The Role of Human-Centered Design in Healthcare Innovation: a Digital Health Equity Case Study

Ximena A. Levander, MD, MCR[1], Hans VanDerSchaaf, PhD, MPA[2], Vanessa Guerrero Barragán, B.S.[2,3], Hetal Choxi, MD[4], Amber Hoffman, MSN, RN[2], Emily Morgan, MD[1], Eva Wong, B.S.[2], Raghav Wusirika, MD[5], and Anthony Cheng, MD[2,6]

[1]Department of Medicine, Division of General Internal Medicine & Geriatrics, Oregon Health & Science University, Portland, OR, USA; [2]Office of Digital Health, Oregon Health & Science University, Portland, OR, USA; [3]Digital Strategy, Oregon Health & Science University, Portland, OR, USA; [4]Department of Family Medicine, Division of Center for Women's Health, Oregon Health & Science University, Portland, OR, USA; [5]Department of Medicine, Division of Nephrology & Hypertension, Oregon Health & Science University, Portland, OR, USA; [6]Department of Family Medicine, Oregon Health & Science University, Portland, OR, USA

ABSTRACT

Healthcare delivery has become more complicated, particularly with the addition of digital tools and advanced technologies that can further exacerbate existing disparities. New approaches to solve complex, multi-faceted problems are needed. Human-centered design (HCD), also known as design thinking, is an innovative set of methods to develop solutions to these types of issues using collaborative, team-based, and empathetic approaches focused on end user experiences. Originally advanced in technology sectors, HCD has garnered growing attention in quality improvement, healthcare redesign, and public health and medical education. During the COVID-19 pandemic, our healthcare organization recognized notable differences in utilization of virtual (video-based) services among specific patient populations. In response, we mobilized, and using HCD, we collectively brainstormed ideas, rapidly developed prototypes, and iteratively adapted solutions to work toward addressing this digital divide and clinic and systems-level struggles with improving and maintaining digital health access. HCD approaches create a cohesive team-based structure that permits the dismantling of organizational hierarchies and departmental silos. Here we share lessons learned on implementing HCD into clinical care settings and how HCD can result in the development of site-specific, patient-centered innovations to address access disparities and to improve digital health equity.

KEY WORDS: design thinking; healthcare improvement; telehealth; telemedicine; digital health; human-centered design

J Gen Intern Med
DOI: 10.1007/s11606-023-08500-0

Prior presentations None.

Received May 3, 2023
Accepted October 20, 2023
Published online: 16 November 2023

INTRODUCTION

Human-centered design (HCD) is an innovation approach well-suited for healthcare redesign where there exists a high degree of ambiguity along with a commitment to creating people-centered, high-value solutions to address complex problems. At its core, HCD is a social technology, leveraging human diversity in thought that harnesses individual and team creativity to generate empathetic and ethnographic-oriented insights as a springboard for generating novel ideas for solutions. These solution ideas are then explored using iterative learning approaches to understand those most likely to create unequivocal value for end users and remain sustainable over time.[1–3] The hallmarks of "human-centered design"—often used interchangeably with "design thinking"—are provided in Table 1.

By embodying an iterative approach to problem-solving requiring smaller bets, HCD can help reduce the overall risk of innovation and increase the probability of solving the right problem. Additional benefits include overcoming psychological and cognitive biases that negatively impact innovation, empowering individuals and teams, enabling creative confidence and psychological safety, and increasing solution quality.[5, 6] Using HCD for intervention generation can result in a net positive effect on outcomes.[4] Initially used for physical product development, HCD has evolved to being used for service and process innovations.[3] It has been used extensively in non-healthcare industries.[7] For example, design for problem-framing and problem-solving has been used at for-profit companies,[8, 9] and in charitable foundations, nonprofits, government entities, and social innovation start-ups.[1, 2]

