Context Based Medicine: Real-time Surveillance and Application of Infectious Diseases Epidemiology

It's a busy emergency room at the beginning of winter. You, the doctor, are working your first shift in weeks. You've seen a few patients, both children and adults, with a similar cough and fever, and are a bit surprised, since you haven't heard anything about flu season having yet started. You check your smartphone to find out the latest: the rates in the past week of pertussis in your community is 18% above normal compared with last year, the rate of influenza is negligible, and the rates of invasive pneumococcal bacterial disease has seen a substantial spike in a neighbouring community the week prior. Using this information, you slightly alter your typical practice, testing for pertussis in one patient, getting a culture for pneumococcal disease in another, not worrying about influenza disease in most. What you have done is novel – used traditional population-based , biosurveillance data and applied them at the individual patient level, putting each patient you see in their own context, one that changes by day and by area code.

We are extraordinarily lucky in Canada that our laboratory diagnostics are, more or less, centralized. Every province has its own provincial lab, in addition to hospital labs, where specimens are sent for testing for a variety of conditions. These provincial labs are integrated with most individual hospitals and clinics, so as to provide support and help tabulate statistics. Unfortunately, much of this information is far removed from the front-line healthcare provider, who either is forced to either sort through mounds of poorly organized data, or have frequent discussions with their local lab, both unrealistic propositions in the busy world of primary and emergency care.

Quick and rapid access to the infectious happenings in one's community, in the form of easy-to-digest bulletins and graphs, customizable by geographic region, would help solve this problem, and provide protean benefits within every sector of healthcare. Patients would have their care individualized, taking traditional evidence-based medicine and optimizing it with real-time contextual updates as it relates to infectious diseases. Physicians and healthcare providers would save valuable time and energy in sorting out what is currently happening, allowing for optimal care. There is a potential for cost-savings and new efficiencies introduced in the system, minimizing unnecessary tests and helping to streamline care. Most importantly, it would be a powerful tool in the surveillance of existing and emerging infectious agents. As the recent influenza pandemic has shown, we will constantly be faced with this issue, and detecting any potential outbreak as early as possible is crucial for an effective sector-wide response. Through built-in technology that notices any unexpected uptick in a specific agent, and having users upload real-time data about what they're seeing, what will result is an ever-changing map of infectious diseases, increasing substantially the sensitivity and responsiveness of existing surveillance techniques.

Logistically (see Figure 1), this idea would be fairly straightforward to set up. A centralized database would be required, where participating hospitals and clinics, in addition to provincial labs, would submit de-identified testing results for various infectious agents, data that already exists. This could be piloted with influenza, for example, and then scaled up to a variety of agents. In addition, individual providers would have the ability to upload data in real-time so as to increase the sensitivity of disease surveillance. The application interface would consist of geographic maps, where users could zoom on in their particular region and graphically visualize rates of disease, as well as enter data such as numbers of

cases of documented influenza seen, or numbers of cases of unexplained fever and cough, for example. The database would be set-up so as to automatically generate these figures so that after initial set-up costs and labour, maintenance costs would be negligible and easily integrated to pre-existing healthcare infrastructure, as well as providing a constantly updated wealth of data for policymakers. Ultimately, this would benefit every individual who accesses healthcare in the primary care or acute setting where this data is collected.

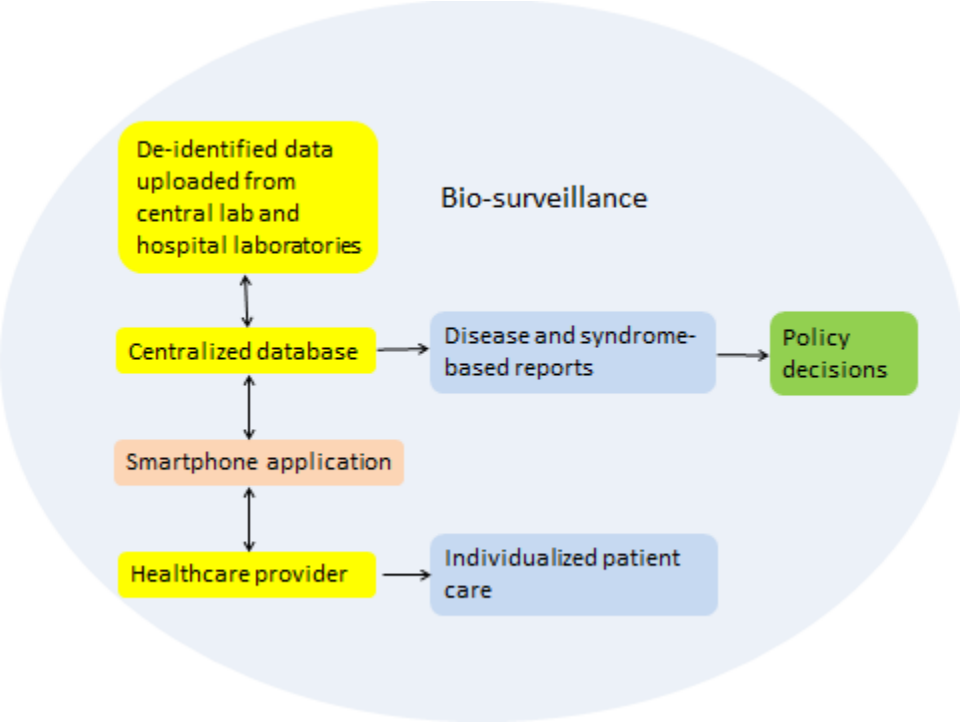

Figure 1: Proposed schematic for Context-Based Medicine Project

As a specialist in pediatric infectious diseases and critical care, I realize that improving the ability to effectively sort through the vast quantities of available epidemiologic data so as to make better decisions is vital in improving the quality of delivered care. One of the major criticisms of the evidence-based medicine movement is that it decontextualizes the individual patient, providing only large, population based estimates of intervention effects and limiting the ability to make decisions about the patient in your office or your emergency room. What this proposal aims to do is help bridge the individual and the population, ultimately optimizing the care of both through an easy-to-use application, so that the patient in your emergency room, who you know is coming from a pertussis-heavy region, can be appropriately tested. In addition, as SARS and pandemic influenza have taught us, any improvements in the detection of emerging and re-emerging infections could have large impacts on the well-being of the country.