Public Health Surveillance in the Age of AI

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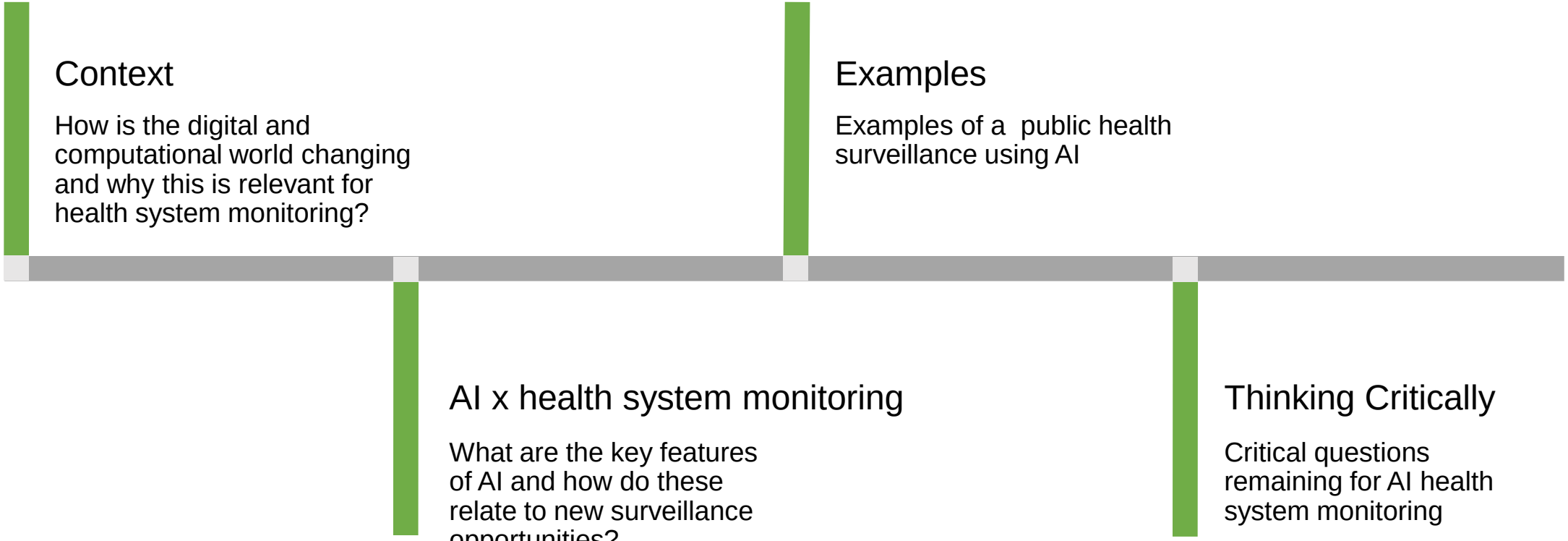
AI4PH AI FOR PUBLIC HEALTH

