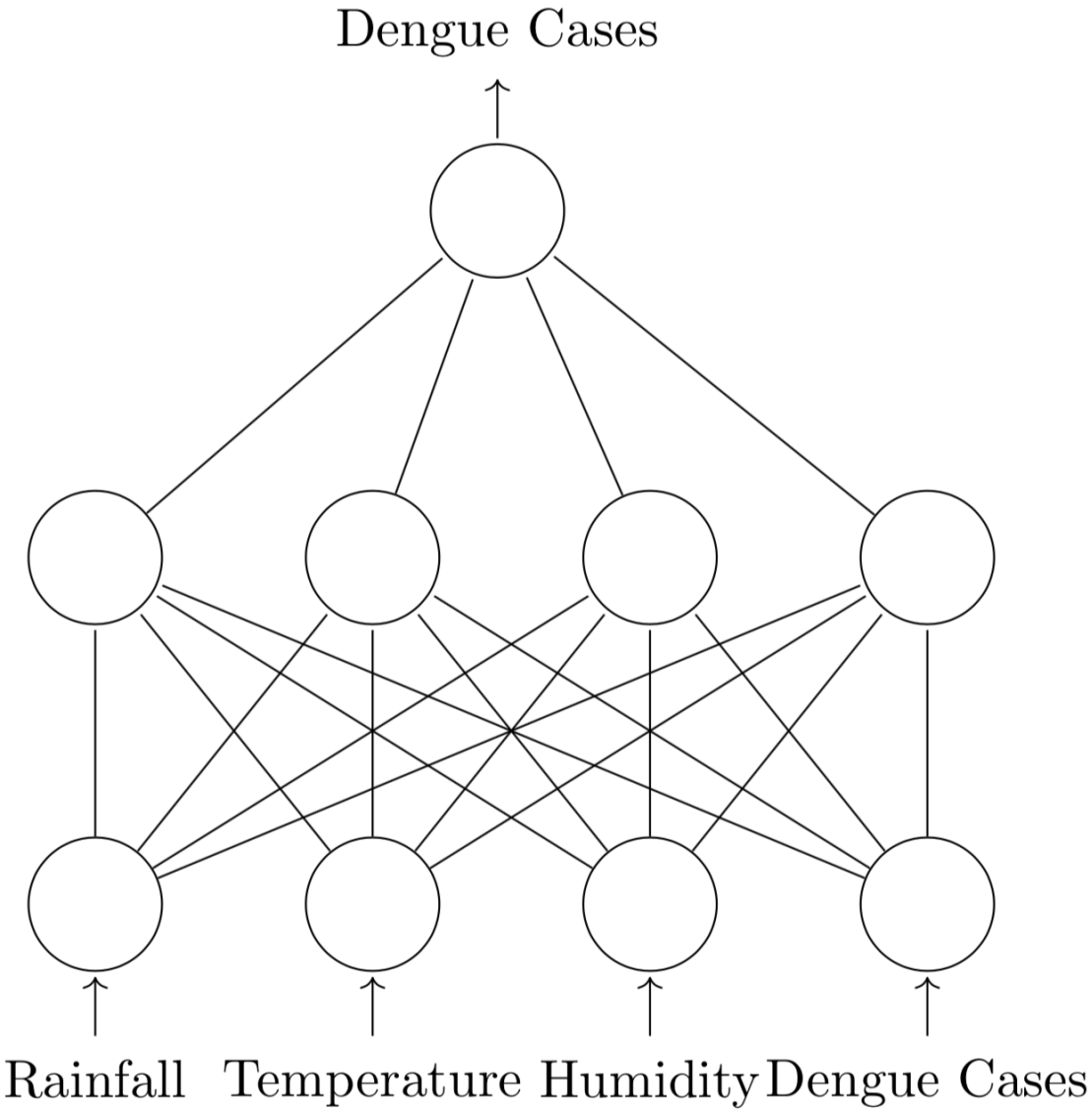
Each set has four models of varying input parameters:

- Standard Model
  - Last Month's Dengue Cases
  - This Month's Rainfall and Temperature
- H Model
  - Standard Model Inputs
  - This Month's Humidity
- P Model
  - Standard Model Inputs
  - Province Index
- HP Model
  - Standard Model Inputs
  - Province Index

