# Populomics, an Emerging E-Health Response to Comtemporary Healthcare Realities

**Michael Christopher Gibbons**
*Johns Hopkins Urban Health Institute, USA*

## INTRODUCTION

There is increasing interest in the role of technology in health care and public health. Several researchers have predicted a coming revolution in health care similar to the transformations that occurred in the finance and retail industries upon the widespread adoption of computer technology (Abrams, 2006; Crane & Raymond, 2003; Gibbons, 2005, 2006). In biomedical research, computer technology has catalyzed the emergence of whole new disciplines such as regulomics, proteomics, phenomics, and pharmacogenetics (Gibbons, 2005). Telemedicine, e-prescribing, Electronic Medical Records, and computerized physician order entry systems are emerging as important tools to improve the quality of health care even though the broad health care transformation historically envisioned has not yet occurred (Crane & Raymond, 2003).

Several important factors, however, are suggesting a need for significant changes in traditional health care and medical research systems. These include (1) the growing proportion of people living over the age of 65; (2) the increasing prevalence of chronic diseases; (3) increasing global urbanization; and (4) the increasing recognition of disparities (inequalities) in health and health care (IOM Committee on Quality of Healthcare in America, 2001). In the United States over the last century, many acute and communicable diseases have either vanished or become much less prevalent. Over the same time period, there has been a rise in the prevalence of chronic conditions and diseases. To date, approximately 60% of UK citizens and 50% of US citizens report having at least one chronic disease (IOM Committee on Quality of Healthcare in America, 2001; National Health Service, 2004). Cardiovascular disease is now the number one cause of mortality in developed nations. Although chronic diseases usually result in symptoms and/or death in the later decades of life, the origins of these diseases can often be traced to the first decades of life. To complicate matters further, the elderly often have more than one chronic condition at the same time.

The rapid increase in urbanization that is occurring worldwide is increasingly causing many people living in the inner cities to experience an urban health penalty. This is due to the concentration of economic decline, job loss, and major health problems often found in urban centers (Andrulis, 1997). In addition, significant racial and ethnic disparities (inequalities) are often found in the urban environment. These disparities appear resistant to interventions and policies designed to reduce or eliminate them (Acheson D, 1998; Macintyre, 1997; Smedley, Stith & Nelson, 2003) Increasing evidence suggests that disparities arise as a result of complex interactions among socioeconomic factors; behavior, biologic, and environmental factors; and disease that are related to race and ethnicity (Smedley et al., 2003; Haynes & Smedley, 1999; Faber & Krieg, 2002; Amick, Levine, Tarlov & Walsh, 1995; Evans, Barer & Marmor, 1994). As such, multifaceted approaches that extend beyond the current medical model are needed to improve health status (Andrulis, 1997), particularly in the urban environment.

In general, the major health care systems of the world function as acute disease treatment systems. Chronic diseases, however, occur and progress over long periods of time, often without obvious personal health impact. They then slowly lead to progressive declines in health, punctuated by intermittent episodes of acute illness. Effectively managing the acute episodes of a chronic disease often does little to the natural progression of the disease or the prevalence of the disease in the population. Effectively preventing illness and promoting health among patients with chronic diseases will undoubtedly require a technological infrastructure that can enable the real-time monitoring of physiologic, behavioral, and environmental data simultaneously among large numbers of patients. All this will need to occur prior to the need for hospitalization and also during sometimes lengthy periods of time between acute episodes of illness.

To improve health in the community setting, many kinds of novel health technologies will likely be required. For instance, new spatial analytic, epidemiologic, and computational methodologic innovations will be required to support clinical decision-making by turning vast amounts of information and data into usable knowledge. Computer technology will be essential to the conduct of complex, large-scale clinical trials to objectively implement interventions and assess outcomes. To be successful, this technology infrastructure must also facilitate the transfer of culturally and linguistically appropriate health information to patients. The ability to tailor information to individual patient needs will be critical to adequately supporting patient health choices and self-care. Finally, computer-based innovations such as nanotechnology, distributed processing, RFID, and advanced sensor technology, will facilitate the ability to detect changes in the physical status of things, enable intelligent interactions between devices, and enable devices to make independent decisions based on collected data, devoid of prejudice, bias, or other "human error." "Smart devices" in health care include smart phones that can automatically communicate patient data to physicians, "intelligent" homes that can detect if a senior citizen has fallen and then notify Emergency Medical Services (EMS), "smart" vehicles that can minimize motor vehicle accident related trauma, and wearable "smart" clothing that can monitor and wirelessly transmit environmental and physiologic data to providers. Scientists are even attempting to develop intelligent ovens and online refrigerators that can be controlled through phones or the Internet (International Telecommunications Union, 2005). Such technology applications in health care will enable "smarter," behaviorally oriented, patient-centered, and therefore potentially more effective prevention, public health, and clinical treatment strategies.

Achieving this vision, however, will require a paradigm shift in the conceptualization and provision of health care services and the conduct of medical research. It will require less dependence on reductionism while increasingly relying on a more comprehensive multifaceted approach to scientific inquiry. The term Populomics has been used to articulate a new integrated, transdisciplinary approach to health research and practice (Abrams, 2006; Gibbons, 2005). The term is derived from the synthesis of the disciplines that comprise the field; namely, the population sciences, medicine, and informatics. More specifically, Populomics is defined as an emerging discipline focused on population level, transdisciplinary, integrative disease/risk characterization, interdiction and mitigation that relies heavily on innovations in computer and information technologies. Populomics seeks to characterize the interplay of pathways and mechanisms that work across levels of existence to impact the health of individuals and populations. Populomics focuses on the interrelatedness of "environments" and their complex codependence on each other, which in the aggregate either protect health or enable disease. On the other hand, a populomics orientation will also facilitate the development of transdisciplinary strategies and inter-

*Figure 1. Populomics "web of disease/health causation"*