TITLE

Design Thinking – A Framework to Teach Innovation for Graduate Medical Education.

ABSTRACT

Background

Human-centered design (HCD) provides a novel approach for problem solving complex medical problems through the lens of Quality Improvement (QI).

Objective

To demonstrate how a QI project applied HCD principles to redesign an emergency department sign-out process, creating a solution that was feasible, sustainable, and desirable.

Methods

This single-center project (2022–2023) engaged emergency medicine residents and attendings, along with consultants from neurology, surgery, and internal medicine. Using a Design Thinking (DT) framework – Discovery, Interpretation, Ideation, Experimentation, and Reiteration – we combined surveys, direct observation, and a literature review to inform design. Two structured brainstorming sessions synthesized findings and guided prototype development.

Results

Within three weeks, we implemented a streamlined sign-out template that improved workflow and communication. Qualitative feedback indicated strong user satisfaction and perceived efficiency gains.

Conclusions:

HCD and DT provide practical, learner-friendly tools for QI projects in GME, enabling rapid, user-centered innovation.

INTRODUCTION

Quality improvement (QI) is a cornerstone of graduate medical education (GME) and requires addressing complex, system-level challenges.[1-2] Human-centered design (HCD) offers a mindset and set of frameworks that program directors can use to guide learners in understanding problems and generating effective solutions.[3-6]

Despite its importance, many QI projects fail due to limited support, interprofessional friction, resource constraints, organizational rigidity, and gaps in methodology.[7] Traditional QI approaches often rely on rapid-cycle change but rarely refine solutions before implementation.[8-9] For innovation to succeed, it must meet three criteria: feasibility, sustainability, and desirability.[3] HCD prioritizes desirability by deeply understanding user needs while integrating feasibility and sustainability throughout the design process. This iterative, user-centered approach can lead to impactful and lasting improvements.

Design Thinking (DT), a widely used HCD framework in healthcare, consists of five stages: Discovery, Interpretation, Ideation, Experimentation, and Reiteration.[10-11] It emphasizes stakeholder engagement and employs both divergent and convergent thinking strategies.[12-13] Studies show that even novice teams using DT can generate solutions for complex problems.[14] For example, DT has been applied to redesign the liver transplant allocation system, with 73.8% of participants agreeing it could address complex health system challenges.[15]

Despite these successes, published examples of DT applied to healthcare remain limited. This report illustrates how DT was used in a QI project to redesign an emergency department (ED)

sign-out process. Our goal is to provide educators and learners with a practical example of applying DT principles to improve clinical workflows within GME.

METHODS

We conducted a QI project to redesign the ED sign-out note template using a DT framework. At our institution, sign-out typically involves two to eight patients and is performed by a team consisting of one attending and one to two residents. This project was deemed IRB-exempt. Four physicians (two emergency medicine (EM) residents and two EM faculty) served as primary investigators and managed the process using Miro Board.[16] Figure 2 illustrates the milestones and tasks completed during the design and implementation phases

Discovery

We began with primary and secondary research.

- Primary research included surveys and direct observation of the sign-out process. End users – EM residents, EM attendings, and resident consultants – were selected.
    - A five-question free-text survey was distributed to EM residents and attendings via SurveyMonkey (Appendix 1).[17]
    - A three-question free-text survey was sent to resident consultants from internal medicine, general surgery, and neurology as these services frequently interact with the ED.
    - Observations of sign-out were conducted, and thematic analysis was applied to survey responses and observation notes.
- Secondary research consisted of a PubMed literature review (April 2023) using search criteria outlined in Appendix 2. Findings informed the design of low-fidelity prototypes to ensure evidence-based components were included.

Interpretation

Investigators held an initial brainstorming session using Miro ~~Board~~ to generate a problem statement. This phase emphasized divergent thinking to explore contributing factors. Techniques included:

- Sorting and condensing research findings
- Identifying patterns and insights
- Framing a point of view
- Defining the problem

Insights were organized into a "Mind Map." We applied the "How Might We" method to reframe problems into actionable questions. For example:

- Problem: "It is cumbersome to click into the chart and wait for it to load."
- Reframed: "How might we improve EHR navigation to reduce wasted time?"

