Improving Healthcare Innovation for Emerging Technologies:
New Ideas to Drive Design for Current Challenges

Sara Chokshi, DrPH
Healthcare Innovation & Technology Lab (HITLAB)
New York, USA
email: sak141@columbia.edu

Abstract*-- Emerging technology promises profound impact, but is dependent on thoughtful, more streamlined integration into care delivery. The increasing complexity of both technology and environments require fresh approaches to innovation capable of optimally balancing a more comprehensive lens with a focus on facilitating relationships. To further the mission of better healthcare innovation, this paper outlines the five presentations in the sessions comprising the special track titled above. These presentations are oriented around four central themes to drive more effective, efficient solution design.: 1) expansive perspective to innovation, 2) leverage Circular Design principles, 3) have a relationship focus, and 4) incorporate solving for core challenges in every design.

Keywords- innovation; circular design; health information technology; digital health

I. INTRODUCTION

A. "Solutions" abound but few diffuse

The amount and importance of Health Information Technology (HIT) tools has grown exponentially in the last decade [1]. Yet successful integration and diffusion of solutions into care- particularly those that incorporate emerging technologies such as internet of things (iOT)-based devices and artificial intelligence remains immature [1][2]. The medical literature is abounded with articles regarding why this is, from more technically focused reasons such as lack of interoperability to human-centered explanations such as poor usability or clinician resistance [3]. The medical literature makes the case for remedies to these problems abundantly clear. What is missing, however, are new ideas and evidence around solution design practices to better solve for these issues.

B. The pace of innovation is rapid, so why is diffusion so slow?

For more than a decade, the practice of "innovation" has proliferated alongside technological advances, bringing new tools to design in healthcare. User- or human-centered design principles and design thinking tools are now widespread as innovation "labs" and "hubs" have become increasingly common in all types of healthcare related organizations and companies [4][5]. What remains under addressed is the need to account for complexities in the design process in ways that are simultaneously imaginative and pragmatic. While traditional, linear "funnel" approaches to innovation can be useful in some situations [6], persistent slow rates of diffusion beg the question: How might we expand our innovation approaches to be more effective and efficient at bringing emerging technology into healthcare delivery?

C. Effective innovation approaches are urgently needed

This paper is designed to serve as part call to action and part inspiration for healthcare innovators looking for new ideas to positively impact their capability to create and incorporate new technology solutions into care. Strategies promoting more holistic and streamlined incorporation of emerging technologies into care delivery are urgently needed and, in this piece, we pull from the discipline of innovation for promising ideas to drive us forward. The Methods section below outlines four concepts presented as recommendations for ideas to drive HIT design: 1) utilize a more holistic model in design activities; 2) leverage principles from the Circular Design movement (currently considered a best practice in design outside of the healthcare sphere); 3) maintain facilitating relationships as a central job to be done; and 4) incorporate solving for "core" challenges into every design. Particular attention is given to two "core" challenges to operationalizing emerging technologies in the current healthcare landscape: healthcare provider (HCP) burnout and healthcare equity.

These ideas are intended to inspire better design practices that positively impact the solution readiness for implementation and integration into care that is crucial to the successful application of emerging technology in healthcare [7].

II. SUBMISSIONS

This section details five contributions to the special track, oriented around these four concepts for driving effective innovation approaches:

1. *Apply holistic models that take an expansive view of*

new ideas in context.

Gurcsenski & Erickson's presentation on "Innovation Farming" applies a farming metaphor to organizational innovation and describes a model approach that recognizes the separate but interdependent components and activities within a system [8]. To design with a "farm's eye view" means to solution while accounting for the complex environments and systems in which HIT tools will be

applied. Implementation and integration of solutions are considered throughout the design process. Innovation as a field champions the benefits of multidisciplinary "cross fertilization" or collaborations over working in silos [5][9]. New approaches must expand multi-disciplinary and multi-stakeholder participation where key facets of solution success such as specific organizational, financial, regulatory, and legal considerations are provided the visibility and space necessary to be systematically considered in the design process [10].

2. Leverage Circular Design.

The concept of Circular Design- that is, design in support of sustainability as per the priority of a circular economy- has emerged recently in the healthcare sphere as an approach to designing services in ways that reduce waste [11]. Proponents of the circular approach throw away the create/use/dispose model for one that promotes recycle and reuse and overall sustainability. What happens if we extend this valuable concept of circular design to ideas themselves? Does it add value to treat ideas as a sort of crop to be grown on a sustainable "farm"? These metaphors call for a more expansive view of each idea and budding solution in context; an opportunity to work in ways that are modular and "recyclable" so that the work typically done to develop and vet one idea is undertaken with an eye towards repurposing. Fleck and Schmeidel present "Making Artificial Cornea Real with Artificial Intelligence" as an example of solution development on the "farm," and how, in conclusion, the learnings from this work provides sustainable fuel for other projects on remote monitoring in their organization [12]. Importantly, this approach marks an important shift from seeing the work done on ideas that don't make it through the funnel as failure to viewing all innovation activities as potential to enrich or "till" the soil to feed other ideas. With a sustainable, circular approach, innovation activities are planned and executed without the fear of "failure" that often plagues traditional organizational innovation [11], providing documented knowledge and value even if the intended individual solution itself is not considered a "win."