HCD approaches are relatively new to and inconsistently used for healthcare innovation and redesign.[4, 10] HCD approaches can complement and bolster other strategies within healthcare delivery, redesign, and innovation including patient-oriented research, quality improvement (QI), and implementation science. Components of the HCD approach resonate with patient-oriented research, where patients and stakeholders are also involved throughout the research process with multidisciplinary research teams to address their

Table 1 Hallmarks of Human-Centered Design Approaches with Definitions

HCD term	Definition
Empathy-building[1, 2, 4]	Developing a nuanced understanding of the audience hypothesized to be affected by the outcomes, including understanding their physical and emotional needs and the key jobs (functional, emotional, and social) that are important to them
Ethnographic approaches[5]	Using qualitative methods with users—such as contextual interviews, observation, journey mapping, empathy maps, personas, and jobs-to-be-done analysis—to work toward a holistic understanding of users and support empathy-building
Developing a deep understanding of problem context[4]	Understanding the problem from a holistic perspective, including how it relates to the systems and/or environments in which the problem exists. This can be accomplished not only through ethnographic approaches, but also through methods such as secondary research, expert input, end user surveys, adjacent stakeholder input and/or surveys, and competitor analysis
User-centeredness and involvement[4]	Directly involving end users in the design process through methods such as ethnography, idea generation, prototype testing, and design team participation
Cultivating variance[1, 2]	Intentionally embracing a value of "more than one," rather than prioritizing standardization and control in the design process to stimulate creativity throughout, including in problem definition, solution idea generation, prototyping, and solution idea testing
Collaborative ideation[5]	Fostering design team behaviors including withholding judgment, creating psychological safety, avoiding argumentative debates, and inviting differences. Brainstorming uses structured techniques to generate a breadth of potential solution ideas in relation to the problem space. Concept development combines these solution ideas into thematically grouped concepts that represent larger-scale solution ideas
Visualization[4, 5]	The use of imagery (visual or narrative) to illustrate or give form to abstract ideas so that design teams and stakeholders can open new avenues of insight and thinking
Iteration and experimentation[5]	Developing and testing prototypes with end users and stakeholders to solicit early input. Prototyping involves making abstract ideas tangible for end users and stakeholders and includes techniques such as cardboard mock-ups, future state journey maps, storyboarding, 3D-printed mock-ups, clickable or tappable software mock-ups, wireframes, and service experience role-playing
Engaging broad stakeholders to work across differences[1, 2]	Intentionally inviting individuals with diverse experiences to the design "table" and using tools and techniques that leverage this diversity in thought and experience. This rests on the assumption that diversity of thought leads to better innovation outcomes and that all participants have valuable contributions to make
Co-creation[5]	Also called "radical collaboration," co-creation involves developing deep-seated trust across a design team and across stakeholders such that all parties actively learn from one another throughout the design process. It hinges on a commitment to learning from others, flexibility in thinking, and an openness to new ideas and influence from others
Creativity and innovation[4]	In the HCD context, creativity means producing novel ideas at both the individual and team level. Innovation is the creation of a significant change in relation to the current state

HCD human-centered design

priorities and outcomes.[11] QI shares similar reliance on structured processes and core guiding principles, though QI approaches differ from HCD in many fundamental ways including the latter's ethnographic approach and focus on understanding the feelings and experiences of end users.[12] Another key difference is HCD's focus on systematic iteration and valuing "quick fails"—making mistakes early and often as critical learning opportunities. HCD provides a complementary approach to implementation science methods that could greatly improve translating evidence-based guidelines into clinical practice.[13, 14] Given the growing interest in HCD, curriculums have begun being introduced in medical and public health education settings.[15, 16] Interventions within healthcare created using HCD approaches have higher end user satisfaction, usability, and effectiveness compared to those developed using more traditional approaches.[4, 10] There is thus a great opportunity to bring HCD expertise into the healthcare redesign arena.

