

Designing Epidemiological Networks for Real-world Surveillance Settings

Ben Y Reis P.h.D., Kenneth D. Mandl M.D., M.P.H.

Children's Hospital Informatics Program at the Harvard-MIT Division for Health Science and Technology

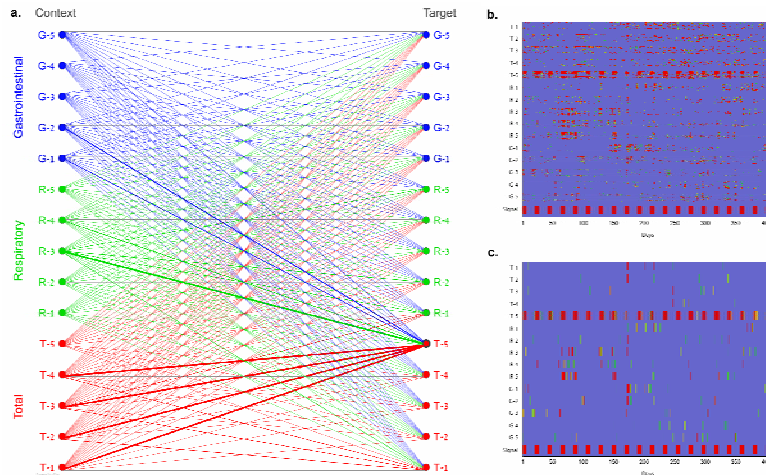


Figure 1 – a. The epidemiological network model tracks the *relationships* amongst healthcare variables. b. The activity at each node is evaluated from the perspective of each of the other nodes. c. A consensus view is constructed for each node by combining all these perspectives. A full network is shown. The paper describes considerations for designing and applying these networks in real-world settings.

OBJECTIVE

This paper describes the syndromic networks paradigm [1] and its application to various surveillance settings.

BACKGROUND

Most current health surveillance systems are vulnerable to unpredictable shifts in the data that they monitor. These shifts can occur during major public events [2] or during epidemics and pandemics as a result of quarantines, the worried-well flooding emergency departments [3] or, conversely, the public staying away from hospitals for fear of nosocomial infection [4]. To address this challenge, we have previously described a class of epidemiological network models that monitor the *relationships* among different healthcare data streams [1]. The results of that study showed that the network models provide better detection of localized outbreaks, and greater robustness to unpredictable shifts than a reference time series modeling approach. However, in order to apply these networks in a real-world setting, the optimal network composition must be determined.

METHODS AND RESULTS

We will review the epidemiological networks model and discuss the various relevant considerations for their design in specific settings, including: which hospitals to include; which syndrome groups at which hospitals to include; whether to build separate networks for different syndromes that span across facilities, or separate networks for different facilities that

span different syndrome groups. We will also discuss the implications for regional and national systems.

CONCLUSIONS

The epidemiological network model offers an alternative, complementary surveillance approach that is more robust to unexpected shifts and offers improved outbreak detection performance. The practical considerations that go into the network design process described here will serve to facilitate the adoption of this approach in real-world surveillance settings.

REFERENCES

- [1] Reis BY, Kohane IS, Mandl KD, PLoS Med. 2007 Jun 26;4(6):e210
- [2] Wetterhall SF, Coulombier DM, Herndon JM, Zaza S, Cantwell JD. (1998) Medical care delivery at the 1996 Olympic Games. Centers for Disease Control and Prevention Olympics Surveillance Unit. JAMA 279: 1463-1468.
- [3] World Health Organization. (2006) Pandemic influenza preparedness and mitigation in refugee and displaced populations, WHO guidelines for humanitarian agencies Programme on Disease Control in Humanitarian Emergencies Communicable Diseases Cluster.
- [4]. Lau JTF, Yang X, Pang E, Tsui HY, Wong E et al. (2005) SARS-related perceptions in Hong Kong. Emerg Infect Dis 11: 417-424.

Further Information:
Ben Reis, ben_reis@harvard.edu