Implementation of AI-driven preoperative care companion for knee replacement surgery at Henry Ford Health System

Michael Royce Tan, BSN, RN, MPH Candidate

University of Michigan—Ann Arbor
School of Public Health

tmroyce@umich.edu

April 25, 2025

Executive Summary

The implementation of an AI-driven preoperative care companion for knee replacement surgery at Henry Ford Health System (HFHS) represents an opportunity to address the critical gap between technical surgical success and patient experience. Despite high technical success rates for total knee arthroplasty (TKA), patient dissatisfaction remains significant, largely due to inadequate preparation, support, and education.

This proposal outlines an implementation approach for an innovative AI companion that provides personalized guidance, proactive support, and evidence-based education throughout the preoperative journey. Through careful consideration of barriers and facilitators using the Consolidated Framework for Implementation Research (CFIR), we've identified three primary challenges: limited evidence-base, varying patient technological literacy, and integration with existing clinical workflows.

Our implementation strategy leverages four evidence-based approaches from the Expert Recommendations for Implementing Change (ERIC): developing academic partnerships, preparing patients as active participants, providing local technical support, and building a coalition of stakeholders. These strategies directly address our identified barriers while capitalizing on HFHS's existing strengths in innovation, patient culture, and quality improvement infrastructure.

Success will be measured through implementation outcomes (acceptability, feasibility, penetration), service delivery improvements (clinical workflow efficiency), and patient-centered outcomes (satisfaction). Our 12-month implementation timeline ensures preparation, pilot testing, gradual scaling, and sustainable integration. As well as addressing ongoing challenges and health equity considerations, in hopes of improving the patient expereince.

1 Background

The journey to better surgical outcomes begins long before the first incision. In the evolving landscape of orthopedic care, where technology and human insights converge, a promising innovation emerges to transform the patient experience for those facing knee replacement surgery.

Total knee arthroplasty (TKA) represents one of modern medicine's most common surgical interventions, performed over 600,000 times annually in the United States.[1] Despite impressive long-term technical success rates of 81-83% at 25 years, a significant percentage of patients remain dissatisfied with their outcomes. Revealing a critical gap between surgical excellence and patient experience.[1] This discrepancy exists not because the procedure fails, but because the patient's journey through preparation, procedure, and recovery lacks adequate support, education, and personalization.

Research demonstrates that participation in comprehensive preoperative education significantly predicts improved patient-reported outcomes at one year post-surgery.[2] Moreover, advanced technological approaches combining artificial intelligence and robotic-assisted technology have achieved remarkably high patient satisfaction rates of 98%, suggesting that technology-enhanced care pathways offer considerable promise.[3] The challenge, therefore, lies not in the surgical technique itself, but in preparing patients thoroughly, addressing their concerns comprehensively, and guiding them confidently through the entire surgical journey.

1.1 The Challenge

When patients fail to adequately prepare for surgery or follow postoperative instructions, often results into: slower recovery, increased complications, higher readmission rates, and escalating healthcare costs.[4-8] Many patients struggle due to confusion, forgetfulness, psy-

chological stress, physical limitations, socioeconomic barriers, or simply lack of motivation during the critical preparation and recovery phases.[4,5,6] Healthcare systems traditionally rely on printed materials, brief verbal instructions, and occasional follow-up calls; interventions that prove insufficient for many patients navigating the complex journey of major surgery.[4] Preoperative factors, such as range of motion, significantly impact surgical success, highlighting the potential value of targeted interventions before surgery even begins.[2] Addressing these crucial preoperative factors can potentially enhanced patient experience and outcomes.

1.2 The Innovation

AI-driven preoperative care companion, a technological innovation reimagining surgical preparation by combining personalized guidance, proactive support, and evidence-based education into a unified patient experience. Designed, by the HFHS team, specifically for knee replacement patients, this digital solution aims to transform the preoperative experience into a supportive partnership between technology and patient.

The AI companion offers continuous support beyond traditional care methods, providing personalized education, automated monitoring, and responsive guidance tailored to each patient's specific needs and concerns. Unlike passive educational materials, this technology actively engages patients, addresses their questions, monitors their progress, and adapts to their changing needs throughout the preoperative journey.