Trillium Health Partners | INSTITUTE FOR BETTER HEALTH

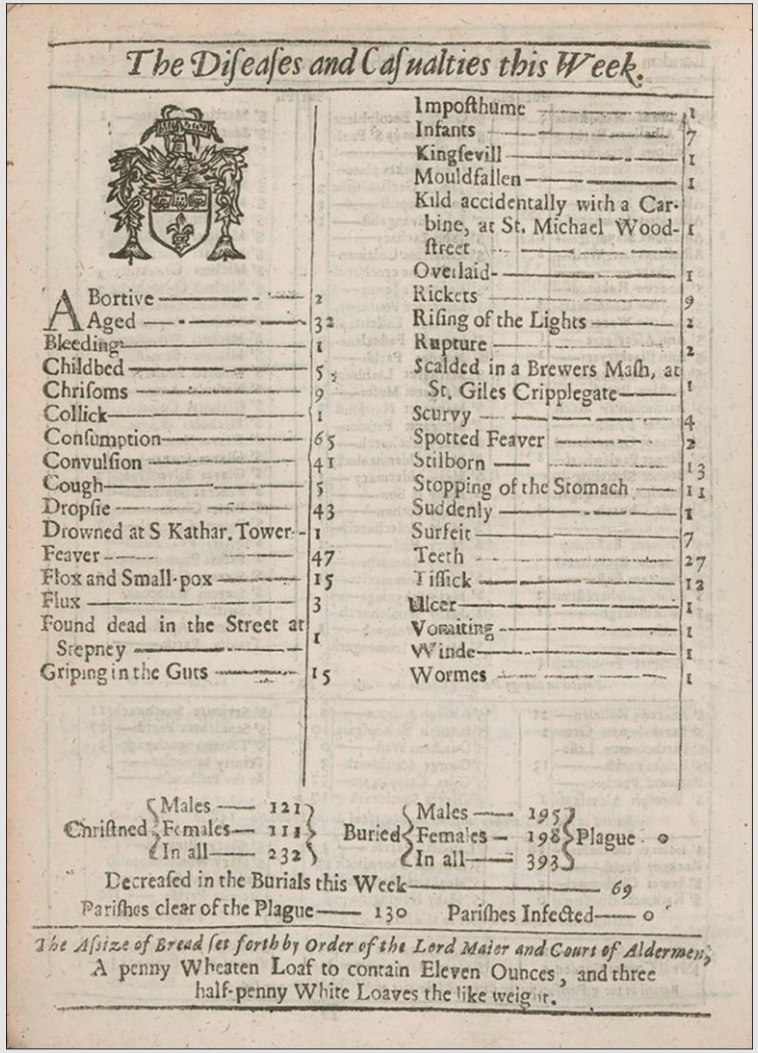
Population Health Analytics Laboratory

Temerty Centre for AI Research and Education in Medicine UNIVERSITY OF TORONTO

Framing AI for Health Monitoring



Surveillance and Public Health: A long history



The Diſeaſes and Caſualties this Week.

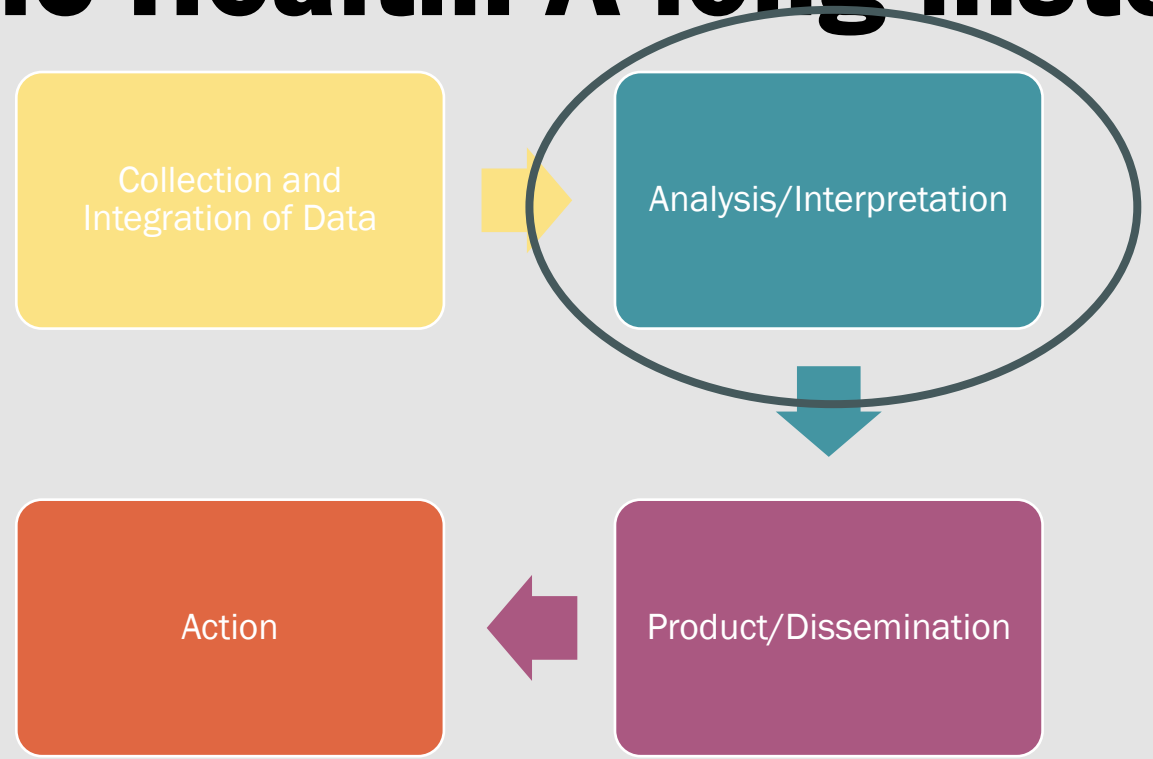
Abortive	2	Impoſthume	1
Aged	32	Infants	7
Bleeding	1	Kingſevill	1
Childbed	5	Mouldfallen	1
Chriſoms	9	Kild accidentally with a Carbine, at St. Michael Wood-ſtreet	1
Collick	1	Overlaid	1
Conſumption	65	Rickets	9
Convulſion	41	Riſing of the Lights	2
Cough	5	Rupture	2
Dropſie	43	Scalded in a Brewers Maſh, at St. Giles Cripplegate	1
Drowned at S Kathar. Tower	1	Scurvy	4
Feaver	47	Spotted Feaver	2
Flox and Small-pox	15	Stilborn	13
Flux	3	Stopping of the Stomach	11
Found dead in the Street at Stepney	1	Suddenly	1
Griping in the Guts	15	Surfeit	7
		Teeth	27
		Tiſſick	12
		Ulcer	1
		Vomiting	1
		Winde	1
		Wormes	1