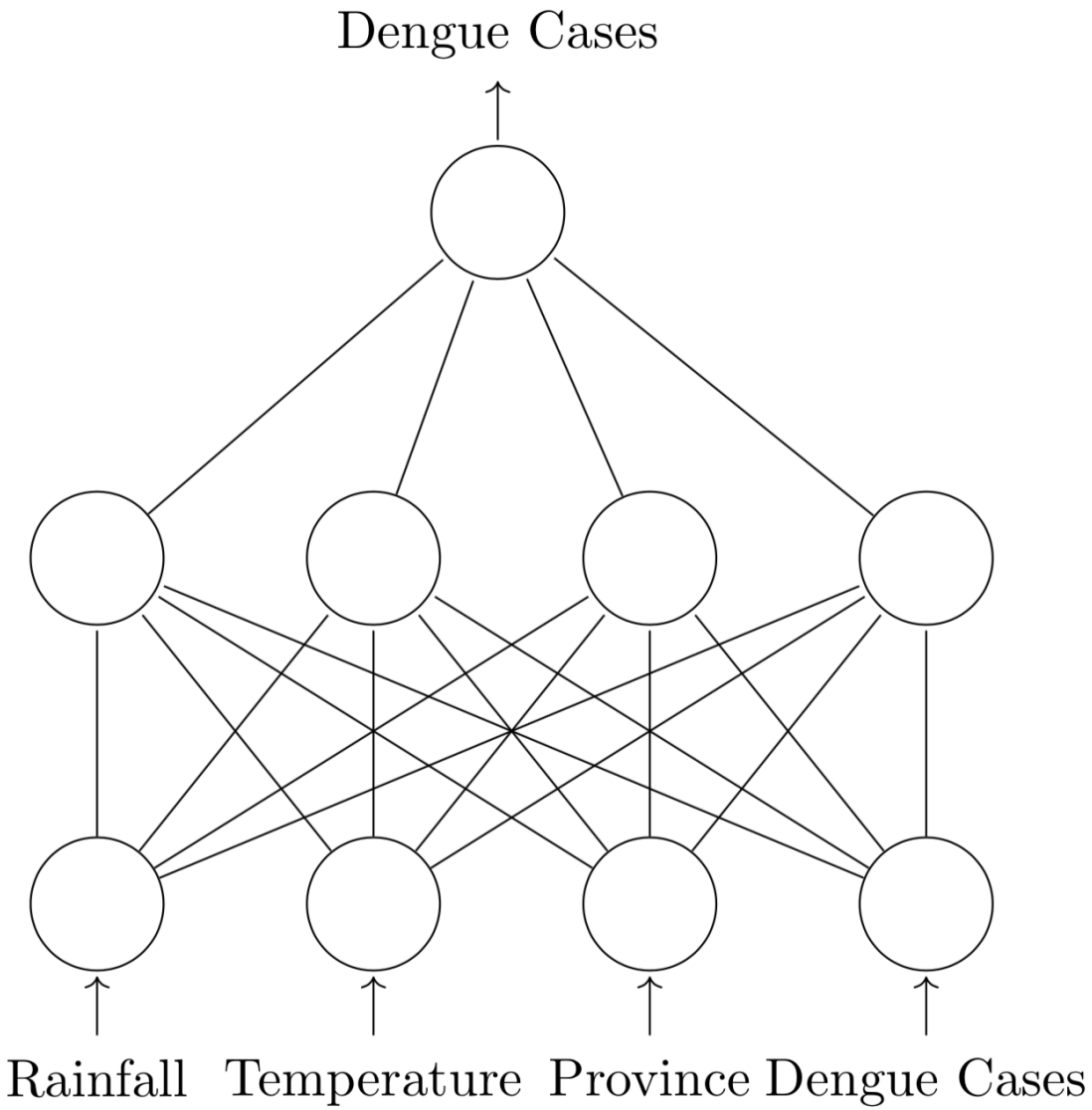
ANN Models



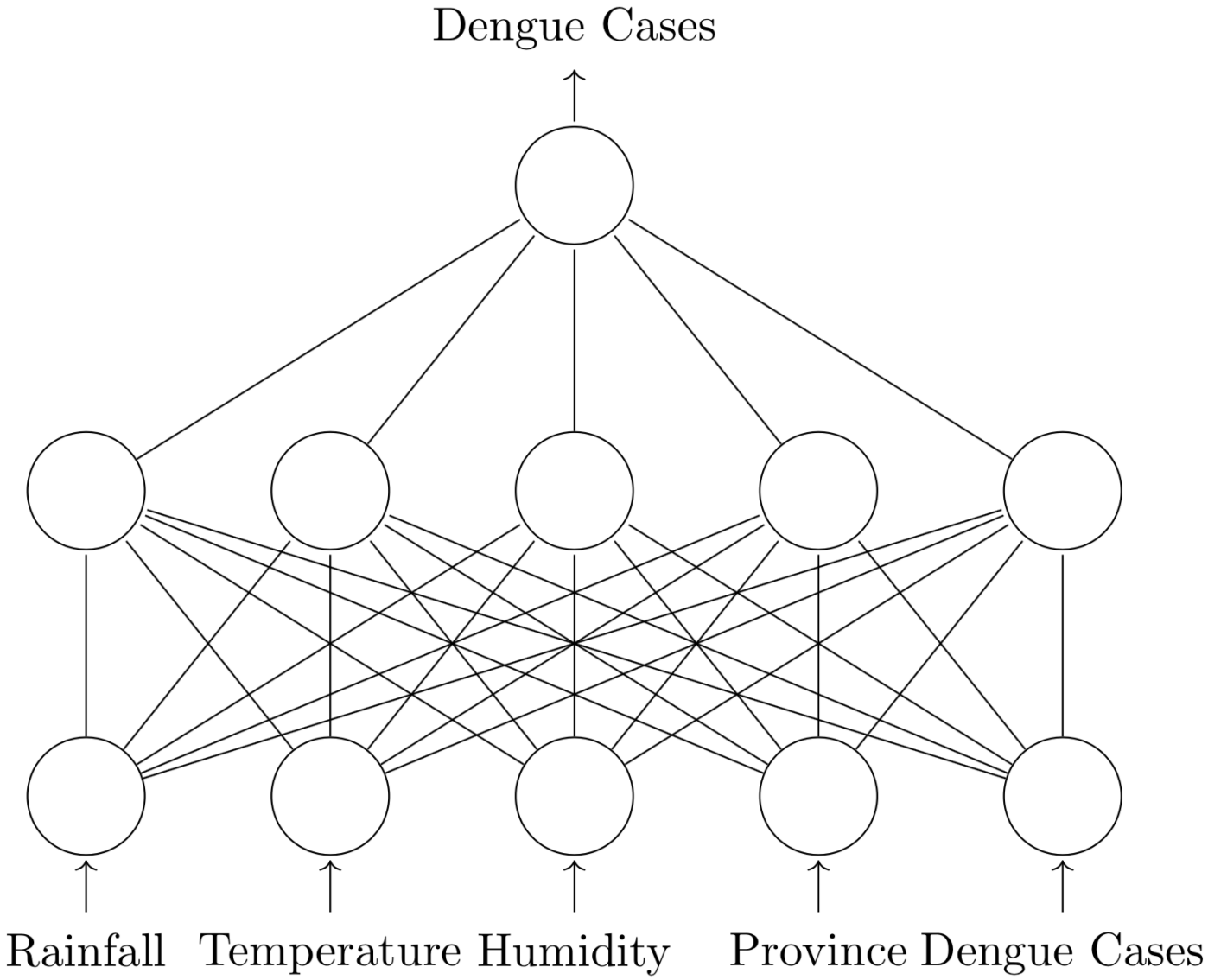
ANN Models



ANN Models



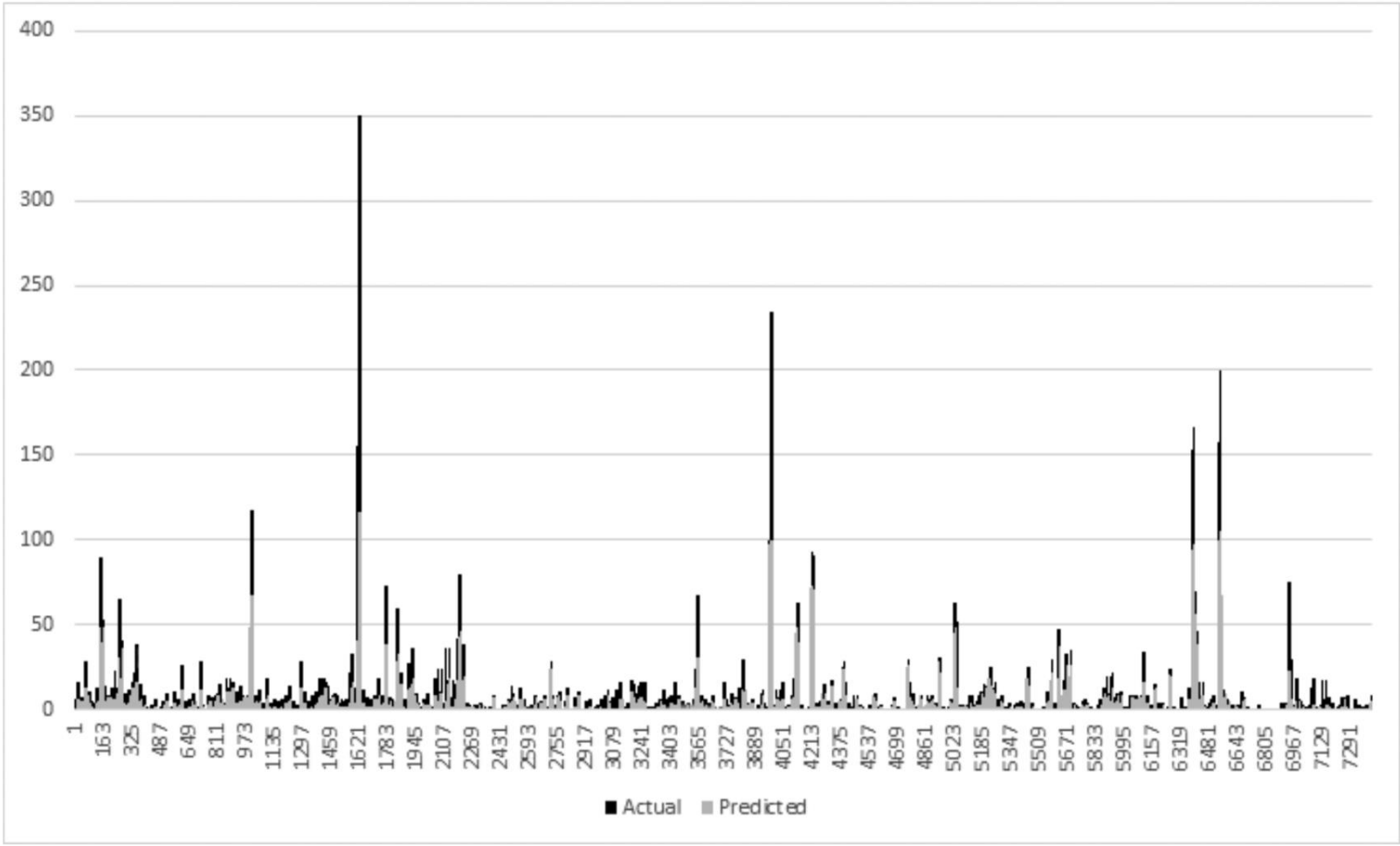
ANN Models


Dengue Cases
Rainfall
Temperature
Humidity
Province
Dengue Cases

ANN Training

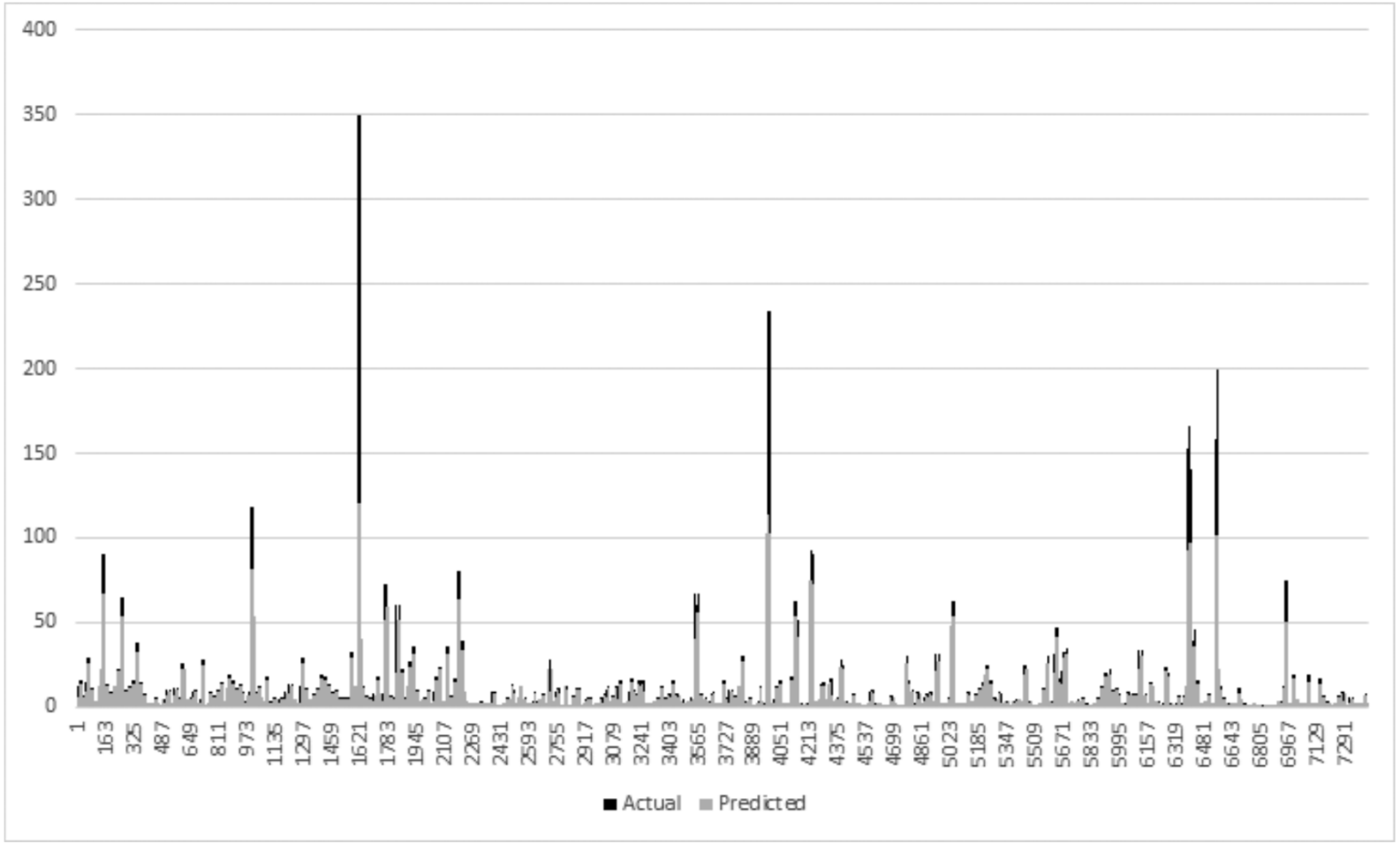
