Guest editors' introduction to the special section on information technology and evidence implementation

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Abstract

Healthcare is experiencing a transformation—perhaps as significant as the publication of the first randomized controlled trial—in the ways in which basic discovery is translated into effective practice. The change is being precipitated by efforts to undergird the healthcare industry with the same transformational capacities from information technology as is afforded to other sectors in the economy. Although the transformation has been slow in materializing, change is expected to accelerate under the stimulating influence of the Health Information Technology for Economic and Clinical Health Act of 2009 and the Patient Protection and Affordable Care Act of 2010. As the changes ripple throughout the healthcare sector, two aspects of medical care in the twenty-first century are expected to rise in importance: *data* and *behavior*. Each of the articles within this inaugural issue of *Translational Behavioral Medicine* has been selected to illustrate treatment of these two assets in one way or another. The editors hope this first issue will serve as a vanguard illustration for how behavioral scientists can be included as integral members of the design team in creating a new platform for evidence implementation in the USA and abroad.

Keywords

Information, Information technology, Data, Behavioral medicine, Evidence translation

The year 1952 marked the publication of the first randomized controlled trial (RCT) and its results—an event that would forever change the face of medicine and the structure of medical science [1]. By the turn of the century, however, it was obvious that the RCT alone could not handle the seemingly intractable problems of healthcare in the twenty-first century. Medical errors [2], delays in the translation of life-saving therapeutics [3], uneven diffusion of extant knowledge [4, 5], chronic disease [6], and patient dissatisfaction [7] all suggested that a crucial part of the puzzle was missing. We had yet to solve the problem of the “last mile” [8] in medicine.

COMPLETING THE “LAST MILE”

A term coined by Chew in 2008, the “last mile” refers to the challenge of moving acquired knowledge from the stage of developing clinical practice guidelines to that of changing routine practice nationwide. Due to problems at the last mile, the benefits of evidence-based medical practice are not accruing uniformly, safely, or equitably for all patients [2, 4, 5, 9]. In cancer, for example, it has been estimated that a large portion of the 569,490 deaths [10] expected to occur in 2010 could be avoided *if only* the healthcare system could apply what it already knows about preventing and controlling the disease [11]. Similar results are reported for cardiovascular disease, diabetes, depression, and other prevalent health conditions. More importantly, the healthcare system has not been learning quickly enough from existing data to make changes quickly and efficiently. The translational evidence needed to adjust therapeutic treatments, improve delivery, or spark new discovery has emerged slowly. Evidence-based guidelines are not being applied uniformly across all practices in the USA, and data from the implementation of therapeutic interventions are not being channeled consistently back to health service researchers, policy makers, or practitioners for quality improvement and new discovery [12–15].

This problem can be solved [9, 16]. Health systems researchers and policy makers increasingly understand that the benefits of the information revolution are not being manifest in the health sector to the same degree that they are in other parts of the economy [17, 18]. From 1995 to 2005, productivity increased dramatically in industries infused with information technology (IT), while it decreased in industries such as healthcare that had fallen behind the modernization curve. It is time to apply the lessons learned from other sectors of the economy to medicine. In 2004, President George W. Bush set a national goal to modernize the healthcare system by providing the majority of US citizens with an electronic medical record by 2014 [19]. In 2009, President Obama and the 111th Congress allocated funds from the Health Information Technology for Economic

and Clinical Health (HITECH) Act to stimulate diffusion of this otherwise unevenly proliferating technology [20]. The result—if successful—will be to create a new foundation for evidence implementation in medicine, a foundation supported by health IT [21].

THE ASCENDANT ROLES OF DATA AND BEHAVIOR

By introducing health IT as a foundation for traversing the last mile in health and healthcare, policy makers are creating a twenty-first century healthcare solution that will revolve around two principal assets: *data* and *behavior*. Both are attributes of an evolving Internet environment as industries reinvent themselves in the information economy; both will be crucial for moving healthcare from a reactive focus on disease management to a proactive focus on health [22].