Christned: Males — 121, Females — 111, In all — 232
Buried: Males — 195, Females — 198, In all — 393
Plague — 0

Decreaſed in the Burials this Week — 69
Pariſhes clear of the Plague — 130 Pariſhes Infected — 0

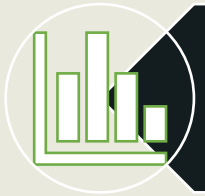
The Aſsize of Bread ſet forth by Order of the Lord Maior and Court of Aldermen;
A penny Wheaten Loaf to contain Eleven Ounces, and three half-penny White Loaves the like weight.

Bills of Mortality, London 1665



"*Public health surveillance* is the continuous, systematic collection, analysis and interpretation of health-related data needed for the *planning*, *implementation*, and *evaluation* of public health practice." WHO

Getting more specific on AI applications



Descriptive

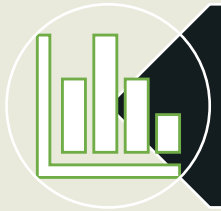
Predictive

Causal Inference

Prescriptive

Hernan et al. CHANCE 2019

Getting more specific on AI applications



What is happening?

- Surveillance
- Health system monitoring

What will happen?

- Planning
- Resource delivery
- Prioritization

Why does it happen?

- Interventions
- Policies/legislation

What should I do about it?