- All neural networks were trained for 600 epochs each.
- Resulting neural networks were then made to predict the subsequent dengue cases for the test years 2014 to 2015. The results were compared to a normalized value of the actual number of dengue cases.
- The positive relationship between the resulting set and the actual set was measured through correlation value.

Correlation



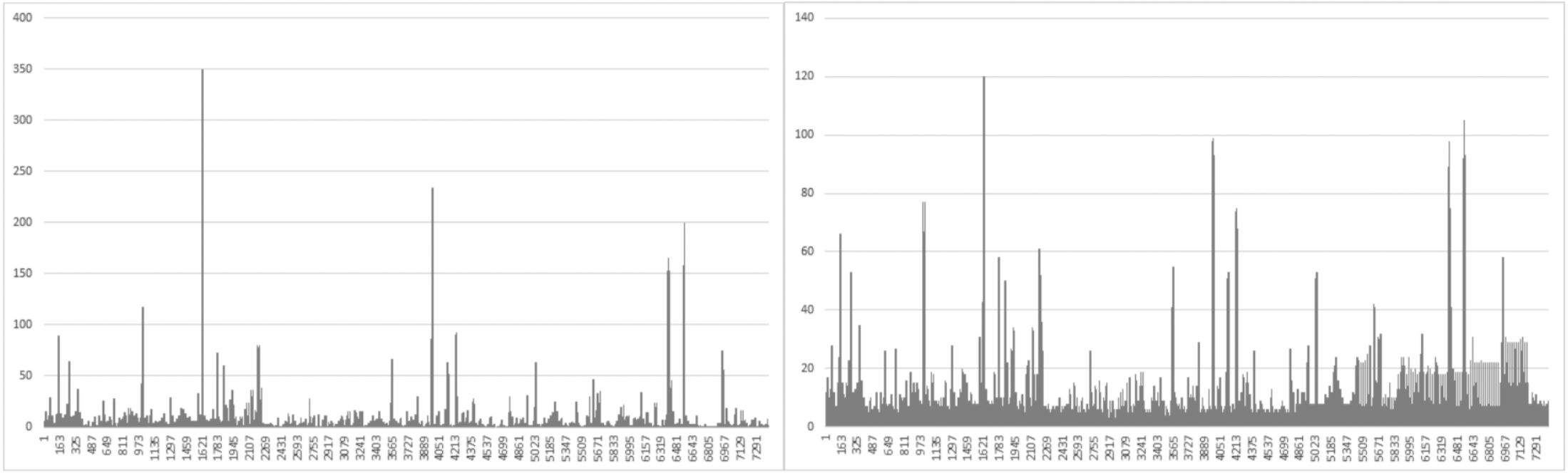
H Model trained with actual dengue cases overlapped with actual cases from 2014 to 2015. Correlation value of 0.79.

