March 2016

Precision Medicine for Infectious Diseases

'Precision' medicine is a recently coined term closely related to what has previously been called 'Individualized' medicine. The goal is to refine standard treatment regimens to individual patient or disease characteristics. The term 'Precision' implies a more scientific or technological approach to the individualization process. This concept has recently been applied to the field of oncology where it is hoped large tumor and patient genetic databases, combined with big data analysis, will lead to better anti-tumor regimens. For more information:
https://medtechboston.medstro.com/blog/2015/02/09/precision-medicine-sounds-good-right/

The discipline of Infectious Diseases (ID) shares many general characteristics with Oncology and lends itself to the same Precision Medicine/Big Data approach. Characteristics in common:

- Large numbers of heterogeneous diseases and patient population.
- Utilization of chemotherapy and immunotherapy. Infectious diseases immunotherapy is currently mostly in the form of vaccines. Modern immunotherapy for infections is on the intermediate horizon. Anti-toxins, a form of immunotherapy, have been available for decades.
- Both disciplines have an acknowledged need to individualize treatment regimens.
- Use of genetics. Oncology utilizes tumor genetic markers on a regular basis. Nucleic acid based techniques are now routine in clinical microbiology.

The biggest barrier to Precision Medicine for Infectious Diseases is the lack of a central database that includes the relevant patient characteristics, similar to that proposed for the NIH Precision Medicine Cohort Program for Oncology. Indeed, the CDC has proposed a limited form of this type of database to monitor some types of bacterial resistance:
http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6430a4.htm?s_cid=mmmm6430a4_w

Infectious diseases are at least an order of magnitude more common than cancer and the collection of a database would be a significantly larger undertaking. A meaningful dataset would require information from both the treating physician and the electronic medical record (EMR). The current practice of using billing codes to track infection details is not an option as it is notoriously inaccurate and is a method to optimize billing, not to accurately describe patient details. The Antibiotic Adjuvant approach to physician antibiotic prescribing is a practical method to build such a meaningful database, using information entered by the prescribers themselves while they rapidly click through the algorithms.

The benefits of this proposed database would be huge from both an epidemiologic perspective and the patient care point of view.

Sample questions to be learned from a Big Data analysis of facility wide or regional treatments of infectious diseases that combines physician designated diagnoses and EMR derived patient characteristics, lab results, microbiology reports and antibiotic usage patterns are:

- Which antibiotic(s) are associated with the best outcomes and the least acquisition of resistant superinfections for a specific bacterial infection or syndrome in a specific type of patient?

- Is the prevalence of specific infection types changing, as well as their outcomes?

- What is the best strategy for mixing or balancing antibiotics to prevent multi-drug resistant clones from propagating in a hospital, medical facility or community?

- What is the best antibiotic mixing pattern to combat a specific type of resistant clone?