Digital health has become a domain clearly in need of redesign based on emerging healthcare delivery inequities.[17] HCD approaches are well-suited to address these disparities which will require innovative, multi-faceted solutions developed in collaboration with patients and stakeholders. Frequently referred to as the "digital divide," the gap in technology and digital access is of growing importance as a key determinant of health.[18, 19] The COVID-19 pandemic only further highlighted these previously existing disparities in technology and service access,[20, 21] particularly as digital health became the main source of healthcare access during lockdown periods.[22] Areas of the USA with more digitally excluded populations experienced worse COVID-19-related outcomes.[23] Given the more established nature of HCD within the technology sector, utilizing these approaches within digital health can be a vital first step toward bringing HCD into other healthcare innovation sectors.

The Oregon Health & Science University (OHSU) Office of Digital Health was formed in 2019 to help institutionalize digital health as a key enabler in the health system and focus transformation efforts within this developing field. Early in the COVID-19 pandemic, our healthcare system rapidly developed a patient care dashboard to monitor disparities in digital health care utilization. We particularly focused on the use of phone (audio-only) compared to virtual (synchronous audio-visual) visits. We identified notably lower utilization of virtual visits among patients who were Black or American Indian/Alaska Native, non-English speaking, and those older in age, or those insured by Medicare or Medicaid,[24] similar to research findings elsewhere.[25] The team embarked on using HCD to help address digital health access gaps at OHSU exacerbated by the pandemic. Starting in November 2021, after identification of our healthcare system's access gaps, a cross-disciplinary team of providers and operational leaders from across the system set out to understand the current state and develop solutions.

While there are a host of HCD approaches,[7, 26] our team used the approach articulated by Dr. Liedtka et al.[1, 2, 27] This approach centers on four key questions which guided our team's methods and the lessons we learned throughout the design process: (1) "What is?"—an exploration of the current state of the problem(s); (2) "What if?"—an opportunity for generation of solution ideas; (3) "What wows?"—a focus on articulating solution ideas as prototypes to enhance learning; and (4) "What works?", where low-fidelity prototypes are used with end users.[1, 2] Fig. 1 visualizes our design process.

LESSONS LEARNED ON IMPLEMENTING HUMAN-CENTERED DESIGN INTO DIGITAL HEALTH INNOVATION

"What is?"—Elevate Diverse Perspectives of Patients, Staff, and Other Key Stakeholders

The first key tenet of HCD is early and continuous end user involvement—those who will interface with the final intended product(s)—by including them throughout the design; prototype development; and testing, iteration, and adaptation phases. Only by including diverse viewpoints can the design team grasp the extent of what problems need to be addressed and their scope (Fig. 1). Conducting qualitative research via surveys, interviews, observations, and focus groups focusing on varied experiences can uncover areas that need to be addressed prior to beginning innovation development.

To learn from patients, providers, and staff about barriers and opportunities to improve digital health, we conducted a qualitative study using a visual mapping technique common in HCD.[28] We incorporated findings to create patient personas that captured the strengths and struggles patients faced with newer healthcare-related technologies. Personas are used in HCD as part of sense-making, attempting to fully understand all components contributing to highly complex settings and the personal and emotional experiences behind these encounters. Patient personas guided our development process as we moved through the key phases of the HCD approach making the patient experience the foundation of our process and facilitating empathy building. Several

