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Case report

Catalyzing healthcare transformation with digital health: Performance indicators and lessons learned from a Digital Health Innovation Group

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A B S T R A C T

Despite considerable investment in digital health (DH) companies and a growing DH ecosystem, there are multiple challenges to testing and implementing innovative solutions. Health systems have recognized the potential of DH and have formed DH innovation centers. However, limited information is available on DH innovation center processes, best practices, or outcomes. This case report describes a DH innovation center process that can be replicated across health systems and defines and benchmarks process indicators to assess DH innovation center performance.

The Brigham and Women's Hospital's Digital Health Innovation Group (DHIG) accelerates DH innovations from idea to pilot safely and efficiently using a structured process. Fifty-four DH innovations were accelerated by the DHIG process between July 2014 and December 2016. In order to measure effectiveness of the DHIG process, key process indicators were defined as 1) number of solutions that completed each DHIG phase and 2) length of time to complete each phase. Twenty-three DH innovations progressed to pilot stage and 13 innovations were terminated after barriers to pilot implementation were identified by the DHIG process. For 4 DH solutions that executed a pilot, the average time for innovations to proceed from DHIG intake to pilot initiation was 9 months. Overall, the DHIG is a reproducible process that addresses key roadblocks in DH innovation within health systems. To our knowledge, this is the first report to describe DH innovation process indicators and results within an academic health system. Therefore, there is no published data to compare our results with the results of other DH innovation centers. Standardized data collection and indicator reporting could allow benchmark comparisons across institutions. Additional opportunities exist for the validation of DH solution effectiveness and for translational support from pilot to implementation. These are critical steps to advance DH technologies and effectively leverage the DH ecosystem to transform healthcare.

1. Background

1.1. A new digital health ecosystem

Digital Health (DH) is broadly defined as the use of information and communications technologies to improve healthcare services for individuals and populations.^{1,2} Advancements in technology, rising healthcare costs, and policy incentives toward value-based care have led to increasing investment in DH solutions and a new era of DH innovation.^{3–6} Health systems are seeking to leverage innovative DH technologies to promote the “quadruple aim” of enhanced patient experience, reduced cost, improved population, health and improved

clinician efficiency.⁷ However, despite considerable venture investment in DH companies and a growing DH ecosystem, there are still multiple challenges to testing and implementing innovative DH solutions.

Innovators (those developing and implementing new DH ideas) often lack familiarity with health system requirements, an understanding of the time needed to test digital products, and clarity around measurements of success. External DH companies may find working with academic medical centers challenging, especially where cultures and expectations may be different from their own. Further, many health systems do not have a standardized approach to identify, develop, validate, or deploy DH solutions.⁸ Just as academic medical centers rigorously evaluate novel pharmaceuticals or medical devices, evidence-

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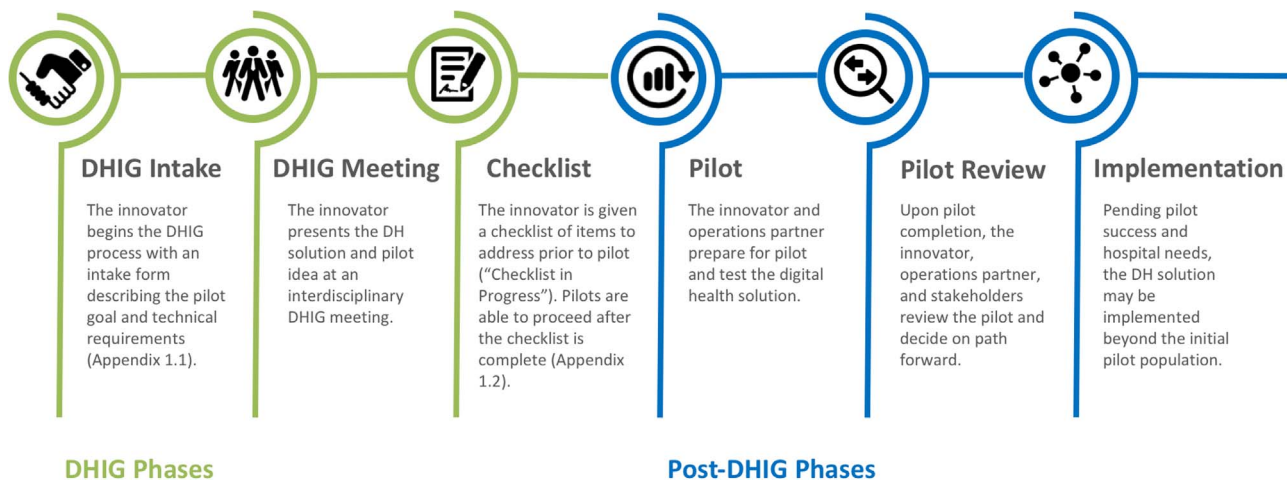