Correlation



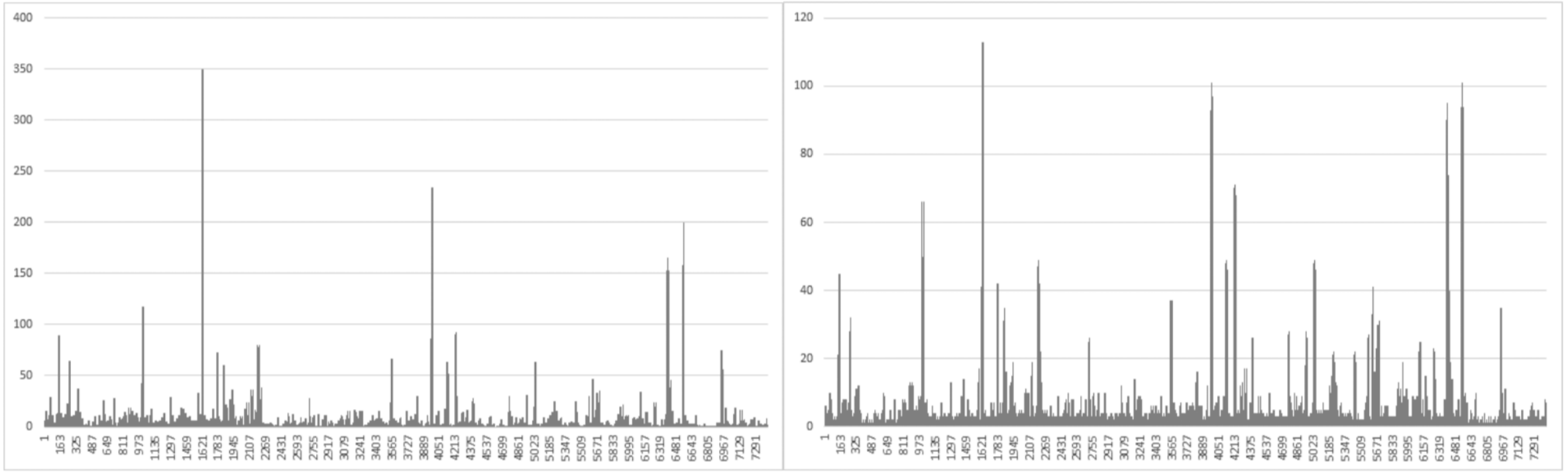
Standard Model trained with average weather data overlapped with actual cases from 2014 to 2015. Correlation value of 0.80.

Correlation



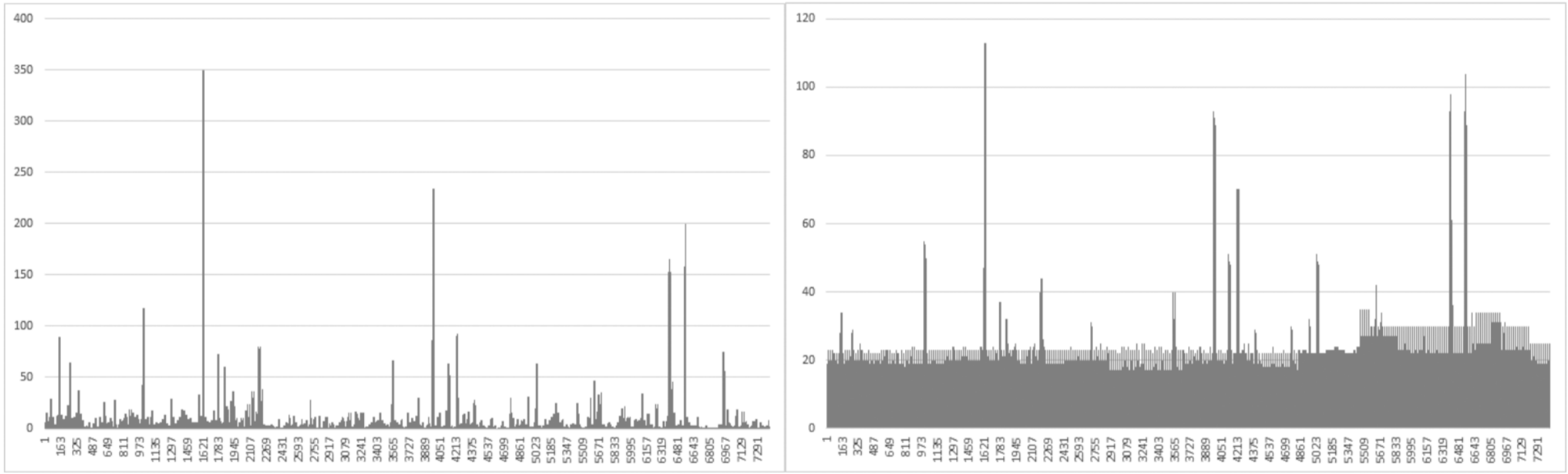
Left: Actual dengue cases from 2014 to 2015, Right: Standard Model trained with actual weather data. Correlation value of 0.77.

