Infectious Epidemiology as a Dynamic Changing Landscape

2019 AMIA Student Design Challenge

Stephen Lee[1,2], MD, Patty Langasek[1], BSc

[1]Oregon Health & Science University, Department of Medical Informatics and Clinical Epidemiology, [2]University of Saskatchewan, College of Medicine

The Problem

- 6 in 10 diseases are transmitted from animals[1]
- 75% of emerging diseases are zoonotic[1]
- Changes in Animal Ecology Change Endemic Regions
  - International Travel
  - Climate Change
  - Human Habitation or Habits (E.g., Urban Farming)
- Physician training revolves around static epidemiology knowledge

Unexpected Zoonotic Disease Emergence

- Cluster of *Histoplasma capsulatum* cases in Saskatchewan, Canada
  - Not endemic to region and likely linked with bat migration
  - Delayed patient treatment because unexpected and not on physicians' differential diagnosis
- Changes in tick borne disease endemicity and vector behaviour from climate change[2,3]
- *Toxoplasma gondii* emergence in whale populations in British Columbia[4]

Epidemiology is *Dynamic*

Figure 1: One Health: Animal, Environmental, and Human Health are intricately connected. Impacts on one affect all.

DynaEpi

https://github.com/DynaEpi

DynaEpi Desktop Browser Navigation Views

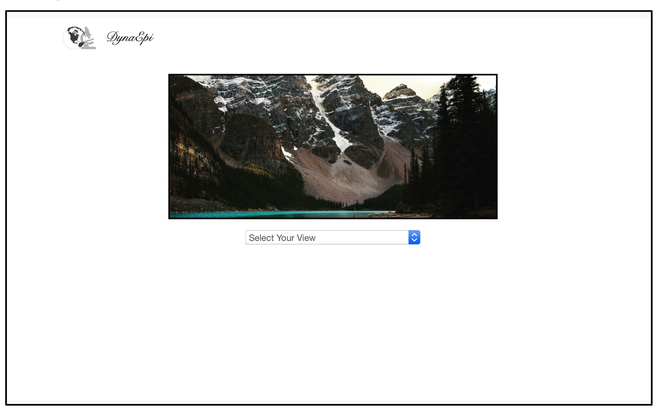

Figure 2: *DynaEpi* Desktop Browser View

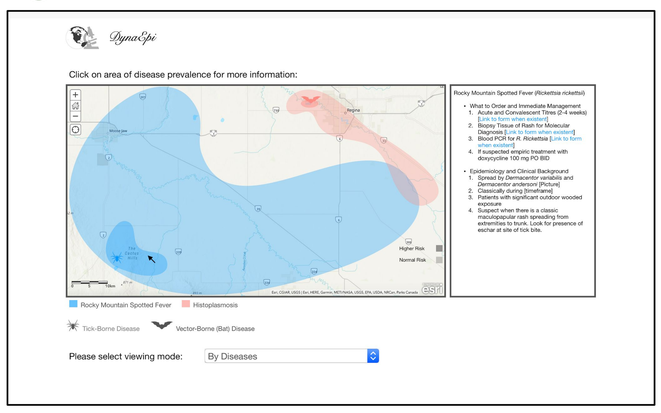

Figure 3: Screenshot for Disease View

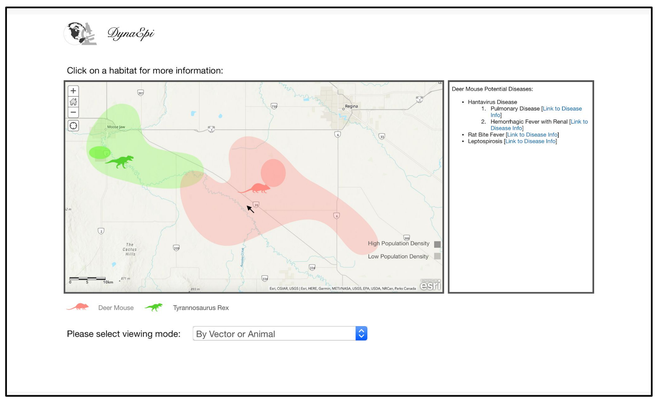

Figure 4: Screenshot for Vector/Animal View

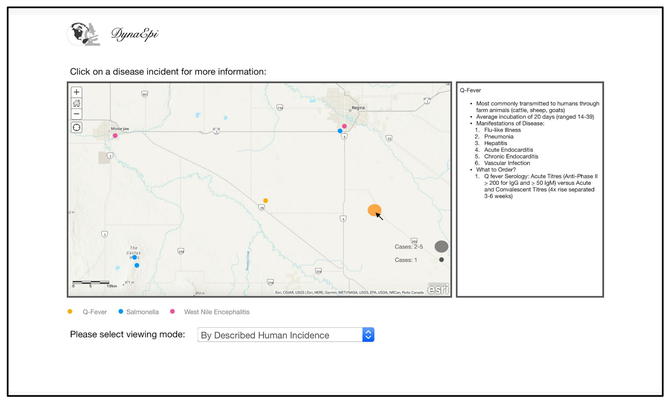

Figure 5: Screenshot for Human Incidence View

UI Design Process

- Iterative design process based on feedback from different countries, practice settings, and specialties.
- Major Feedback Points and How We Addressed Them:
  - High workload and limited time:
    - User-friendly UI
    - Disease view
    - Mobile phone app
  - Limited Day-To-Day Applicability:
    - Not for routine clinician use
    - Intended for specific specialties (ID, Emergency Medicine & Critical Care, Epidemiology, Travel, and Public Health)

Back-End Data Requirements

- Animal migration information to be collected from zoological studies from partnering:
  - Veterinary Schools
  - Researchers
  - Public Health Authorities
- Disease Mapping Database specifically designed and to be curated for ***DynaEpi***'s current and future visions.

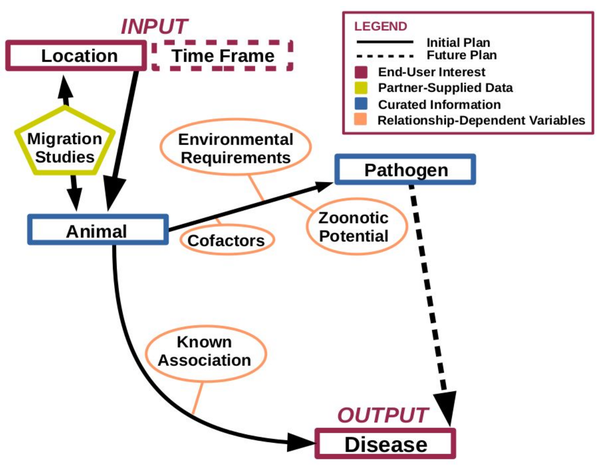

Figure 6: Animal-to-Zoonotic Disease Mapping Database Schema: implement expectation is Neo4j. Boxes are nodes, ovals are relationship variables.

Future Plans

- Mobile phone application
- AI and machine learning/systems models to predict emergence of disease and changes in epidemiology

References

1. CDC. Zoonotic Diseases. Accessed on October 24, 2019.
2. Bouchard C, Dibernardo A, Koffi J, Wood H, Leighton PA, Lindsay LR. Increased Risk of Tick-Borne Diseases with Climate and Environmental Changes. CCDR. April 2019. 45(4):81-89.
3. Brownstein JS, Holford TR, Fish D. Effect of Climate Change on Lyme Disease Risk in North America. Ecohealth. 2005. 2(1):38-46.
4. Dolgin E. As the ice melts. Nature. 2017 Mar 29; 543(7647):S54.

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