- Recommendations
- Automated systems
- Modelling

Emerging data for health system monitoring

⇒More data
⇒New types data
⇒More complexity

Electronic health records

Environmental data

Wearables

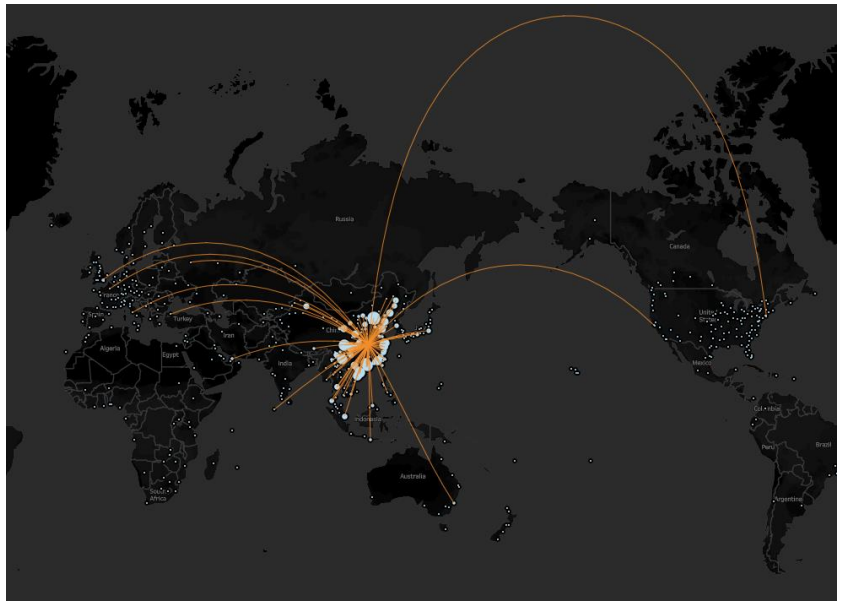
Internet sources

How Canadian AI start-up BlueDot spotted Coronavirus before anyone else had a clue

bluedot

An AI Epidemiologist Sent the First Warnings of the Wuhan Virus

The BlueDot algorithm scours news reports and airline ticketing data to predict the spread of diseases like those linked to the flu outbreak in China.