By optimizing surgical readiness, reducing anxiety, and enhancing outcomes, the AI companion addresses the critical gap in patient preparation while potentially reducing hospital length of stay and readmission rates. Through its personalized approach, the technology seeks to increase treatment adherence and patient satisfaction. Transforming what was once a confusing and anxiety-producing period into a structured, supportive experience.

1.3 The Setting

Henry Ford Health System (HFHS) in Detroit, Michigan, represents an ideal implementation setting for this innovative technology. As an active participant in the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI), HFHS is already engaged in statewide efforts to improve outcomes for hip and knee replacement patients.[9] This existing quality framework provides a robust foundation for introducing innovative digital health solutions.

Moreover, HFHS has demonstrated successful AI implementation through its RapidAI program, which has decreased time to stroke diagnosis and treatment. Providing evidence of both technical capability and organizational commitment to leveraging AI for improved patient outcomes.[10] This combination of established quality improvement infrastructure and proven experience with AI technologies uniquely positions HFHS to successfully integrate an AI-driven preoperative care companion into their clinical workflow.

2 Barriers & Facilitators

The implementation of any healthcare innovation requires careful consideration of potential obstacles and supportive factors. Using the Consolidated Framework for Implementation Research (CFIR), we identify three prioritized barriers and several key facilitators across different implementation domains.

2.1 Prioritized barriers

First, the (1) limited evidence-base represents a significant implementation hurdle. The lack of extensive published research specifically on AI companions for preoperative orthopedic care may create stakeholder hesitation, particularly among orthopedic surgeons whose endorsement significantly influences patient acceptance.[7,8,9] Second, (2) varying

technological literacy among HFHS's diverse patient population poses a critical challenge, as patients are the primary users whose ability to effectively engage with the technology directly impacts implementation success. Third, (3) integration with existing clinical workflows represents perhaps the most practical barrier. The AI companion must seamlessly fit into processes used by orthopedic surgeons, physical therapists, and nurses without disrupting patient care or adding burden to clinical staff.

2.2 Key Facilitators

HFHS possesses numerous strengths that can facilitate successful implementation. The organization features an established orthopedic service line that can provide focused leadership to champion the initiative.[11] A strong patient-centered care culture aligns perfectly with the AI companion's purpose.[13] HFHS demonstrates a culture of innovation and continuous improvement, with leadership emphasizing digital transformation.[10] The existing technology infrastructure provides technical readiness. Executive support for digital innovation, respected orthopedic surgeons serving as potential champions, and staff motivation to improve patient experience create a receptive environment. The involvement of clinicians in the implementation process will build crucial buy-in, and feedback mechanisms for ongoing refinement.

3 Implementation Strategies

The Expert Recommendations for Implementing Change (ERIC) compilation offers a set of 73 implementation strategies developed through systematic consensus-building among implementation science experts.[14] From this comprehensive toolkit, we select strategies that directly target our identified barriers.

3.1 ERIC Framework

(1) To address the limited evidence-base, we are planning to develop academic partnerships creating a bridge between practice and research. This strategy involves partnering with a university or academic unit to bring research skills to the implementation project and create shared training opportunities.[15] Academic partnerships can generate new evidence during all stages of implementation, creating a cycle of knowledge development and application. Recent research demonstrates that academic partnerships strengthen implementation efforts by bringing methodological rigor to real-world implementation challenges.[14]

(2) To address varying technological literacy, we intend to prepare patients to be active participants, empowers them to engage meaningfully with the AI care companion. This strategy involves preparing patients to be active in their care, specifically around the use of technology-assisted healthcare interventions.[15] Recent research identified training and educational programs as key enablers to enhance the adoption of digital interventions.[16] By preparing patients in advance, we can mitigate the barrier of varying technological literacy and create more equitable access to innovation benefits.

(3) To address workflow integration challenges, we are developing and providing local technical support offering specialized support focused on implementation challenges. By providing real-time, context-specific implementation support, this strategy has proven effective in helping healthcare professionals integrate new technologies into existing workflows.[17]

To complement our other strategies and strengthen our implementation effort, we plan to build a (4) coalition, creating a collaborative foundation for sustainable change. This strategy involves recruiting and cultivating relationships across all stages of the implementation. Coalition-building was identified as the most endorsed strategy when addressing

barriers related to implementing lifestyle-related treatment modalities.[17] By bringing together diverse stakeholders with shared implementation goals, we create a collective force that can overcome barriers through collaborative problem-solving.

