

VIEWPOINT

A Maker Movement for Health

A New Paradigm for Health Innovation

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There is great interest in fostering health care innovations to achieve the triple aim of improving the health of populations, improving the patient experience of care (quality and satisfaction), and reducing the per capita cost of health care. As a result, there are a variety of innovation models being supported in the health care ecosystem, including care system redesign, incorporation of digital technology, and alternative payment models.¹ Less familiar to health care stakeholders is a participatory model of innovation called the Maker Movement, which can provide novel and transformative solutions for health care. In this Viewpoint, we define the Maker Movement, describe its contributions to health care innovation, and discuss future challenges and opportunities for the movement.

The Maker Movement is a technology-focused do-it-yourself (DIY) movement that emphasizes "learning by doing" and empowers individuals to become makers or creators of physical solutions to local and immediate problems.² Individuals are encouraged to "make" or "tinker" using technologies that were once limited to manufacturers but are now becoming more readily available to the average consumer such as mobile technology, cloud-based computing, and 3-dimensional printing. Knowledge of how to make or build is shared through social media, peer-to-peer interactions at community Maker Spaces, or community gatherings called Maker Faires.

There are clear examples of the contributions of the Maker Movement to health care. First, it can lead to the development of innovative solutions by health care outsiders. Jorge Odon, an Argentinian car mechanic, watched a YouTube video that showed how to remove a cork from inside a wine bottle by inserting and inflating a plastic bag in the bottle, surrounding the cork, and then pulling it out. Odon wondered whether a similar approach could be used to extract a baby stuck in the birth canal during childbirth. He therefore sought out a local obstetrician, receptive to the concept, and developed the Odon device, which is a simple low-cost device for assisting with vaginal delivery that could replace the forceps and the vacuum extractor. The device is now in clinical trials and has endorsement from leaders at the World Health Organization, who stated that the device "promises to transfer life-saving capacity to rural health posts, which almost never have the facilities and staff to perform a C-section."³

Second, the Maker Movement has provided concrete solutions for medical needs of children that may never be addressed by the market. Children with neuromusculoskeletal impairment need power wheelchairs to be able to explore their physical environment, but unfortunately, this technology is unavailable to chil-

dren younger than 2 years of age. For children who do qualify, there are extensive wait times to receive the equipment. A new wheelchair costs approximately \$30 000, and the chairs are heavy and difficult to transport and maintain. Cole Galloway, a professor of Physical Therapy, devised a low-cost method for developing personalized motorized chairs using toy cars from Toys R Us, modifying them using common materials from the hardware store. The total cost of the cars with modification is approximately \$200 and a nonprofit organization called Go Baby Go (<http://sites.udel.edu/gobabygo/>) provides DIY guides and instructions to the public about how to create their own workshops for building these mobility cars for children in their communities; to date, there are 60 chapters worldwide that have built approximately 5000 cars. Galloway and his colleagues have just begun the process of quantifying the therapeutic benefit of this intervention, documenting improvement in both mobility and vocalizations for a 21-month-old patient with cerebral palsy postintervention.⁴

Third, the Maker Movement provides an opportunity to not only disseminate low-cost solutions for health care at scale, but also improve the design of health innovations through open-source collaboration. The E-NABLE community started when Ivan Owen created a metal functional puppet hand and posted a video on YouTube. A man from South Africa who lost his fingers in an unintentional injury reached out to him, and they collaborated on a hand prototype that was then noticed by the mother of a 5-year-old boy born without fingers on one hand. Owen developed a 3-dimensional printed hand prototype for the boy and elected to publish the files open-source and online (<http://www.enablingthefuture.org>), enabling individuals around the world to download and print the hand prototypes for other individuals in need. This sharing allowed for iteration, improvement, and resharing of designs within the community, which has grown to more than 7000 members, with approximately 2000 devices created and gifted to individuals in more than 45 countries.

Fourth, the Maker Movement is creating opportunities for patient-designed solutions for health. The Nightscout Project began when the father of a 4-year-old boy who was a computer programmer created his own DIY mobile technology system to download blood glucose data from his son's US Food and Drug Administration-approved continuous glucose monitor and display the data on personalized mobile and wearable technology.⁵ He shared and exchanged the code with a group of caregivers and patients with type 1 diabetes, who found it so useful that they open-sourced the code, provided instructions on what components to purchase and how to set up the system, and created a

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private Facebook group for providing technical support and information, which now has more than 20 000 individuals from all over the globe. Furthermore, personalization of care through “making” inside the diabetes community has been unleashed as individuals can now choose from an array of personalized wearable watchfaces and mobile applications and DIY hardware systems and can even construct their own artificial pancreas systems. The effectiveness of these patient-designed solutions on health outcomes should be formally studied.

The Maker Movement is gaining prominence nationally, with support from President Obama, the National Science Foundation, and novel Maker initiatives focused on health. For example, the MakerNurse (<http://makernurse.com/>) project is supporting a community of nurses who are sharing DIY solutions to improve patient care and is building Makerspaces inside hospitals to promote greater tinkering and innovation among health care stakeholders. Furthermore, the Chief Technology Officer of the Department of Health and Human Services announced the “Invent Health Initiative,” supporting the concept of government as a platform to support a Maker Movement for health care.⁶

There are a number of challenges to confront regarding a Maker Movement inside health care. First, we must acknowledge the possibility of many “failed” prototypes, as is expected with any innovation model; evidence of its effect on health outcomes is needed. Second, the “democratization” of Making raises questions about the safety and quality of the health technologies being developed and what entities might be liable in the case of possible harm. Third, it may lead to cultural tensions in a traditional health care system that assumes that only health care professionals should be developing health solutions. Fourth, the model may not be the most efficient organizational system for scaling and disseminating health solutions.

The Maker Movement represents a compelling model for advancing the health care delivery system with the development of technology-driven, low-cost innovations and in the creation of opportunities for collaboration and engagement with patients, caregivers, and communities. In a health care delivery system that is pivoting toward a consumer-focused, patient-centered model of care, we believe that engaging patients in the design and making of personalized tools, technologies, and systems for health will lead to the most innovative and transformative solutions.

ARTICLE INFORMATION

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