Correlation



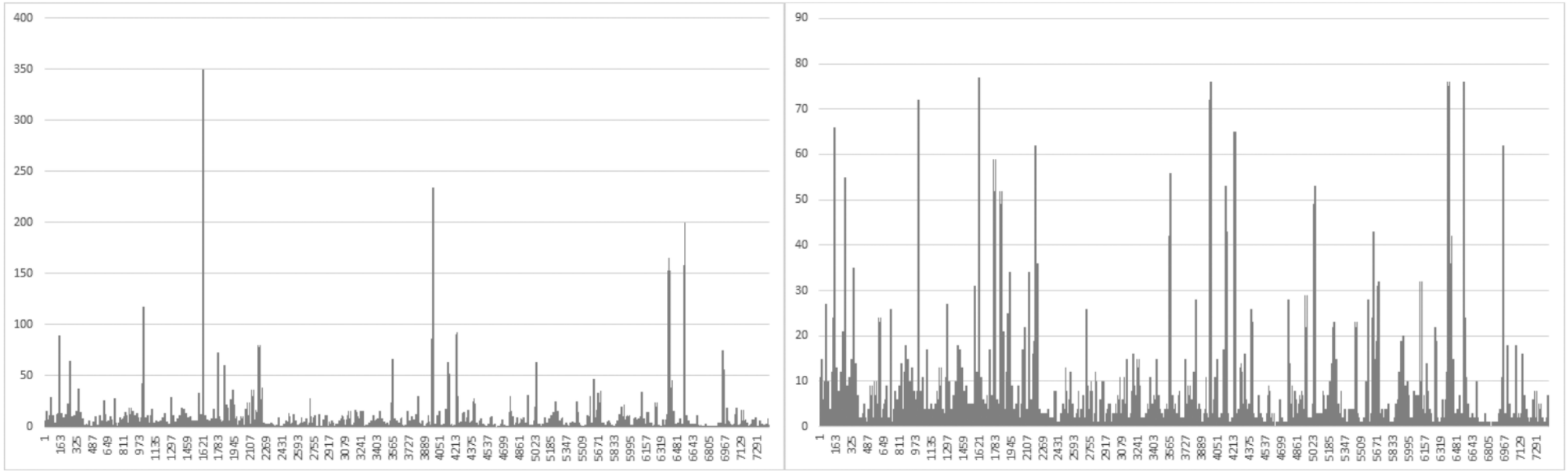
Left: Actual dengue cases from 2014 to 2015, Right: P Model trained with actual weather data. Correlation value of 0.77.

Correlation



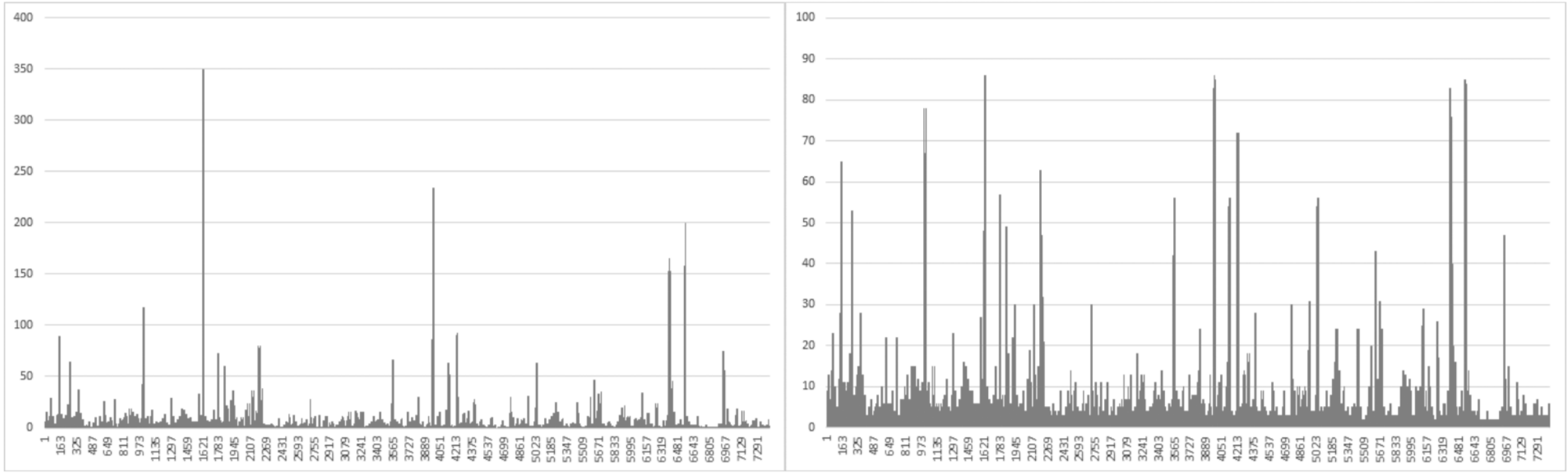
Left: Actual dengue cases from 2014 to 2015, Right: HP Model trained with actual weather data. Correlation value of 0.61.