3.2 Proctor's Framework

The following table specifies our selected strategies according to Proctor's seven criteria:

Strategy 1: Develop academic partnerships

Specification	**Description**
Actor	implementation team leadership
Action	establish formal partnership with university research department
Target	research infrastructure and evidence-based knowledge
Temporality	pre-implementation and continuing throughout
Dose	monthly research meetings
Implementation Outcome	appropriateness, feasibility
Justification	addresses limited evidence base by generating new knowledge while implementation occurs

Strategy 2: Prepare patients to be active participants

Specification	**Description**
Actor	clinical staff and patient educators
Action	conduct pre-intervention training sessions and create self-paced learning modules
Target	patient knowledge, skills, and confidence with technology
Temporality	pre-implementation and continuing as new patients enter
Dose	1-hour initial training; monthly sessions; on-demand learning materials
Implementation Outcome	acceptability, adoption
Justification	addresses varying technological literacy by providing tailored support based on patient needs

Strategy 3: Provide local technical support

Specification	**Description**
Actor	IT support team and clinical champions
Action	offer real-time technical support and workflow integration guidance
Target	clinical workflow processes and staff technology use
Temporality	pre-implementation and implementation
Dose	daily on-site support for first month; weekly for months 2-3; as-needed thereafter
Implementation Outcome	feasibility, fidelity
Justification	addresses workflow integration by providing support at the point of use

Strategy 4: Building a coalition

Specification	**Description**
Actor	implementation team
Action	identify and engage stakeholders from all affected departments and patient representatives
Target	organizational relationships and collaborative decision-making
Temporality	pre-implementation and continue throughout
Dose	bi-weekly coalition meetings; monthly progress reports
Implementation Outcome	acceptability, penetration
Justification	creates shared ownership and collaborative problem-solving capacity across the implementation process

3.3 Implementation Outcomes

Drawing from Proctor's framework, we focus on three key implementation outcomes, beginning with acceptability, the degree to which stakeholders find our AI care companion technology satisfactory. To measure (1) acceptability, we'll use a usability scale administered to both providers and patients at strategic intervals: before implementation, then three and six months after. Success means achieving a mean score of 70 or higher by the six-month mark, indicating that users find the system genuinely usable. Our electronic survey will capture both quantitative ratings and qualitative insights through open-ended questions.

Next, (2) feasibility examines how our AI care companion truly functions in real-world clinical settings. We will measure the percentage of user interactions users without requiring technical assistance through the app automated tracking, and help-desk logs. Success means reaching a threshold where at least 70% of interactions occur smoothly, without users needing to call for help by the sixth month of implementation.

Lastly, (3) penetration measures how deeply our AI care companion integrated into the organization's orthopedic service. We will track this through the percentage of patients and providers who regularly engage with the technology. Success means reaching at least 70% of users actively participating by the sixth month.

3.4 Client & Service Level Outcomes

Beyond implementation outcomes, we will also assess the impact of our implementation effort on client outcomes and service delivery. (1) Patient satisfaction with our AI care companion, captures whether our innovation truly serve those who we intended to help. We will measure this using a 5-point scale brief electronic surveys after each help-desk encounter, and in our monthly follow-up sessions. Success means reaching a mean satis-

faction score of 4 and above.

(2) Clinical workflow efficiency, we will examines how the AI care companion technology impacts patient wait times. We compare workflows before implementation and again six months after documenting how this innovation reshapes patient journeys and provider processes. With success means achieving a 15% reduction in overall patient wait times within six months of implementation.

3.5 Implementation Research Logic model

Please see Appendix A: Implementation Research Logic Model

4 Anticipated Problems & Solutions

This section outlines anticipated problems across different implementation phases and our strategic approaches to address them:

(1) The implementation may face resistance from clinicians concerned about AI replacing clinical judgment or disrupting established care pathways. To prepare for this anticipated barrier, we will leverage our planned coalition team to identify and address concerns from all the affected departments and patients. In addition, we will distribute monthly progress reports to main transparency.