The resulting problem statement guided subsequent phases.

Ideation

Two prototype templates, one brief and one detailed, were developed and tested with six EM residents (two from each of the three training years). These residents were selected as peer leaders likely to disseminate information. The lead investigator observed sign-out sessions and conducted interviews to gather user feedback. Prototypes were iteratively refined using convergent thinking techniques.

Experimentation

A second brainstorming session produced a single, consolidated sign-out template. This template was implemented department-wide with usage instructions. The initial five-question survey was repeated among EM residents and attendings to assess user experience (Appendix 1).

Reiteration

A designated "Resident Champion" will oversee ongoing iterations of the template using the same design cycle to ensure continued alignment with user needs.

RESULTS

The initial five-question survey achieved response rates of 81% (27/33) among EM residents and 10% (5/49) among attendings. Thematic analysis revealed three key issues with the existing sign-out template:

1. It was cumbersome and time-consuming.
2. It required redundant information that did not enhance patient care.
3. Sign-out was frequently interrupted.

The three-question survey for consultants had a 100% response rate (3/3). Consultants reported awareness of the sign-out note and considered it an important communication tool between care teams.

From primary research, we developed a Mind Map (Figure 1) and generated the following problem statement:

> *"We don't have an issue with our note alone, but with our broader sign-out culture. We need a more streamlined note and build a culture to protect sign-out time."*

Three major themes emerged as opportunities for improvement:

1. Redesign the note template to reduce redundancy while meeting billing and communication requirements.
2. Ensure clear, actionable patient plans within the template for receiving physicians.
3. Minimize interruptions during sign-out by restructuring workflow.

Secondary research identified eight systematic reviews supporting the use of sign-out tools to reduce adverse events.[18-20] We also reviewed an article detailing the development of our institution's original template, which highlighted similar challenges.[21]

During brainstorming sessions, the most frequently used techniques were storytelling and *"How Might We"* questions, which were used to foster empathy and innovation. Low-fidelity prototypes were created as electronic medical record (EMR) dot phrases and iteratively refined based on resident feedback and direct observation.

The five-question survey was repeated post-implementation, with response rates of 93% (31/33) for residents and 6% (3/49) for attendings. Qualitative analysis identified three themes:

1. The redesigned template was simpler and more desirable.
2. Residents requested reminders for note completion.

3. A department-wide understanding of protected sign-out time was needed.

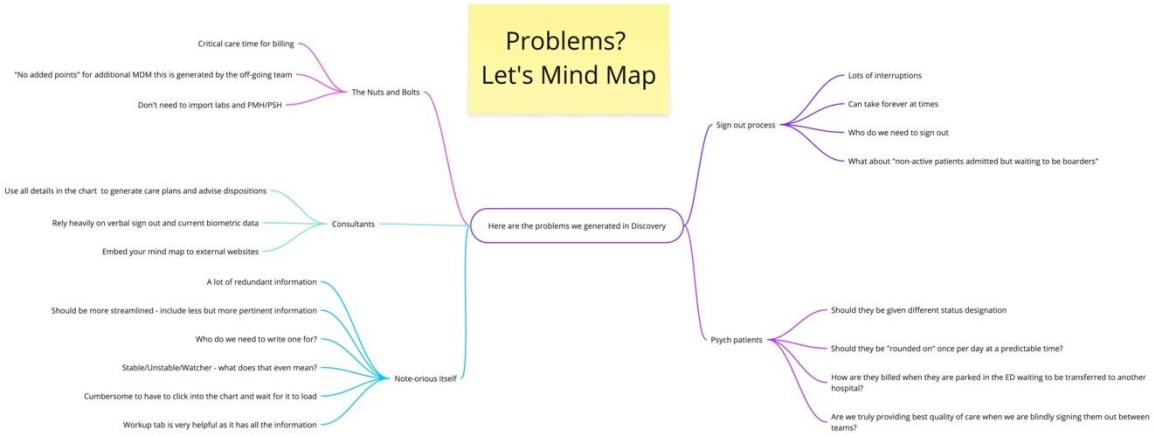

Figure 1 – Mind Map

Three broad themes were identified as opportunities for solution generation.

