THE UNIVERSITY OF LOWA **College of Public Health**

Introduction

Healthcare-Associated Infections (HAIs)

Over 5,500 registered hospitals across the United States are available to receive consultation and remedies for disease (AHA, 2018).

- In such institutions, HAIs are infections patients can acquire while receiving treatment.
 - This not only poses a threat to those seeking clinical help, but it also endangers those that are present in the exposed area, including providers and visitors.
- On any given day, about one in 25 hospital patients has at least one HAI (CDC, 2018).
- Clostridium difficile (C. diff) is a prevalent HAI that causes a range of symptoms, from lifethreatening inflammation of the colon to non-threatening diarrhea (Mayo Clinic Staff, 2016).

Practicum Plan

Understanding the highly active and transmissible infection motivates my practicum. Looking into how and thwarting the spread of C. diff, related HAIs, and other diseases is of high importance and poses a relevant public health problem to be solved. Through proper planning, review of protocol, and analyzing what drives transmission of disease, the spread of HAIs can be prevented.

Background

State Hygienic Laboratory: A Brief Glimpse

The State Hygienic Laboratory (SHL) is the state of Iowa's leading public health and environmental laboratory.

- It has been the forefront of some of the biggest issues in public health through the facilitation of various public health efforts across all of Iowa's 99 counties.
- Some of these public health efforts include but are not limited to: education of public health topics to lowan communities, newborn and maternal screening, testing of environmental quality, and disease detection.

SHL Mission Statement:

"The State Hygienic Laboratory at the University of Iowa protects and improves quality of life by providing reliable environmental and public health information through the collective knowledge and capabilities of our organization."

SHL Funding Sources

All SHL funding sources are overseen by their Grants and Contracts Staff (see below): Internal: University of Iowa

External: State agencies – Iowa Department of Natural Resources, Iowa Department of Public Health, Iowa Department of Inspections and Appeals; *Federal agencies* – Centers for Disease Control and Prevention, Food and Drug Administration, Environmental Protection Agency, U.S. Department of Agriculture, Association of Public Health Laboratories

Personal Assessment & Public Health Competencies

Merging Public Health with Big Data

- Public health is one of many fields that take advantage of the data that is available.
- The three defining properties of big data are described using three V's: 1. Volume
 - 2. Variety
 - 3. Velocity
- Big data is quite pervasive and is quickly changing the way we practice public health.
- From its increasing availability of information to the way its practitioners are incorporating data-driven methodology into research and development, public health is changing as big data explodes further.

Plenty of Public Health to Go Around

The biggest and most positive lesson I have learned from the practicum is that there is never enough help when working in public health.

- On my own, I was able to accomplish an immense amount of work with the guidance of my copreceptors, given the short amount of time provided in a summer session.
- However, having people with similar skills as mine and others with completely different ones would have tremendously improved the quality of work.

Public health demands an interdisciplinary approach to solving its problems, and there is plenty of room for practitioners to facilitate the development of the best answers to population health-based problems.

The Disease Network: A Surveillance Tool to Track & Analyze Disease Spread Jarren Santos, M.P.H. Candidate, Quantitative Methods **Location:** State Hygienic Laboratory **Preceptors:** Michael Pentella | Jacob Simmering

Evaluate current protocol and tools to monitor disease surveillance within the state of lowa.

 Determine if such protocol and tools exist, whether there are resources at the state, county, and organizational levels.

- Summarize findings and make recommendations based on findings in a report V to be submitted.



Figure 1: Example data visualizations incorporated into the IA HCUP Network Visualization Tool. Hospital transfer networks were drawn to convey information on the transmission of disease, resulting in a traditional network visualization (left) and a geographic visualization (right).

five-number summaries and histograms.

Epidemiology – C-4: Explain the importance of epidemiology for informing scientific, ethical, economic, and political discussion of health issues.

Health Policy and Management – D-2: Describe determinants of health and analyze their impact or individuals, communities, and society.

draw connections between these two aspects.



Activities



Analyze what factors determine the transmission of disease through lowan healthcare institutions.