Correlation



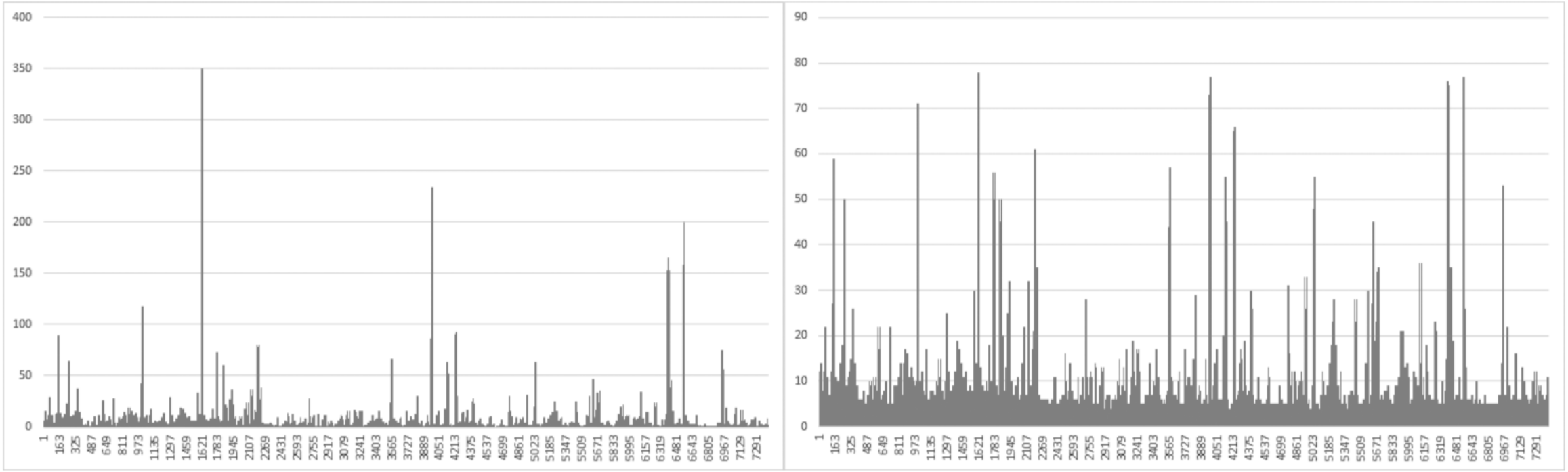
Left: Actual dengue cases from 2014 to 2015, Right: H Model trained with averaged weather data. Correlation value of 0.78.

Correlation



Left: Actual dengue cases from 2014 to 2015, Right: P Model trained with averaged weather data. Correlation value of 0.78.

Correlation

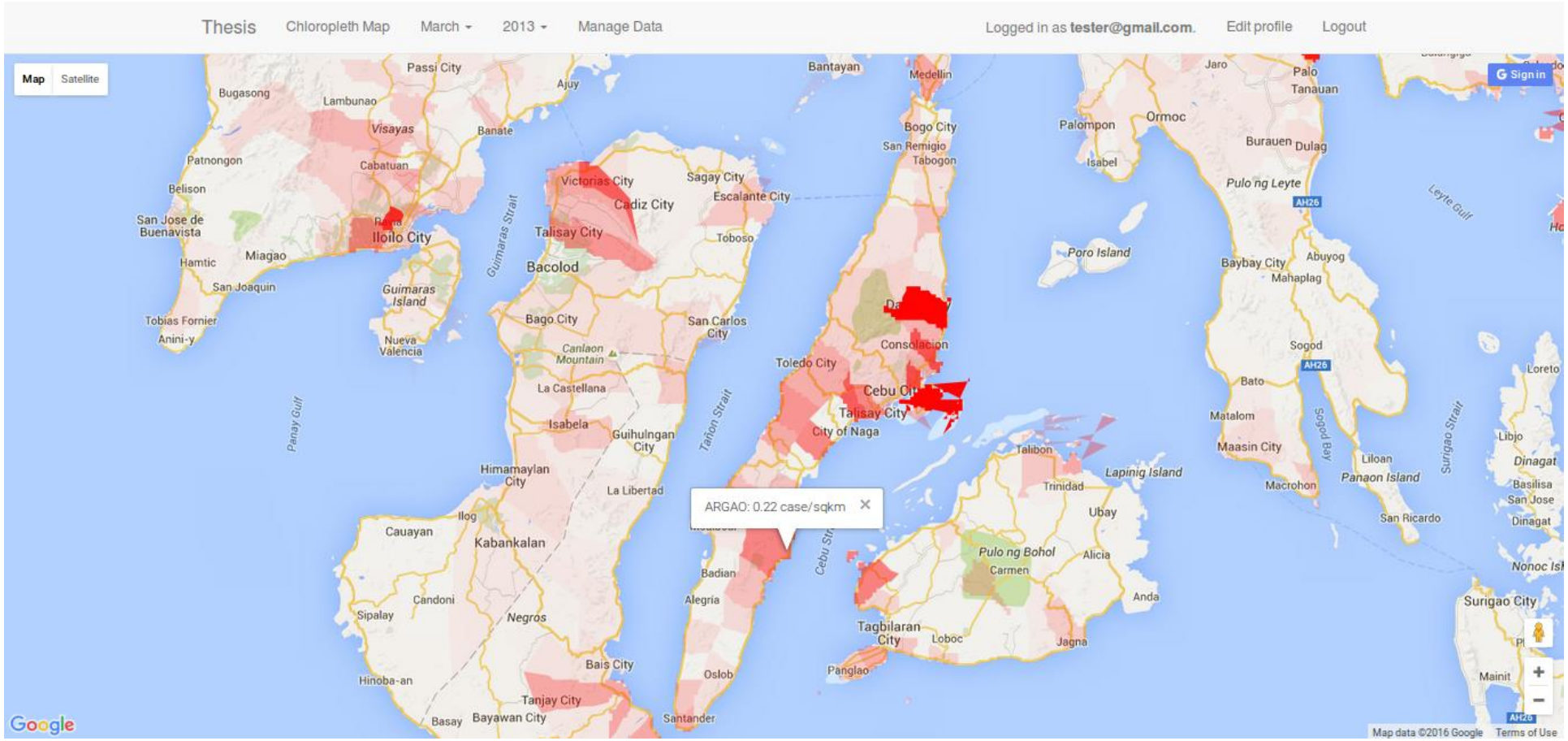


Left: Actual dengue cases from 2014 to 2015, Right: HP Model trained with averaged weather data. Correlation value of 0.77.