1. The note template needed to be redesigned to reduce redundancy while meeting requirements for billing and communication.
2. Our clinicians needed to have defined plans for patients that can be enacted by receiving physicians, and this should be clear in the template.
3. We needed to restructure the way we sign out to ensure interruptions from ED staff were minimized.

Our secondary research, in the form of a literature search, found 8 systematic reviews that were analyzed in full. Our review showed that sign-out tools are associated with a reduced risk of adverse events for the patient.[18–20] We also found a paper that explained how our institution's current note template was developed.[21] This article demonstrated that similar issues were present when our original note template was designed. Appendix 2 shows the literature review.

The two most utilized techniques during brainstorming sessions were storytelling and the *"how might we"* question. The lead investigator synthesized the primary and secondary research into a *"story"* about sign-out to ensure designers empathized with end users as they developed solutions. We created low-fidelity prototypes as dot phrases in the EMR for our identified resident users and made small changes to the template based on feedback and direct observation.

The five-question survey (Appendix 1) was repeated to the same residents and faculty, with response rates of 93% (31/33) and 6% (3/49), respectively. Qualitative analysis showed three main themes:

1. The note template was simplified and more desirable.
2. Residents need a way to be reminded about note completion.
3. We need to have a department-wide understanding that sign-out time is protected.

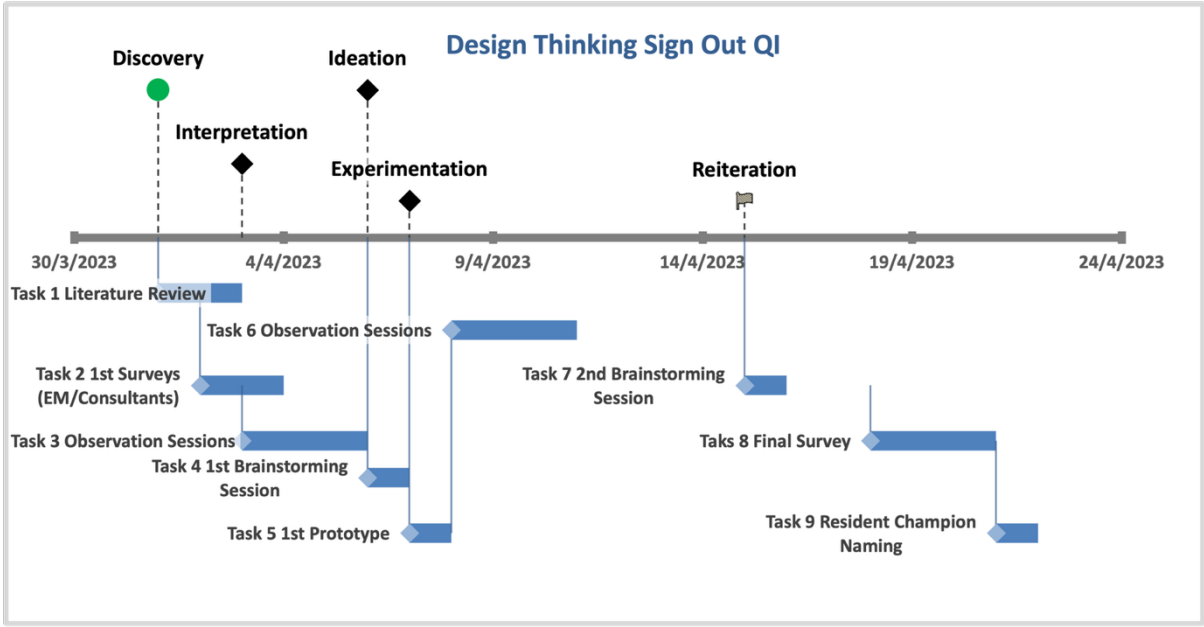

Figure 2 – Milestone and Task Control Chart

DISCUSSION

This QI project employed an HCD framework to develop, test, and refine a prototype that enhanced end-user workflow, as indicated by qualitative survey feedback. The design cycle was completed within three weeks, producing a solution that was perceived as desirable by stakeholders.

