Advances in medicine and clinical care are increasingly tied to computing technologies. This special issue explores emerging trends in smart health and the benefits they bring to individual patients and society as a whole.

The $4 billion Human Genome Project successfully completed its mission to map the entire human genome 13 years ago. As hoped, the project galvanized development of personalized treatments and precision medicine as well as new capabilities for early disease detection and diagnosis. At the same time, the rapid expansion of big data analytics and cloud computing technologies has led to the creation of powerful new tools including virtualized tissue banks and disease-specific clinical-trials recruiting and selection databases. Such tools let researchers more nimbly leverage our growing knowledge of human biology to directly improve patients’ health outcomes and quality of life.
Despite these advances, many people still do not have access to affordable and effective healthcare, and significant challenges remain for many patient populations, including the elderly and those with chronic conditions or diseases. To address these needs, researchers are designing, implementing, and evaluating novel smart-health and wellness applications to better understand disease etiology and pathogenesis, reduce medical costs, customize care, and shift the focus from disease treatment to prevention. Key ongoing research activities include analyzing physiological and behavioral data from mobile and environmental sensors, improving telemedicine services, and exploiting emerging information sources such as social media and health data aggregators.

IN THIS ISSUE
For this special issue we received numerous high-quality submissions for consideration, and after rigorous assessment by many dedicated reviewers, we selected five articles showcasing several important facets of smart health. These include a vision of smart health’s future, software innovations, behavioral aspects of health conditions, decision support for doctors, and privacy challenges in smart health.

In “The Future of Smart Health,” S. Jay Olshansky, Bruce A. Carnes, Yang Claire Yang, Norvell Miller, Janet Anderson, Hiram Beltrán-Sánchez, and Karl Ricanek Jr. describe how longitudinal individual and crowdsourced data from wearable (and soon-to-be-implantable) sensors can be translated into empirically verifiable measures of risk that can be used by both patients and doctors to detect and treat disease, enhance quality of life, and increase longevity. Using several examples of applications their company is developing, the authors foresee the development of a health-data economy in which such technologies help engender new relationships among caregivers, patients, and industry.

In “Key Success Factors for Smart and Connected Health Software Solutions,” Noel Carroll explains how smart and connected health (SCH) software innovations help providers and caregivers achieve desired coverage requirements and quality, reduce costs, and improve patient health outcomes and quality of life. Given the increasing reliance on software to support healthcare decisions, tools are needed to help evaluate the software’s efficacy and impact. The author provides an overview of the key success factors for SCH software as it evolves and becomes more broadly adopted.

In “Using Smart Homes to Detect and Analyze Health Events,” authors Gina Sprint, Diane J. Cook, Roschelle “Shelly” Fritz, and Maureen Schmitter-Edgecombe focus on how the application of behavior change detection (BCD) to patient activity data collected from environmental sensors can
improve our understanding of behavioral changes that accompany health events. The authors describe three case studies of older adults living in smart homes who experience major health events; they compared observed behaviors of the subjects with those described in the medical literature and found that the behaviors are consistent and thus can be automatically recognized and detected, highlighting the usefulness of sensor data mining for exploring the relationship between behavior and health.

In “Machine Learning in Cardiac Health Monitoring and Decision Support,” Shuroq Hijazi, Alex Page, Burak Kantarci, and Tolga Soyata describe how portable medical devices can enhance and personalize healthcare. In particular, the authors introduce a system that identifies patterns in the flood of sensor data that can provide diagnostic decision support to clinicians. This system uses filtering and machine learning techniques to identify circadian patterns in long-term electrocardiograms of patients with certain genetic disorders. Based on this information, the patient’s physician is provided with an estimate of health risk. In addition, the authors investigate the system’s scalability, which—considering the explosive growth of medical data—is an important concern.

In “Privacy as a Service: Protecting the Individual in Healthcare Data Processing,” Xiang Su, Jarkko Hyysalo, Mika Rautiainen, Jukka RiekkI, Jaakko Sauvola, Altii Ilari Maarala, Harri Hirvonsalo, Pingjiang Li, and Harri Honko emphasize the continuing challenge and importance of privacy in e-healthcare delivery. The authors propose a privacy-focused architecture that provides tools for delivering user consent as a service. The architecture integrates data security and semantic descriptions into a trust-query framework that establishes the required interoperability and cooperation support for future smart-health services. This approach benefits all stakeholders through safer data management, cost and process savings, multiprovider participation, and innovative services based on emerging business models.

We thank the authors, reviewers, and Computer’s editor in chief and staff for their hard work in preparing this special issue. We hope it will help shed some light on some of the cutting-edge technologies in healthcare that are providing unprecedented benefits to individual patients and society as a whole.

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