(2) Evolving regulations for AI-based medical technologies may create implementation hurdles. To prepare for this anticipated barrier, we will proactively address regulatory requirements by staying current with guidelines and regulations for AI in healthcare, collaborating with regulatory affairs specialists and organizations early in the implementation process, and documenting compliance measures throughout implementation.

(3) When our planned strategies for addressing varying technological literacy among pa-

tients may deem not enough or create inequitable access, particularly among older adults and socioeconomically disadvantaged populations. To address this barrier, we've developed a set of strategies that begins with technology readiness assessments to identify support needs. Our approach provides a tailored assistance options including in-person training sessions, family member involvement opportunities, and simplified interface alternatives. Additionally, we'll establish a "technology buddy" program pairing tech-savvy volunteers with patients needing additional support. Creating a supportive environment where tech-savvy volunteers, including students, community members, and previous knee replacement patients with digital literacy, are carefully matched with patients requiring additional technological assistance. Providing one-on-one tailored guidance to individual learning styles, language preferences, and accessibility needs. Importantly, traditional care pathways will remain available for patients unable to effectively engage with the technology, ensuring no one is left behind during implementation.

5 Potential Impacts on Health Outcomes

The implementation of an AI-driven preoperative care companion for knee replacement surgery at Henry Ford Health System (HFHS) has significant potential to transform patient care and outcomes.

5.1 Patient Experience & Surgical Outcomes

The AI-driven preoperative care companion aims to transform the often confusing preoperative period by offering structured support with personalized engagement. The AI companion seeks to address patient questions, provide guidance and educational reinforcement that may help with common challenges like confusion and forgetfulness during surgical preparation. By focusing on preoperative factors that research suggests contribute to better outcomes, the care companion has the potential to enable proactive interventions

and potentially fewer recovery complications.

5.2 Service Outcomes

The implementation of the AI-driven preoperative care companion promises service delivery improvements at HFHS. The technology aims to improve clinical efficiency, with implementation metrics targeting a 15% reduction in overall patient wait times within six months, while potentially reducing staff workload. In addition, the potential health improvements could result in reduced complications, shorter hospital stays, and fewer readmission.

5.3 Health Equity Considerations

While the AI companion offers promising benefits, its implementation requires careful attention to health equity considerations. Varying technological literacy among HFHS's diverse patient population represents one of the barriers, with potential to exacerbate existing disparities if not specifically addressed. Despite these challenges, the technology offers meaningful potential to bridge healthcare access gaps, particularly benefiting underserved or remote populations who currently have limited follow-up care options. Implementation planning must also include strategies that that monitor or addresses potential bias in how the AI companion interacts with different demographic groups to ensure the technology reduces rather than reinforces existing healthcare inequities.

6 Implementation Timeline

The AI-driven preoperative care companion implementation at Henry Ford Health System will follow a 12-month timeline with five overlapping phases.

Phase 1: Pre-Implementation (Months 1-3) begins with establishing an implementation leadership team in Month 1 that brings together clinical champions (orthopedic surgeons,

nurses), IT specialists, patient representatives, and administrative leadership to guide the entire process. Simultaneously, the team initiates academic partnership development with a local university research department to address the limited evidence-base barrier and create shared training opportunities. Months 1-2 focus on conducting a detailed needs assessment through comprehensive stakeholder interviews and workflow analysis to understand the current state and implementation requirements. By Month 2, the team will develop implementation protocols and customize the AI companion specifically for Henry Ford Health System workflows based on the assessment findings. The final month of this phase involves creating comprehensive training materials and establishing the necessary technical infrastructure for pilot deployment while simultaneously finalizing the evaluation metrics and data collection processes needed to measure implementation and clinical success.

Phase 2: Pilot Implementation (Months 4-6), deploying the AI companion with a limited patient cohort. Throughout Months 4-5, the implementation team conducts daily meetings to assess progress and address emerging challenges, while the academic partners begin collecting preliminary research data on implementation processes and outcomes. Month 5 focuses on gathering initial user feedback through interviews and application analytics, with academic researchers assisting in developing robust methodologies. By Month 6, the team analyzes pilot data in collaboration with academic partners and revises implementation strategies based on these findings. Academic collaboration strengthens the evidence base for the intervention while providing real-time insights to refine the implementation approach.