A key strength of using HCD is its ability to rapidly develop and refine prototypes based on real-time user feedback. For GME educators, HCD frameworks align well with ACGME core competencies, including practice-based learning and improvement, system-based practice, interpersonal and communication skills, and professionalism. Additionally, this approach supports the ACGME Clinical Learning Environment Review program, which emphasizes patient safety, QI, and transitions of care.[22]

Creativity and problem-solving are learnable skills, and Design Thinking (DT) equips clinicians with tools to strengthen both.[10,12,23-25] In this project, techniques such as storytelling and *"How Might We"* questions helped designers empathize with end=users and synthesize insights. This is particularly important because traditional medical solutions often prioritize input from senior or vocal stakeholders and have low tolerance for failure. Our secondary research revealed that the original sign-out template was well-constructed but failed to address underlying workflow issues. HCD encourages divergent thinking to explore user needs before converging on solutions, ensuring outcomes that are both desirable and feasible, and sustainable. DT provides a structured process and mindset shift to achieve these goals.

This case study did not include quantitative measures. Future projects should assess metrics such as sign-out duration, rates of sign-out-related complications, and pre-post comparisons

of workflow efficiency. This data would provide a more robust evaluation of the impact of HCD-designed solutions.

CONCLUSION

This report demonstrates how DT can be applied to solve real-world clinical challenges within the QI framework in GME. Familiarity with HCD principles and tools empowers learners to design solutions that improve workflows and communication, ultimately benefiting patients, colleagues, and healthcare systems.

REFERENCES

1. Brown A, Atchison K, Hecker K, Kassam A. A Tale of Four Programs: How Residents Learn About Quality Improvement during Postgraduate Medical Education at the University of Calgary. *Teach Learn Med*. 2021;33(4):390-406. doi:10.1080/10401334.2020.1847652

2. Buckley R, Spadaro A, Rosin R, Shea JA, Myers JS. Comparing the Effects of Design Thinking and A3 Problem-Solving on Resident Attitudes Toward Systems Change. *J Grad Med Educ*. 2021;13(2):231-239. doi:10.4300/JGME-D-20-00793.1

3. Benishek LE, Kachalia A, Daugherty Biddison L. Improving Clinician Well-being and Patient Safety Through Human-Centered Design. *JAMA*. 2023;329(14):1149-1150. doi:10.1001/jama.2023.2157

4. Hall Barber K, Schultz K, Scott A, Pollock E, Kotecha J, Martin D. Teaching Quality Improvement in Graduate Medical Education: An Experiential and Team-Based Approach to the Acquisition of Quality Improvement Competencies. *Acad Med J Assoc Am Med Coll*. 2015;90(10):1363-1367. doi:10.1097/ACM.0000000000000851

5. Chen A, Wolpaw BJ, Vande Vusse LK, et al. Creating a Framework to Integrate Residency Program and Medical Center Approaches to Quality Improvement and Patient Safety Training. *Acad Med J Assoc Am Med Coll*. 2021;96(1):75-82. doi:10.1097/ACM.0000000000003725

6. Wong BM, Levinson W, Shojania KG. Quality improvement in medical education: current state and future directions. *Med Educ*. 2012;46(1):107-119. doi:10.1111/j.1365-2923.2011.04154.x

7. Madu A. Challenges in conducting quality improvement projects: reflections of a junior doctor. *Future Healthc J*. 2022;9(3):333-334. doi:10.7861/fhj.2022-0076

8. Berwick DM. A primer on leading the improvement of systems. *BMJ*. 1996;312(7031):619-622. doi:10.1136/bmj.312.7031.619

9. Taylor MJ, McNicholas C, Nicolay C, Darzi A, Bell D, Reed JE. Systematic review of the application of the plan–do–study–act method to improve quality in healthcare. *BMJ Qual Saf*. 2014;23(4):290-298. doi:10.1136/bmjqs-2013-001862

10. Gottlieb M, Wagner E, Wagner A, Chan T. Applying Design Thinking Principles to Curricular Development in Medical Education. *AEM Educ Train*. 2017;1(1):21-26. doi:10.1002/aet2.10003

11. Design Thinking for Educators | ideo.com. Accessed April 1, 2022. https://www.ideo.com/post/design-thinking-for-educators