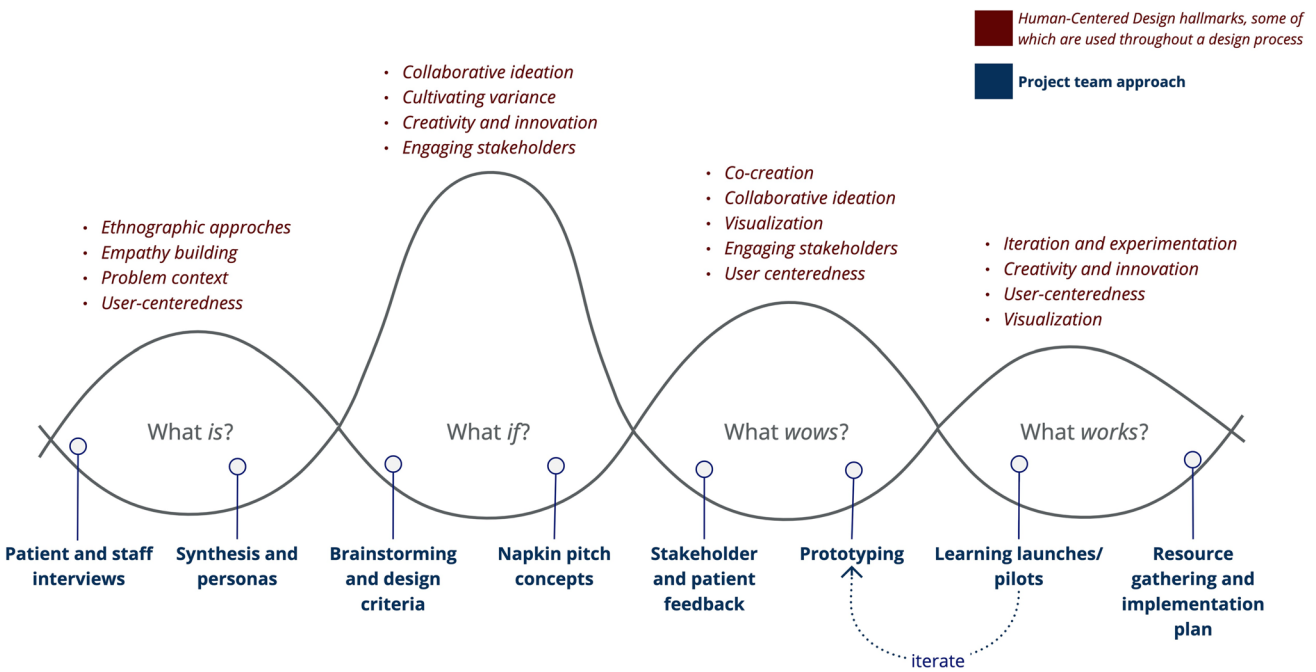

Figure 1 Four stages of human-centered design process. ***Adapted from: Liedtka J, King A, & Bennett K.*** **"Solving Problems with Design Thinking." Columbia University Press; 2013.**

insights emerged through this process. One critical observation was the framing of the problem space. Instead of "how do we shift patients from telephone to virtual visits," our ethnographic work led us to reframe the problem statement to "Some patients want to build their technology skills and confidence to access virtual care (functional job) to feel empowered engaging in their healthcare (emotional job)." A connection to literacy (and health equity) also became a focus based on a persona that highlighted a gap in confidence that lead some patients to feel illiterate, even though they can read.

"What if?"—Foster Creativity and a Shared Language and Mission Among Team Members

Another key HCD component is creativity—asking team members to think broadly about all possible design solutions to address the issues identified during the "what is?" phase. The focus here is taking a "no wrong answers" approach. This resulted in a large diversity of ideas, allowing team members to stretch what could be possible during brainstorming to reduce the likelihood of missing out on potential solutions. We used strategies including structured brainstorming and visualization for concept development, and napkin pitches for summarizing solution ideas. Early concepts we developed included MyChart app additions (e.g., help button), connecting patients to live IT help, in-person help, community outreach, free online tech training, MyChart simulation, visiting patient homes, voice control features, default as most accessible, and language translation. Through an iterative process of combining and prioritizing ideas, we developed six napkin pitches: low tech solutions, virtual care support booth, traveling outreach, connect to live IT help, MyChart practice, and patient curriculum.

This phase can run counter to some QI and healthcare strategies, which may focus on getting to a solution at the cost of upfront idea generation. HCD emphasizes failing early and often as a strategy to encourage creativity, to improve the likelihood of successful solution identification, and to reduce the long-term costs of incorrect innovation development.