3. Employ relationship-centered design.

User- or human-centered design was borrowed from the design world and applied to healthcare, revolutionizing the way we build things in recent years [13]. It is time once again, however, for healthcare to look outside itself to the design world generally which has begun to view establishing and maintaining positive relationships as the beacon guiding development of new solutions [14]. Relationship-centered design as a construct in the design discipline generally emerged in recent years, applied to the creation of technology solutions in fields such as Education [15]. Beach and colleagues shared this construct in a 2006 article highlighting the value of relationship-focused care [16]. In our increasingly technologically complex discipline, is time to again bring the latest in what design has to offer to bear on healthcare.

As demonstrated in the GoodLife Media case study entitled, "The design and testing of a personalized health engagement platform," by Chokshi, McClennan & Schoenthaler, the solutions we get look different depending on how we ask our questions [17]. How might our tools look different if our questions center on how to support caring relationships rather than solely completing tasks? For one, a relationship signifies that there are at least two and sometimes more "users" to consider in design. This addresses an important weakness in current practices that tend to focus on one person in the relationship (e.g. the patient), failing to recognize and account for the impact on the other(s) in the relationship even though their interconnection means that user experience and action directly impacts the other as well as outcomes. From this perspective, facilitating and supporting care relationships is the ultimate "job" to be done. We can imagine what this perspective shift might do to mitigate the current crisis of provider burnout while at the same time promoting the principles of patient-centered healthcare.

4. Consider how each new tool solves key "core" challenges in healthcare.

In addition to their primary goal, solutions leveraging emerging technologies should be developed to also solve for two current core challenges in healthcare: burnout and health equity. Failure to prioritize these central issues in HIT design threatens meaningful integration of tools into care delivery and, worse, serves up tools that may further stress our workforce and patients, yielding lower rather than higher quality experiences overall. Two presentations- Shah's "Opportunities Created by Healthcare's Adoption of AI & ML," and Erickson's "UX Measures - A Tool for Measuring and Improving User Experience for Patients and Clinicians" produced in collaboration with Node.Health- offer both high level perspectives and practical measures to address the persistent core issues of burnout and health inequity [18][19].

Burnout: Burnout among healthcare providers (HCPs) was gaining awareness [20] as a critical issue even prior to the recent COVID-19 pandemic[21]. HIT tools are believed to be a significant contributor to this problem [22]. And yet we believe they could be a significant part of the solution; but only if we approach their design with fresh eyes informed by new perspectives and strategies around innovation. Solving for existing as well as potential administrative burden as we develop new HIT tools is a prerequisite then to solving for any other problem.

While we may begin an innovation exercise with "How might we apply (emerging technology) to solve (health condition)?", in this new approach this question shifts to "How might we make the work of patients/providers

managing (health condition) (easier/simpler/more impactful) with emerging technology?" Human-centered design as a practice has created great value thus far; however, this subtle yet meaningful shift is aimed at addressing a lasting and stubborn tendency in innovation to prioritize technology over human experience.

Health inequity: While technologists and sociologists have been writing on the potential for artificially intelligent tools to exacerbate social issues, it is only very recently that there issues have begun to feature widely in the medical literature. What is still lacking as we consider the proliferation of these solutions in care delivery is where is the proliferation of practical guidance in how to not only think about but assess these tools in the design and developent stages?

To ensure new HIT tools are not contributing to bias at minimum, and confirm that they challenge existing inequalitites, evaluative tools must be developed and applied systematically. Only when processes for examining potential bias and application of tools to address bias are applied systematically can we begin to break down this major barrier to implementation of machine learning-based tools.

II. DISCUSSION

The advent of iOT-driven technologies along with advances in data science and machine learning capabilities could exponentially expand our ability to predict, diagnose, manage, and even treat health conditions, prevent chronic illness, and improve quality of life. Yet adoption and diffusion remain slow and uneven. Key drivers of low adoption and slow diffusion can simply serve as 'blockers", or they can result in failure and failed promise as startups and health care institutions struggle to anticipate and design for the challenges of real-world healthcare.

Slow adoption or painstaking implementation of emerging technology solutions is not entirely a bad thing. The slow, awkward implementation of tools demonstrates that the field has begun to recognize the complexity more fully- not only technically but clinically, ethically, and socially- that should go into integrating highly complex tools into care. In some ways the complexity of the science involved in putting them into practice outweighs that of creating these technologies in the first place [16].

III. CONCLUSION AND FUTURE WORK

New approaches to innovation offer the opportunity to push HIT design forward, leaving the field with strategies to build tools that improve rather than exacerbate current challenges. Each design effort is pursued an opportunity to prove out multiple ideas while recognizing the inherent success of the approach in, if nothing else, fertilizing the soil from which it sprouts. In this way, innovation efforts move from linear go/no go affairs to a continuous, cyclical process expanding the innovation capacity of an organization or group. If successful, these presentations and the four orienting ideas described here will inspire further thinking in others as they seek to apply them toward crafting HIT solutions that are ripe for implementation and widespread adoption, and in ways that are efficient and equitable.

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