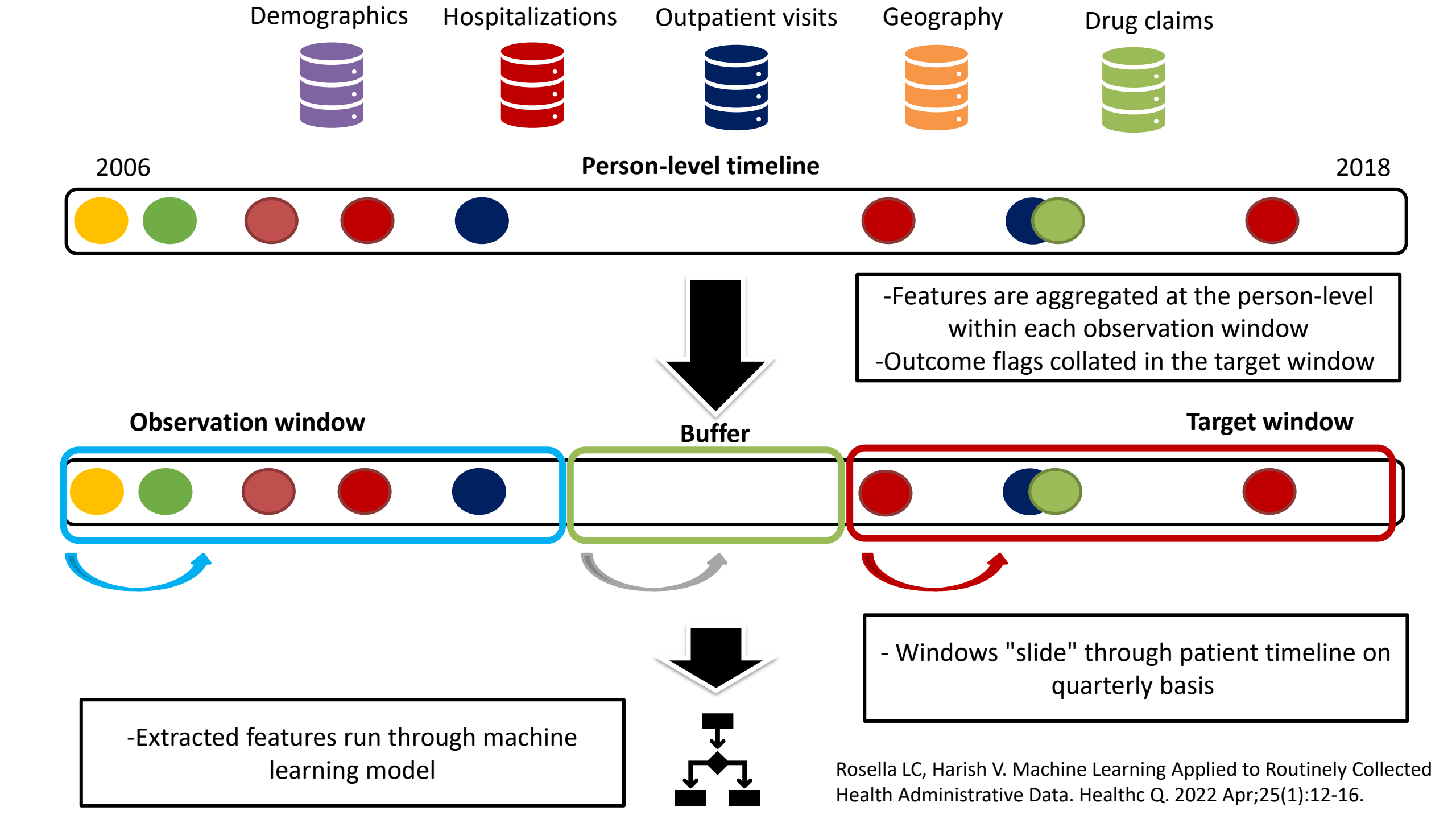


- Focused on detecting early threats
- Built an intelligence platform to sort through massive amounts of data to pick up emerging infectious disease threats earlier
- Using AI on multiple sources of data
  - Air travel
  - Climate
  - News
  - Vector populations ect….

https://www.dlsph.utoronto.ca/2023/08/09/ai-artificial-intelligence-infectious-diseases-vaccines-cvpd-kamran-khan/

Text classification for foodborne illness outbreak investigations using deep learning

- Local public health agencies are required to investigate all cases of foodborne illness
  - Investigators use detailed food history to help identify the source of infection
- The CDC trained a model to automatically categorize food exposures from free text, which can then be used for analysis
- Using cluster computing, the CDC trained a **deep neural network** language model to predict food categories for free text observations



Rosella LC, Harish V. Machine Learning Applied to Routinely Collected Health Administrative Data. Healthc Q. 2022 Apr;25(1):12-16.

- Identify the data that matter most
- Make better use of the data that we have
- Embrace complexity that gives us more information on the factors that influence population health

Opportunities to integrate complex and unstructured data sources on the broader determinants of health into health system monitoring

Thinking Critically

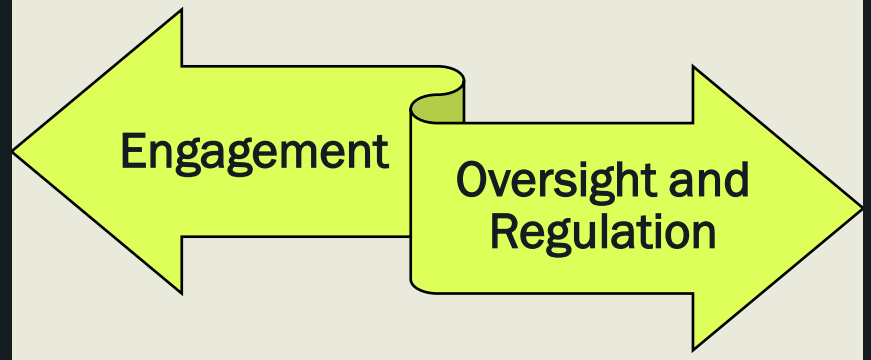
Morgenstern, J.D., Rosella, L.C., Daley, M.J. *et al. BMC Public Health* **21,** 40 (2021).