Phase 3: Full implementation (Months 7-11) expands the implementation through strategic expansion. Beginning in Month 7 with extending the AI companion to eligible knee replacement patients while delivering refresher training to clinical staff based on pilot learnings. By Month 9, the team conducts a thorough mid-implementation assessment of

outcomes and implementation fidelity in collaboration with academic researchers, using mixed-methods approaches to evaluate both quantitative metrics and qualitative experiences of stakeholders across the system.

Phase 4: Evaluation (Month 12-13) marks the culmination of the implementation process through comprehensive assessment and operational transition. Months 12-13 focuses entirely on evaluation, beginning with measuring all implementation outcomes against established targets, followed by analyzing these results and identifying long-term improvement opportunities.

Phase 5: Sustainment (Month 13 and beyond), the final month transitions to permanent operational team, and implementing the final adjustments based on evaluation findings that will ensure the AI companion's continued success and evolution.

7 Conclusion

The implementation of an AI-driven preoperative care companion at Henry Ford Health System presents an opportunity to transform the patient-provider relationship towards patient-centered care that bridges the gap between technical surgical excellence and the lived experience of patients preparing for knee replacement surgery. This comprehensive implementation proposal addresses the critical barriers of limited evidence base, varying technological literacy, and workflow integration through evidence-based implementation strategies. Our 12-month implementation timeline creates a structured pathway from initial foundation-building through pilot testing, scaling, and ultimately sustainability. By incorporating robust monitoring and evaluation processes with proactive approach to anticipated challenges and ongoing commitment to health equity, we ensure both implementation fidelity and continuous improvement to benefit all patients. In hopes of creating a collaborative partnership throughout the surgical journey.

References

1. Spiering, T. J., Firth, A. D., Mousoulis, C., Hallstrom, B. R., & Gagnier, J. J. (2024). Establishing the Minimally Important Difference for the KOOS-Joint Replacement and PROMIS Global-10 in Patients After Total Knee Arthroplasty. Orthopaedic journal of sports medicine, 12(2), 23259671231218260. https://doi.org/10.1177/23259671231218260

2. Marques, C. J., Bohlen, K., & Lampe, F. (2021). Participation in a Preoperative Patient Education Session Is a Significant Predictor of Better WOMAC Total Index Score and Higher EQ-5D-5L Health Status Index 1 Year After Total Knee and Hip Arthroplasties: A Retrospective Observational Study. American journal of physical medicine & rehabilitation, 100(10), 972–977. https://doi.org/10.1097/PHM.0000000000001689

3. Michigan Knee Institute. (2023, March 7). First came robotic surgery. Then artificial intelligence. Now leading Detroit-area physician reveals a "balancing act" for knee replacement. PR Newswire. https://www.prnewswire.com/news-releases/first-came-robotic-surgery-then-artificial-intelligence-now-leading-detroit-area-physician-reveals-a-balancing-act-for-knee-replacement-301764622.html

4. Shultz, K., Mastrocola, M., Smith, T., & Busconi, B. (2023). Patients Have Poor Postoperative Recall of Information Provided the Day of Surgery but Report Satisfaction With and High Use of an E-mailed Postoperative Digital Media Package. Arthroscopy, sports medicine, and rehabilitation, 5(4), 100757. https://doi.org/10.1016/j.asmr.2023.100757

5. Truong, E. I., DeMario, B. S., Hendrickson, S., Kalina, M. J., Jr, Vallier, H. A., Tseng, E. S., Claridge, J. A., & Ho, V. P. (2020). Factors Influencing Nonadherence to Recommended Postdischarge Follow-Up After Trauma. The Journal of surgical research, 256, 143–148. https://doi.org/10.1016/j.jss.2020.06.009

6. Javed, H., Olanrewaju, O. A., Ansah Owusu, F., Saleem, A., Pavani, P., Tariq, H., Vasquez Ortiz, B. S., Ram, R., & Varrassi, G. (2023). Challenges and Solutions in Postoperative Complications: A Narrative Review in General Surgery. Cureus, 15(12), e50942. https://doi.org/10.7759/cureus.50942

7. Romero-Brufau, S., Wyatt, K. D., Boyum, P., Mickelson, M., Moore, M., & Cognetta-Rieke, C. (2020). Implementation of Artificial Intelligence-Based Clinical Decision Support to Reduce Hospital Readmissions at a Regional Hospital. Applied clinical informatics, 11(4), 570–577. https://doi.org/10.1055/s-0040-1715827