"What wows?"—Dismantle Silos in Organizational Structure to Flatten Hierarchy

The third key component involves moving from the large number of team-generated ideas into those which could "wow" end users. These "wow" concepts are further developed and refined into prototypes for end user testing. The iterative process of presenting, reviewing, refining, and curating the ideas generated by the interdisciplinary groups within our team helped to dismantle organizational silos and flatten hierarchies. We used team-based exercises that encouraged psychological safety and decentered individual egos to maintain focus on the end users. Our team included two dedicated design thinking experts who guided the team of volunteers from across the institution. Team members included clinicians from a range of specialties, nurses, operational leaders, patient support specialists, and patient advocates. We solicited internal stakeholder and patient feedback on the napkin pitches developed during "What if?" Internally, we shared the napkin pitches in presentations and meetings with larger groups (approximately 130 participants), and through asynchronous feedback from three clinic's staff. Engagement methods included rank order voting and discussion. To engage patients, we solicited feedback through patient phone interviews after receiving mailed letters with napkin pitches, and through community vaccine equity events. This feedback directed us to move forward with two main solution ideas: (1) connect to live IT help by increasing visibility of pre-existing patient MyChart help desk information; and (2) traveling digital navigation outreach including in partnership with community-based organizations (CBOs), and development of patient-facing tipsheets. The diverse points of view from the design team, internal stakeholders, and patients brought forward context and contributing factors that needed to be addressed when tackling the complex multi-faceted issues surrounding digital health access disparities.

"What works?"—Cultivate Relationships with Community Partners and Healthcare Members

Finally, HCD involves developing and then testing prototypes with end users to determine "what works." Our team used learning launches, a structured approach to real-world prototype testing in HCD, to test ideas and make needed iterative adaptations. Through these learning launches, our team developed and fostered long-term commitments with diverse internal organizational and external community partners and adjusted and pivoted our solution ideas. For example, an on-site help desk was a leading idea among internal stakeholders but a muted response in the learning launch helped us avoid a low value investment. Learning launches allowed our team to better understand what truly works for each partner and the people they serve and to build confidence about potential interventions.

Our strategy now centers on a variety of interventions under the digital health navigation umbrella. Our interventions include (1) partnerships with CBOs to train Community Health Workers to provide digital navigation support; (2) tabling at community health–related events where a digital health navigator provides 1:1 support; (3) proactive phone outreach to support virtual visits; and (4) widescale deployment of patient-facing tipsheets. Early results of these interventions such as proactive phone outreach at one clinic to patients with scheduled telephone visits are positive—43% of patients that the navigator spoke with accepted transition

to a virtual visit, with 78% of these completing a virtual visit. This has positive care implications (virtual visits are generally regarded as better quality than telephone), and financial implications (higher virtual visit reimbursement rates). Importantly, *how* this intervention is delivered is critical, and we think a "secret" to its success—the approach and scripting for the digital health navigator supports insights from our "What is?" work, including taking a relationship-building approach with patients, building trust by working on their timelines, and using asset-based language that supports confidence-building. A pilot testing proactive phone outreach strategy is underway at additional clinics. We see additional opportunities for digital navigation on the horizon, including proactive navigation support with the use of the Digital Health Readiness Indicator (a score embedded within our electronic health record system indicating whether a patient may need virtual visit assistance), enabling more specific and proactive outreach.

CONCLUSION

HCD approaches provide an opportunity for innovation that recognizes and designs for the unique experiences of all users within healthcare. Our team continues to expand prototype learning launches with an array of organizational partners and CBOs developed using the above outlined 4-stage approach. We found that HCD fostered creative solution ideas that perhaps would not have resulted from more traditional QI approaches. Our process also allowed for meaningful stakeholder engagement whose time is at a premium given competing clinical responsibilities. It was also in-depth, which enabled team members from diverse specialties and disciplines to learn about HCD to bring back to their respective groups. Limitations and challenges we faced in utilizing HCD included balancing institutional goals and constraints with patient and stakeholder needs; limited resources particularly to address language barriers; and limited ability to fully redesign the digital portal. As healthcare continues to re-orient itself toward the utilization of digital tools with a goal of achieving digital health equity, HCD could help us identify needs and develop solutions that truly address the problems of most importance to our patients and other stakeholders.