Algorithmic Bias
Data Quality
Signal vs. Noise
Oversight and Regulation

Building Responsible AI for Health Monitoring

Centering patients, practitioners & operators

- All stages of problem identification, design, implementation, evaluation
- Address real public health and community challenges
- Based on authentic relationships



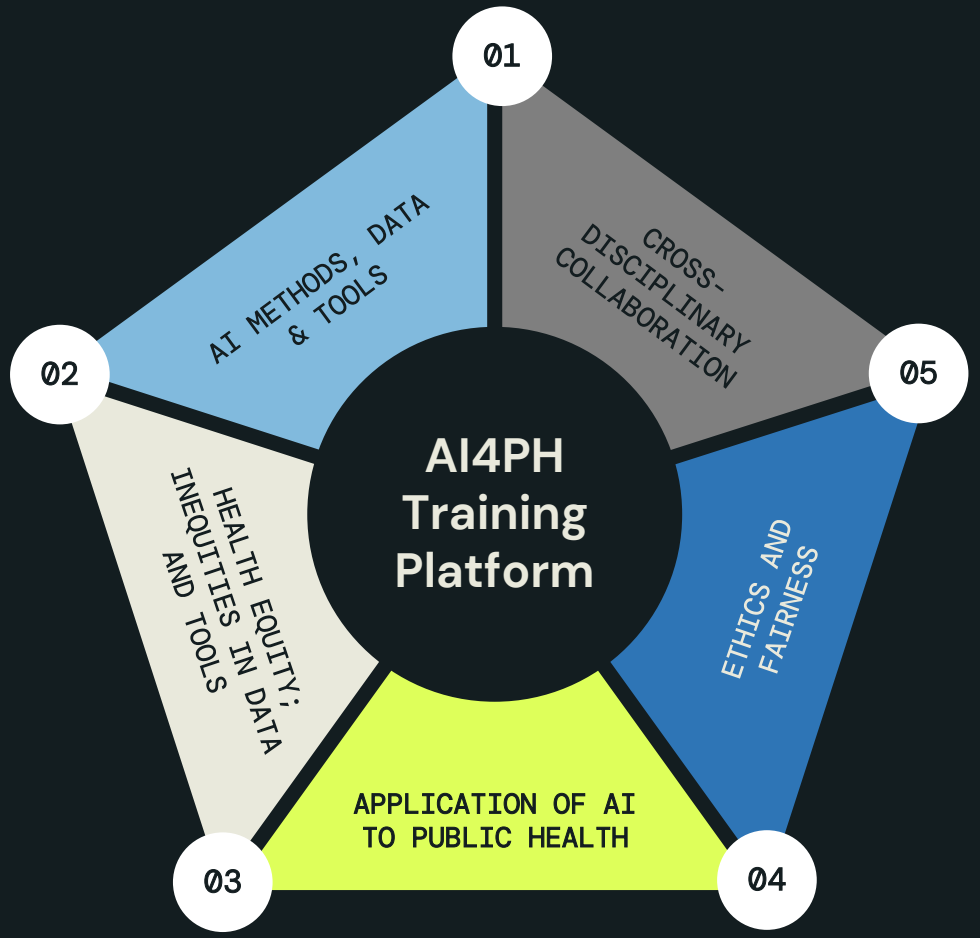
Regulation: Formal rules or laws created by a government or regulatory authority

Guidelines: Guidance or Strong Recommendations without enforcement

Standards: Standards are formal documents that establish specific criteria requirements; more detailed than guidelines

This is a team sport

AI FOR PUBLIC HEALTH (AI4PH) TRAINING PLATFORM



MISSION

To establish a workforce of public health researchers and practitioners who develop and apply innovations in equitable artificial intelligence (AI) and machine learning (ML) to public health research, policy, and practice in Canada.

Future of AI x Health Monitoring

- AI and ML allow for use of new data sources which can open new surveillance/monitoring opportunities
- Allow for scale and impact
  - Potential to expand and streamline the ability to detect information for action
- To complement or enhance existing public health activities (NOT replace)

- Assessing and mitigating bias is a priority
  - Focus on quality of data
  - Ensure engagement and co-leading by health system experts
- Strengthening data infrastructure and data quality are critical

Oversight and monitoring are needed for effective and responsible healthcare and public health monitoring

Thank you!

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/ai4ph-health-research-training-platform