IT luminary Tim O'Reilly observed that, after the “dot.com” implosion, surviving companies oriented themselves around a core set of design principles. Central among these principles was that of valuing data as the “New Intel Inside,” the ingredient that empowers managers with evidence-based decision support and supports consumers in the myriad decisions they make daily [23]. O'Reilly believed that healthcare would benefit especially from this new evolution. Healthcare is notoriously slow in translating discovery into practice, rectifying systemic errors, seizing opportunities for preemptive intervention, and following patients across providers. It needs an “Information Nervous System” that would allow it to respond to a changing patient environment as changes occur [24].

The concept of equipping healthcare with a more efficient information nervous system is intriguing. In a healthcare industry supported by interoperable (i.e., seamlessly integrated) information technologies, data could become the *neural impulse* enabling the development of an adaptive, learning system of care. By studying the *efferent* properties of a system designed to turn data into information, information into knowledge, and knowledge into action, designers of the new healthcare enterprise can begin to improve the ways in which medical evidence is translated into high-quality practice. By studying the *afferent* properties of data systems designed to bring signals from the point of care back into the laboratory, health system designers can begin to shorten the time it takes to gather evidence on implementation and use that evidence to improve therapeutic regimens and shore up vulnerabilities in practice [14, 15].

More efficient use of data is one aspect of the transformational change occurring in the evolution of healthcare information services. Another is a focus on how the use of new systems influences behaviors. *Usability analysis* [25] and *human factors engineering* [26], once the purview of sectors such

as aviation and aerospace, are now becoming a necessary component of business anywhere in the information economy. Likewise, healthcare systems are adopting the goal of supporting a sense of engagement between service provider and users and allowing users to co-create value through social networking and various forms of online participation. Businesses in the new economy are actively leveraging modes of user participation by soliciting reviews, helping users connect with suppliers, and facilitating their efforts to spread the word of appreciated products or services [23, 27]. New information ecologies are emerging in health [28–30] as systems begin supporting users' basic need to connect with others socially and to gain autonomy over their own health decisions through the “collective intelligence [31–33].”

Medicine has yet to fully join the trend toward crafting an information environment that optimally supports users' behavior [34]. In a systematic review of the industry by the US-based National Research Council, engineers gave multiple examples of computational technologies that appeared to be interfering with, rather than supporting, the effective actions of users. The report's authors argued that it was time to rebalance the federal portfolio of research in medicine away from development of new technology and toward a better understanding of how to provide cognitive support for physicians, patients, and their families in the use of existing IT. User behavior, the report suggested, must become the standard to which technology is calibrated in a patient-centered system of care [35].

INTEGRAL MEMBERS OF THE DESIGN TEAM

The success of this new phase in medicine depends on the healthcare system's ability to incorporate intelligence and best practice from two new members of the design team [36]. One is the information scientist, or informaticist, who applies intelligence garnered from the IT world to the task of delivering the right information to the right member of the healthcare team at the right time, so as to ensure delivery of effective, patient-centered care. He/she coordinates expertise from information design, data visualizing, data processing, digital display, systems engineering, and operations management to improve communication channels within healthcare systems [37].

The other new team member, we believe, is the behavioral scientist. If the refined healthcare system fails to bring about true support for physicians, office staff, patients, and their families, all of the technological improvements in medicine will be for naught. The new information environment will be perceived as unappealing, unfriendly, or even hostile if it fails to take into account basic human characteristics such as cognitive capacity, cultural

backgrounds, attitudinal dispositions, linguistic capabilities, motivations, or affective states. Conversely, a health information environment that systematically supports positive health behaviors can save lives by optimizing the reach, effectiveness, and efficiency of current best practice [11, 38, 39].