- Extract HCUP data and clean into a format ready for manipulation and analysis.

- Develop a model that appropriately accounts for factors associated with the transmission of disease and communicate related findings and actionable strategies.



Develop a surveillanc tool that is readily and easily accessible to those that utilize it.

- Prepare HCUP data for display in appropriate data visualizations.

- Research design and accessibility standards to incorporate into the tool.

 Convey how disease can spread throughout the state of lowa in a comprehensib manner, based on HCUP hospital and simulation dat

Biostatistics – A-5: Apply descriptive techniques commonly used to summarize public health dat Summary statistics are displayed for the selected type of transfer of interest, including corresponding

Biostatistics – A-8: Apply basic informatics techniques with vital statistics and public health reco in the description of public health characteristics and in public health research and evaluation. Data mining and manipulation were conducted using appropriate software and algorithms via R for Statistical Computing. Data were extracted from the HCUP database notably using the *tidyverse* libraries, while the surveillance tool was created mainly using the shiny and visNetwork libraries.

The surveillance tool was created for users to navigate how disease transmission looks like in lowa, specifically using a network analysis approach. Although network analysis is quite complex and expansive, the surveillance tool can communicate foundational information and spark discussion.

In-depth analysis was not necessarily conducted, but the surveillance tool includes information about relationship between the determinants of health (ie. sex, age) and disease transmission to help users



Recommendations & Conclusions

ce d	Although I may not have been able to fully accomplish what I had initially planned for my practicum, I felt that I made the most of my time available during the summer session to produce tangible results for SHL, an organization that can make use of my work and continue looking into the transmission of disease from a network analysis approach.
2	Continue Improving the IA HCUP Network Tool The disease surveillance tool is considered as an alpha- release; it is not a fully polished product that is ready for distribution <i>vet</i> .
te ble ta.	 The current features produce some advanced data visualizations and other basic ones that allow for a variety of audiences to grasp the conveyed information. This can be further improved by creating a smoother user-experience for the user. Run-time on some of the features could be shortened for better response and reactivity. Thematically matching each of the tool's sections may help create a holistic experience.
	 Consider Quality Control Protocol using Networks Iowa currently does not approach the development of quality control protocol using hospital transfer networks. Putting consideration into which hospitals are within a specific network may help drive quality control measures & result in improved outcomes throughout the network. For example, implementing a new hand-washing routine in one clinic may immediately help that specific location, but it may later help other connected institutions. Future interventions could look at this particular impact
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a.	 and assess the effects and the degree at which these institutions were affected. References American Hospital Association (AHA). (2018). AHA Hospital Statistics: A Comprehensive Reference for Analysis and Comparison of Hospital Trends, 2018 Edition, ISBN: 978-0-87258-972-8. About the SHL. Accessed on 2018 Jul 20. State Hygienic Laboratory at The University of Iowa. Available at http://www.shl.uiowa.edu/about/mission.xml Best EL, Fawley WN, Parnell P, Wilcox MH. (2010 Jun 1). The Potential for Airborne Dispersal of Clostridium difficile from Symptomatic Patients. Clinical Infectious Disease 50(11): 1450-1457. DOI: https://doi.org/10.1086/652648 Centers for Disease Control and Prevention (CDC). Healthcare Associated Infections Progress Fact Sheet, Iowa. Available at https://www.cdc.gov/hai/pdfs/stateplans/factsheets/IA.pdf Centers for Disease Control and Prevention (CDC). Last updated 2018 Jan 9. Healthcare-associated Infections. Available at https://www.cdc.gov/hai/surveillance/index.html Donker, T, Wallinga, J, Slack, R, Grundmann, H. (2012). Hospital networks and the dispersal of hospital-acquired pathogens by patient transfer. PLoS One 7(4): e35002. doi: 10.1371/journal.pone.0035002 Iowa Department of Public Health (IDPH). (2015 Sep 14). New HAI Initiatives 9.3.15. Recorded webinar. Available at https://www.voutube.com/watch?v=he?r&9S9HEM&feature=voutu be
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