Acknowledgements *We would like to thank all the members of the Oregon Health & Science University (OHSU) Office of Digital Health and all the patients and stakeholders who continue to be provide their time and expertise in healthcare redesign.*

Corresponding Author: *Ximena A. Levander, MD, MCR; Department of Medicine, Division of General Internal Medicine & Geriatrics, Oregon Health & Science University, Portland, OR, USA (e-mail: levander@ohsu.edu).*

Funding *This work was supported by a C4 Community Engagement Grant and a 2021 Quality Funding Program for Digital Health Navigator Program through OHSU Health Integrated Delivery System (IDS). This work was also supported by a Centering Community Expertise in Designing for Digital Health Equity Grant through Association of American Medical Colleges. XAL is supported by AHRQ K12 HS026370. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. Funders had no role in decision to publish or preparation of manuscript.*

Declarations

Conflict of Interest *The authors declare that they do not have a conflict of interest.*

REFERENCES

1. **Liedtka J, Salzman R, Azer D.** Chapter One: Catalyzing a Conversation for Change. In: *Design Thinking for the Greater Good: Innovation in the Social Sector*. Columbia University Press; 2017:3-21.
2. **Liedtka J, Salzman R, Azer D.** Chapter Two: How Do We Get There from Here? A Tale of Two Managers. In: *Design Thinking for the Greater Good: Innovation in the Social Sector*. Columbia University Press; 2017:22-39.
3. **Brown T.** Design Thinking. *Harv Bus Rev*. 2008;86(6):84-92.
4. **Altman M, Huang TTK, Breland JY.** Design Thinking in Health Care. *Prev Chronic Dis*. 2018;15(E117):180128. https://doi.org/10.5888/pcd15.180128
5. **Hookway S, Johansson MF, Svensson A, Heiden B.** The Problem with Problems: Reframing and Cognitive Bias in Healthcare Innovation. *Des J*. 2019;22(sup1):553-574. https://doi.org/10.1080/14606925.2019.1595438
6. **Jaskyte K, Liedtka J.** Design thinking for innovation: Practices and intermediate outcomes. *Nonprofit Manag Leadersh*. 2022;32(4):555-575. https://doi.org/10.1002/nml.21498
7. **Baker FW, Moukhliss S.** Concretising Design Thinking: A Content Analysis of Systematic and Extended Literature Reviews on Design Thinking and Human-Centred Design. *Rev Educ*. 2020;8(1):305-333. https://doi.org/10.1002/rev3.3186
8. **Dantas de Figueiredo M.** Design is cool, but … A critical appraisal of design thinking in management education. *Int J Manag Educ*. 2021;19(1). https://doi.org/10.1016/j.ijme.2020.100429
9. **Carlgren L, Elmquist M, Rauth I.** The Challenges of Using Design Thinking in Industry – Experiences from Five Large Firms. *Creat Innov Manag*. 2016;25(3):344-362. https://doi.org/10.1111/caim.12176
10. **Elliott A, Lang S, Truby H, Brennan L, Gibson S.** Tackling the challenge of treating obesity using design research methods: A scoping review. *Obes Rev*. 2022;23(2):1-13. https://doi.org/10.1111/obr.13360
11. **Kaur N, Pluye P.** Delineating and Operationalizing the Definition of Patient-Oriented Research: A Modified e-Delphi Study. *J Patient-Centered Res Rev*. 2019;6(1):7-16. https://doi.org/10.17294/2330-0698.1655
12. **Crowe B, Gaulton JS, Minor N, et al.** To improve quality, leverage design. *BMJ Qual Saf*. 2022;31(1):70-74. https://doi.org/10.1136/bmjqs-2021-013605
13. **Chen E, Neta G, Roberts MC.** Complementary approaches to problem solving in healthcare and public health: implementation science and human-centered design. *Transl Behav Med*. 2021;11(5):1115-1121. https://doi.org/10.1093/tbm/ibaa079
14. **Dopp AR, Parisi KE, Munson SA, Lyon AR.** Integrating implementation and user-centred design strategies to enhance the impact of health services: Protocol from a concept mapping study. *Heal Res Policy Syst*. 2019;17(1):1-13. https://doi.org/10.1186/s12961-018-0403-0
15. **Ku B, Shah A, Rosen P.** Making Design Thinking a Part of Medical Education. *NEJM Catal*. 2016:1-9. https://catalyst.nejm.org/making-design-thinking-part-medical-education/.
16. **Abookire S, Plover C, Frasso R, Ku B.** Health Design Thinking: An Innovative Approach in Public Health to Defining Problems and Finding Solutions. *Front Public Heal*. 2020;8(August):1-6. https://doi.org/10.3389/fpubh.2020.00459
17. **Yao R, Zhang W, Evans R, Cao G, Rui T, Shen L.** Inequities in Health Care Services Caused by the Adoption of Digital Health Technologies:

Scoping Review. *J Med Internet Res*. 2022;24(3). https://doi.org/10.2196/34144

18. **Richardson S, Lawrence K, Schoenthaler AM, Mann D.** A framework for digital health equity. *npj Digit Med*. 2022;5(1). https://doi.org/10.1038/s41746-022-00663-0
19. **Sieck CJ, Sheon A, Ancker JS, Castek J, Callahan B, Siefer A.** Digital inclusion as a social determinant of health. *npj Digit Med*. 2021;4(1):5-7. https://doi.org/10.1038/s41746-021-00413-8
20. **Eruchalu CN, Pichardo MS, Bharadwaj M, et al.** The Expanding Digital Divide: Digital Health Access Inequities during the COVID-19 Pandemic in New York City. *J Urban Heal*. 2021;98(2):183-186. https://doi.org/10.1007/s11524-020-00508-9
21. **O'Shea AMJ, Baum A, Haraldsson B, et al.** Association of Adequacy of Broadband Internet Service with Access to Primary Care in the Veterans Health Administration before and during the COVID-19 Pandemic. *JAMA Netw Open*. 2022:E2236524. https://doi.org/10.1001/jamanetworkopen.2022.36524
22. **Patel SY, Mehrotra A, Huskamp HA, Uscher-Pines L, Ganguli I, Barnett ML.** Variation in telemedicine use and outpatient care during the covid-19 pandemic in the United States. *Health Aff*. 2021;40(2):349-358. https://doi.org/10.1377/hlthaff.2020.01786
23. **Li F.** Disconnected in a pandemic: COVID-19 outcomes and the digital divide in the United States. *Heal Place*. 2022;77(July):102867. https://doi.org/10.1016/j.healthplace.2022.102867
24. **Sachs JW, Graven P, Gold JA, Kassakian SZ.** Disparities in telephone and video telehealth engagement during the COVID-19 pandemic. *JAMIA Open*. 2021;4(3):1-5. https://doi.org/10.1093/jamiaopen/ooab056
25. **Rodriguez JA, Betancourt JR, Sequist TD, Ganguli I.** Differences in the use of telephone and video telemedicine visits during the COVID-19 pandemic. *Am J Manag Care*. 2021;27(1):21-26. https://doi.org/10.37765/ajmc.2021.88573
26. **Lorusso L, Lee JH, Worden EA.** Design Thinking for Healthcare: Transliterating the Creative Problem-Solving Method Into Architectural Practice. *Heal Environ Res Des J*. 2021;14(2):16-29. https://doi.org/10.1177/1937586721994228
27. **Liedtka J, Oglivie T.** Four questions, ten tools. In: *Designing for Growth: A Design Thinking Tool Kit for Managers*. Columbia Business School Publishers; 2011.
28. **Choxi H, VanDerSchaaf H, Li Y, Morgan E.** Telehealth and the Digital Divide: Identifying Potential Care Gaps in Video Visit Use. *J Med Syst*. 2022;46(9):3-5. https://doi.org/10.1007/s10916-022-01843-x