12. Roberts JP, Fisher TR, Trowbridge MJ, Bent C. A design thinking framework for healthcare management and innovation. *Healthc Amst Neth*. 2016;4(1):11-14. doi:10.1016/j.hjdsi.2015.12.002

13. Brown T, Wyatt J. Design Thinking for Social Innovation IDEO. Published online 2010:4.

14. Adopting Design Thinking in Novice Multidisciplinary Teams: The Application and Limits of Design Methods and Reflexive Practices - Seidel - 2013 - Journal of Product Innovation Management - Wiley Online Library. Accessed April 1, 2022. https://onlinelibrary.wiley.com/doi/full/10.1111/jpim.12061

15. Marcus D, Simone A, Block L. Design thinking in medical ethics education. *J Med Ethics*. 2020;46(4):282-284. doi:10.1136/medethics-2019-105989

16. Miro. Concept Map. Published online 2024. www.miro.com/app

17. Survey Monkey. Published online 2024. www.surveymonkey.com

18. Reay G, Norris JM, Nowell L, et al. Transition in Care from EMS Providers to Emergency Department Nurses: A Systematic Review. *Prehosp Emerg Care*. 2020;24(3):421-433. doi:10.1080/10903127.2019.1632999

19. Alimenti D, Buydos S, Cunliffe L, Hunt A. Improving perceptions of patient safety through standardizing handoffs from the emergency department to the inpatient setting: a systematic review. *J Am Assoc Nurse Pract*. 2019;31(6):354-363. doi:10.1097/JXX.0000000000000160

20. Tortosa-Alted R, Reverté-Villarroya S, Martínez-Segura E, López-Pablo C, Berenguer-Poblet M. Emergency handover of critical patients. A systematic review. *Int Emerg Nurs*. 2021;56:100997. doi:10.1016/j.ienj.2021.100997

21. Heilman JA, Flanigan M, Nelson A, Johnson T, Yarris LM. Adapting the I-PASS Handoff Program for Emergency Department Inter-Shift Handoffs. *West J Emerg Med*. 2016;17(6):756-761. doi:10.5811/westjem.2016.9.30574

22. ACGME Common Program Requirements (Residency).

23. Kolko J. Design Thinking Comes of Age. *Harv Bus Rev*. Published online September 1, 2015. Accessed April 1, 2022. https://hbr.org/2015/09/design-thinking-comes-of-age

24. Garcia L, Altawil Z, Oskvarek J, Stark N. Empowering Emergency Medicine: Leveraging Design Thinking to Address Challenges and Drive Solutions. *SAEM Pulse*. (July-August 2024):46-47.

25. Catalani C, Green E, Owiti P, et al. A clinical decision support system for integrating tuberculosis and HIV care in Kenya: a human-centered design approach. *PloS One*. 2014;9(8):e103205. doi:10.1371/journal.pone.0103205

Appendix 1

Discovery - 5 Question Survey using Survey Monkey:

1. How is the ED to ED provider sign-out process working for you?
2. How is the current IPASS note?
3. Are there any areas of improvement that could be made to the IPASS note?
4. Are there areas of strength to the IPASS note? What do you like/dislike?
5. Do you have any general thoughts/feedback on the IPASS note?

49 Faculty – 5 responses (10% response rate)

33 Residents – 27 responses (81% response rate)

Discovery – 3 Question Survey using Survey Monkey:

1. Did you know that there are two notes utilized by physicians in the Emergency Department? The ED Provider Note and the IPASS Note (used for sign-out between ED providers).
2. Do you use any of the notes to guide your care of patients and your recommendations?
3. How can we make our notes better to make taking care of the patients more effective and efficient?

3 Consultant Residents – General Surgery, Neurology, Internal Medicine (100% response rate)

Appendix 2

Literature Review

In April of 2023 we performed a search of PubMed (Emergency Department) AND (((((handoffs) OR (inter-shift transition of care)) OR (standardized handoffs)) OR (standardized ed handoff)) OR ((implementation of standardized handoffs) OR (standardization of inter-shift handoffs))) filtered by "systematic review" within the last 10 years (2013-2023). This yielded 11 articles, with 4 articles excluded based on relevance. 7 manuscripts were reviewed in full, and after review of references, 1 additional article was added due to significant relevance to the current project.