Matthew Samore, 2015

Research

The mission of our VA and University health services research program is to advance scientific discovery, implement novel interventions, promote collaboration, increase research capacity, and engage operational partners to improve healthcare delivery. We use methods drawn from socio-technical systems theory to examine the gaps and needs of decision-makers. Using tools such as ethnographic observation, cognitive task analysis, psychometrics, and social network analysis, we examine interactions between technology and human behavior in complex systems of care.

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Population analytics provides another set of tools to convert experience and observations, as represented in healthcare data, into knowledge and evidence. Analysis of “Big Data” requires integration of expertise in informatics and epidemiology. Natural language processing methods are needed because much of the clinical data in electronic health records are in text form. Discerning treatment effects from observed associations entails an understanding of methods of causal inference. Predictive modeling involves the construction of statistical algorithms to forecast future events or to classify current status.

Our research on clinical practice and decision-making lays the groundwork for development of innovative solutions. We design theory-driven systems for decision-support which have high potential for translation and generalizability. In cooperation with our operational partners, new interventions are fit to clinical workflow to ensure adoption and enhance impact. The clinical environment is transformed, producing a new set of needs in an iterative cycle.

Our work in the area of antibiotic resistance and antibiotic stewardship illustrates these processes. Through epidemiological investigation, we characterized mechanisms by which antibiotic use contributes to spread of antibiotic resistant pathogens and identified sources of variation in management of acute infection. Analyses of secular trends demonstrated increased use of broad spectrum antibiotics which was usually not justified by results of microbiological tests. Overuse of antibiotics constitutes a major target for practice improvement.

Research Service Project: Develop Capacity for Simulation and Modeling at the University of Utah.

The purpose of this Benning Research project is to expand capacity at the University of Utah in the use of simulation and models in population health science. Our activities in this area during the past year has been highly productive. We recently submitted three major grants to expand our research portfolio in simulation and modeling. At least two more grant submissions will be forthcoming in the fall of 2015.

Our work demonstrates the myriad kinds of models that can be used to support population analytics. For some types of investigations, the research innovation is in the size and scope of the data, rather than the techniques of analysis. Our application of computational models to examine “Big Data” derived from electronic health records highlights this approach. We have been able to show the power of combining structured data with information extracted from text. For other types of problems, existing methods of analysis are insufficient. For example, in order to adequately characterize transmission of antibiotic resistant organisms within healthcare systems, we had to develop new procedures to estimate parameters from data.

The examination of variation in practice is a key initial step to identify opportunities to improve the quality of care. Hierarchical statistical models are useful for contrasting different levels of variation, encompassing patient, clinician, and facility. We used hierarchical models to examine antibiotic prescribing practices for acute respiratory infection in the national VA healthcare system. More than one million outpatient visits were included, representing approximately...
45,000 providers and 990 clinics. Natural language processing was applied to clinical notes to ascertain antibiotic prescriptions that were not captured in fill orders. We showed that the clinician was the most important source of variation and that most variation across clinicians was not accounted for by differences in patients.

Another area of modeling for which we are expanding capacity is in causal inference. Causal models play a fundamental role in the generation of evidence about the comparative effects of alternative treatments. A new area of focus of our group is the comparative effectiveness of dynamic treatment regimes. Our capabilities to fit transmission models to infection data have also been significantly extended this past year. These models make it feasible to quantify the distinct impact of system factors – such as patient flow, microbiological detection, healthcare worker behavior, and antibiotic use – that influence transmission of resistant organisms.

Papers published by our modeling group this year addressed emerging pathogens such as Ebola, pandemic influenza, and carbapenem-resistant *Klebsiella pneumoniae*. We used agent-based models to evaluate the predicted impact of regional coordinated strategies on control of carbapenem-resistant *K. pneumoniae* infection in a network of hospitals and nursing homes. Our group of investigators also published results from a series of studies to model the health and economic effects of healthcare-associated infections on mortality, length of stay, and costs.

**Biographical Summary**

*Education and Professional Experience:* Undergraduate in Biology at Macalester College (1975-1979); MD at University of Wisconsin-Madison (1980-1984); Internal Medicine Residency at Washington University; Fellowship in Infectious Diseases at Brigham & Women’s Hospital and Beth Israel Hospital (1987-1990); Faculty Member at Harvard Medical School (1990-1998); Faculty Member at University of Utah Department of Internal Medicine (1998-present)

*Current Professional Service:* Chief, Division of Epidemiology; Director, Informatics, Decision Enhancement and Analytic Sciences (IDEAS) Center; Co-Chair Search Committee for Chair of Population Health Sciences

*Honors and Awards:* National Merit Scholar; Phi Beta Kappa; Alpha Omega Alpha; Cora M. & Edward Van Liere Award for Highest Academic Achievement; Elbert and Marie Christensen Research Professorship; Association of American Physicians

**References**