8. Johns Hopkins Medicine. (2021, September 21). Study shows use of smartphone app associated with lower hospital readmission rates for heart attack survivors. Johns

Hopkins Medicine.
https://www.hopkinsmedicine.org/news/newsroom/news-releases/2021/09/study-shows-use-of-smartphone-app-associated-with-lower-hospital-readmission-rates-for-heart-attack-survivors

9. Michigan Arthroplasty Registry Collaborative Quality Initiative. (2025). https://marcqi.org/

10. Mazur, S. (2024, April 29). How AI is helping experts care for stroke patients. Henry Ford Health.
https://www.henryford.com/blog/2024/04/how-ai-is-helping-experts-care-for-stroke-patients

11. Liao, X., Yao, C., Jin, F., Zhang, J., & Liu, L. (2024). Barriers and facilitators to implementing imaging-based diagnostic artificial intelligence-assisted decision-making software in hospitals in China: a qualitative study using the updated Consolidated Framework for Implementation Research. BMJ open, 14(9), e084398.
https://doi.org/10.1136/bmjopen-2024-084398

12. CFIR Research Team. (2025). Strategy Design. The Consolidated Framework for Implementation Research.
https://cfirguide.org/choosing-strategies/

13. Silver, S., Jones, K. C., Redmond, S., George, E., Zornes, S., Barwise, A., Leppin, A., Dong, Y., Harmon, L. A., Kumar, V. K., Kordik, C., Walkey, A. J., & Drainoni, M. L. (2023). Facilitators and barriers to the implementation of new critical care practices during COVID-19: a multicenter qualitative study using the Consolidated Framework for Implementation Research (CFIR). BMC health services research, 23(1), 272.
https://doi.org/10.1186/s12913-023-09209-w

14. Powell, B. J., Waltz, T. J., Chinman, M. J., Damschroder, L. J., Smith, J. L., Matthieu, M. M., Proctor, E. K., & Kirchner, J. E. (2015). A refined compilation of implementation strategies: results from the Expert Recommendations for Implementing Change (ERIC) project. Implementation science : IS, 10, 21.
https://doi.org/10.1186/s13012-015-0209-1

15. Powell, B. J., Waltz, T. J., Chinman, M. J., Damschroder, L. J., Smith, J. L., Matthieu, M. M., Proctor, E. K., & Kirchner, J. A. E. (2015). A refined compilation of implementation strategies: Results from the Expert Recommendations for Implementing Change (ERIC) project. Implementation Science, 10(1), 21.
https://impsciuw.org/wp-content/uploads/2019/08/ERIC-Strategy-Handout.pdf

16. Borges do Nascimento, I. J., Abdulazeem, H., Vasanthan, L. T., Martinez, E. Z., Zucoloto, M. L., Østengaard, L., Azzopardi-Muscat, N., Zapata, T., & Novillo-Ortiz, D. (2023). Barriers and facilitators to utilizing digital health technologies by healthcare professionals. NPJ digital medicine, 6(1), 161.
https://doi.org/10.1038/s41746-023-00899-4

17. Bouma, S., van den Akker-Scheek, I., Schiphof, D., van der Woude, L., Diercks, R., & Stevens, M. (2023). Implementing lifestyle-related treatment modalities in osteoarthritis care: Identification of implementation strategies using the Consolidated Framework for Implementation Research-Expert Recommendations for Implementing Change matching tool. Musculoskeletal care, 21(4), 1125–1134. https://doi.org/10.1002/msc.1791

18. Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Administration and policy in mental health, 38(2), 65–76. https://doi.org/10.1007/s10488-010-0319-7

19. Gold, R., Bunce, A. E., Cohen, D. J., Hollombe, C., Nelson, C. A., Proctor, E. K., Pope, J. A., & DeVoe, J. E. (2016). Reporting on the strategies needed to implement proven interventions: An example from a "real-world" cross-setting implementation study. Mayo Clinic Proceedings, 91(8), 1074–1083. https://doi.org/10.1016/j.mayocp.2016.03.014

Appendix A: Implementation Research Logic Model