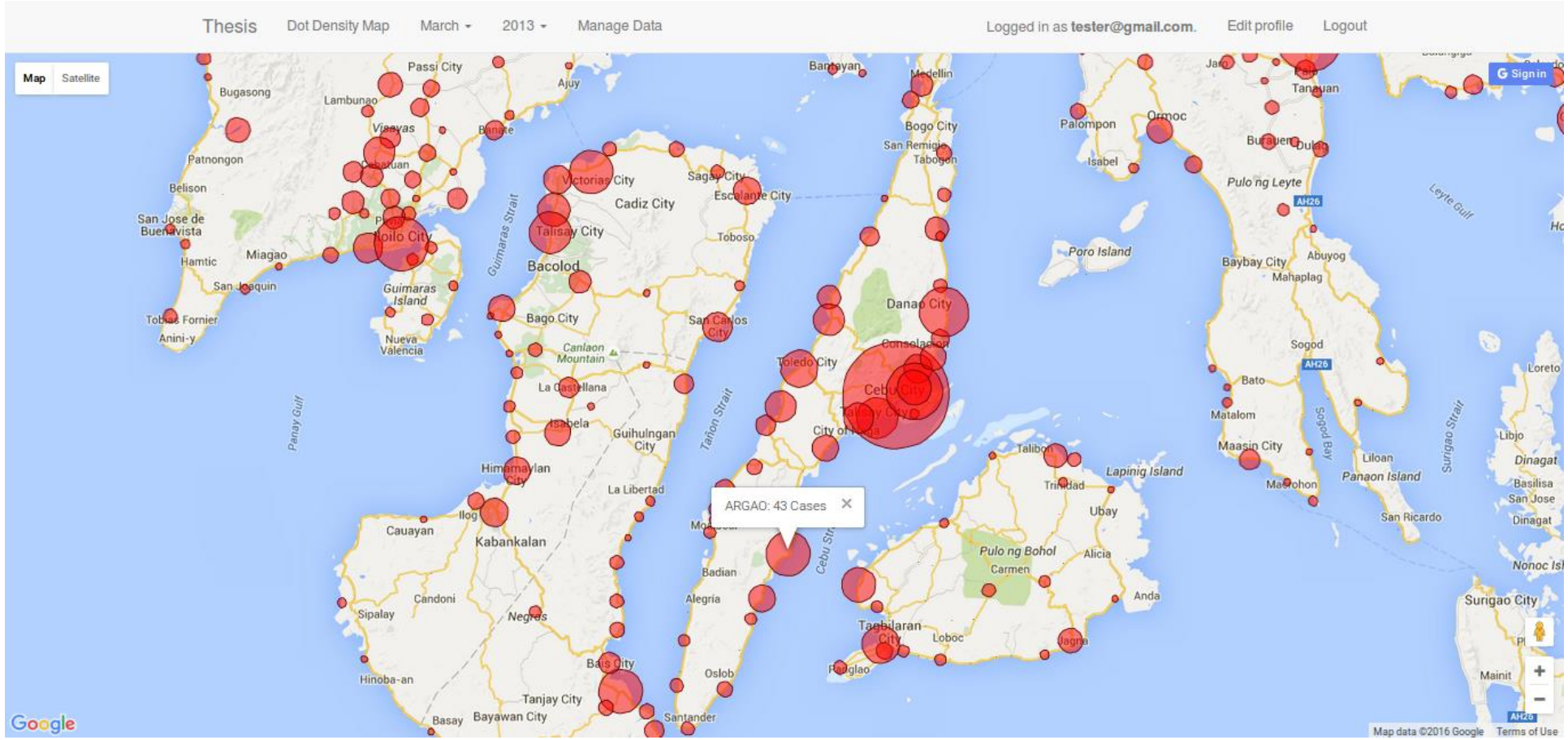
Visualization

- An online web system was selected as it serves as the most suitable platform to allow accessibility of information to the general public.
- All data and records are stored on the basis of a single geophysical unit, the city. Each city stores three types of data, geographic, weather, and dengue data.
- Artificial Neural Network integrated into the system to predict the next month’s dengue cases.
- A visualization of the resulting predicted dengue cases is then generated in the form of dot density and choropleth maps.

Heat Map


Thesis
Chloropleth Map
March
2013
Manage Data
Logged in as tester@gmail.com.
Edit profile
Logout
Map
Satellite
Sign in
ARGAO: 0.22 case/sqkm
Iloilo City
Bacolod
Cebu City
Tagbilaran City
Surigao City
Google
Map data ©2016 Google
Terms of Use

Choropleth Map



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- Previous month's dengue cases, and averaged temperature and rainfall proved to be the most e↵ective in predicting dengue cases with a correlation value of 0.80.
- An online platform was implemented to contain all records of dengue cases and weather data, and the neural network was integrated into the website. The data visualization of the predicted dengue cases is generated through the use of dot density and chloropleth maps that are then displayed on the online platform.

Objective

- Understand IHITM 2016-17
- Propose engineering solutions with a one health perspective