Fig. 1. Digital Health Innovation Group (DHIG) process map with key process benchmarks. Benchmarks include: DHIG Intake, DHIG Meeting, Checklist, Pilot, Pilot Review, and Implementation.

based analysis of DH tools is needed.⁹ There is an opportunity for improved collaboration between DH innovators and health systems to address this gap.

Recognizing challenges between innovators and health systems, some hospitals have created innovation centers to help accelerate internal DH innovation.^{8,10,11} For example, University of California, San Francisco created its Center for Digital Health Innovation in 2013, Brigham and Women's Hospital (BWH) launched the Digital Innovation Hub (iHub) in 2013, and both University of Pennsylvania and Stanford created their respective Centers for Digital Health in 2017.^{12–15} Despite significant investment and resource allocation to DH innovation centers like these, little has been published on their processes, best practices, or outcomes.

2. Problem and objectives

2.1. Unclear digital health innovation center processes and indicators

Few studies describe in-depth innovation center processes or specific indicators to measure innovation center success. To address these gaps, this paper reviewed an innovation process created at the BWH, the Digital Health Innovation Group (DHIG). We described the DHIG process, defined and measured key DHIG process indicators, and summarized lessons learned from 54 DH solutions reviewed by the DHIG.

3. Organizational context

3.1. Brigham and Women's Hospital innovative origin

BWH is a large academic medical center, affiliated with Harvard Medical School, and a founding member of Partners HealthCare System (PHS). BWH has a rich history of research and discovery in Healthcare Information Technology (HIT), such as the Brigham Integrated Computing System created in the 1990s.¹⁶ Growing interest in using HIT and DH technology to improve safety and efficiency of care delivery in the 2000s has been followed by a number of innovative ideas across a wide range of stakeholders at BWH. Without a standard process to funnel and catalyze ideas, many innovators within BWH attempted to advance their ideas without input from institutional experts and leaders. This led to frustration at the slow pace of implementation, hospital leadership concerns about information security, and potentially unreliable technical solutions.

4. Solution

4.1. The Digital Health Innovation Group process at Brigham and Women's Hospital

In 2014, the BWH Information Systems team created the DHIG to safely and efficiently accelerate DH innovation from idea to pilot by developing a structured process and organizational path through the health system. Led by a project specialist and facilitated by a chief medical information officer, the DHIG engages and aligns a cross-departmental team of BWH and PHS experts. The DHIG provides a forum for regular review of DH innovations, provides innovators with a checklist of items to address prior to piloting, and connects innovators with internal teams whose approval is needed to move to pilot. The DHIG process was merged with the iHub, BWH's innovation center, in 2016 and is now a core service of the iHub.

The DHIG is funded and supported through internal Information Services funds. Funding for the DH pilots are reviewed as a part of the DHIG process to ensure that adequate resources are allocated to support the pilot. However, the DHIG does not fund individual pilots or pay external vendors.

5. Results

5.1. Defining the DHIG process

The stages of the DHIG process are outlined in Fig. 1 and include:

- 1) DHIG Intake: The innovator completes the intake form that describes the pilot goal and known technical requirements (Appendix 1.1).
- 2) DHIG Meeting: The innovator presents the DH solution and proposed pilot at a DHIG meeting. At the meeting, interdisciplinary experts discuss the proposal and identify steps required prior to pilot. DHIG participants include representatives from legal, compliance, supply chain, information security, research computing, the licensing office, and the electronic health record team. DHIG meetings are held in person, and include innovators, pilot operations leaders, and technical contacts. The participants review key requirements for the pilot, such as data needs and information security requirements, and adjust the rigor of security, legal, and compliance requirements based on the pilot's risk level.
- 3) Checklist: After the meeting, the DHIG provides the innovator with a checklist of items to address prior to piloting ("Checklist In Progress", Appendix 1.2). The DHIG connects innovators with

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