Scientists and practitioners in behavioral medicine now have an unprecedented opportunity to improve the delivery of psychosocial services in patient care. Provisions in the Patient Protection and Affordable Care Act of 2010—a companion to the HITECH Act of 2009 [40]—seek to ensure that services are provided for the “whole patient” [41], with a special emphasis on preventive services. Requirements for “meaningful use” [42], a legislatively mandated precondition for reimbursement of health IT expenses, will emphasize safety, patient engagement, continuous care, population health, and patient privacy as targets for IT support [43]. Meaningful use is the harbinger to the next phase for the US healthcare system—rapid learning healthcare [12]. In this context, using the IT tools developed to support a nimble, adaptive, patient-centered healthcare system, behavioral scientists can (a) ensure that psychosocial services are included in the checklists and guidelines supporting patient-centered care, (b) embed evidence-based decision support into IT platforms, (c) encourage greater patient participation and empowerment, and (d) generate evaluative data on the effectiveness of interventions deployed within healthcare settings.

CONTENT OF THIS FIRST ISSUE

In this context, we are very pleased to have participated in production of the inaugural issue of *Translational Behavioral Medicine: Practice, Policy, Research*. Within the issue, readers from all walks of behavioral and general medicine should find relevant content. Scientists and practitioners interested in reviewing original research will find the articles led by Baker, Midboe, Bowen, Hawkins, and Winnett to be insightful. These articles present data from controlled studies on the translational deployment of behavioral applications within eHealth settings, defined in terms of broad Internet use as well as focused healthcare environments. Case studies led by Dearing and Peterson complement the original research with in situ descriptions of networked applications intended to improve practice and to serve as a basis for comparative effectiveness studies, respectively. The patient-reported outcomes based adverse event monitoring system being developed by Basch and colleagues bridges practical behavioral-focused IT applications with drug discovery and testing.

Those with an interest in the application of research within public health and care settings are directed to several articles of an applied nature. Vinson and colleagues describe an approach for

incorporating research-tested, computerized, tailored interventions into consumer-facing informatics systems. Jones and Basch describe techniques for including patient preferences and behavioral outcomes in the decisional milieu of clinical care. We are especially pleased to include a practice-oriented synopsis of consumer health informatics applications as they have been implemented in real-world settings: Gibbons and colleagues provide a comprehensive roadmap for what works and what does not in the expanding field of consumer-facing informatics.

Finally, for those with an eye toward theory and policy implications, we have several cutting-edge offerings. Riley and colleagues take on the burgeoning market of real-time mobile applications and ask whether extant behavioral theories are up to the task of steering these applications toward optimal outcomes. Morris and Beckjord examine what it may take to include psychosocial services, including tobacco cessation and mental health services, into care delivery managed through fully functional IT systems. Expanding on that notion, Hesse and colleagues point to the broader policy implications of designing a healthcare system that uses incentives, mental models, defaults, feedback, error tolerance, and structured decision making to support better patient outcomes. Finally, Abernethy and colleagues expand the perspective further by describing the role of IT in supporting translational research across the spectrum from efficacy trials to practice implementation. In another paper, Abernethy et al. discuss the importance of data liquidity as the basis for an inherently information-based, intelligent healthcare system.

CONCLUSION

When commenting on the transformation of the global economy, Thomas Friedman once confessed that many of the big changes in the order of the world around him had occurred “while he was sleeping;” the process of transformation went on unnoticed until he awoke one day to realize that the world had changed in significant ways [44]. This is the case, we believe, in twenty-first century medicine. The combined influence of forces including the HITECH Act, Affordable Care Act, diffusion of Electronic Health Records, and evolution of Internet-based services is changing the world of medicine importantly and universally. In this new era, two critical assets—data and behavior—are rising in value. Both are the stock and trade of behavioral scientists in medicine. Working in close collaboration with other members of the “design team” for healthcare reform, behavioral scientists are therefore fundamental to the process of crafting the new translational milieu in which evidence-based medicine can flourish. We hope that the content of this issue will illustrate, from diverse perspectives, how that can happen.

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