Research Article

Understanding Human-AI Interaction in Healthcare: The Mediating Role of Trust and Moderating Influence of Cognitive Load

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Abstract: *The integration of Artificial Intelligence (AI) in healthcare is often hindered by a lack of trust among healthcare professionals, impacting the effectiveness of Human-AI interaction. This study examines how Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) influence trust in AI, with trust mediating the relationship between these constructs and Human-AI interaction in healthcare settings. Additionally, the researcher investigates the moderating role of Cognitive Load, positing that higher cognitive demands may weaken the positive effects of trust on Human-AI interaction. By surveying doctors, nurses, and medical technicians in Malaysia, the study aims to provide a comprehensive understanding of these dynamics. It is expected to find that increased PU and PEOU enhance trust, leading to improved Human-AI interaction, while Cognitive Load may diminish the strength of this relationship. Anticipated findings will underscore the importance of designing AI systems that are intuitive, beneficial, and mindful of cognitive demands to optimise healthcare outcomes and clinician support. This research holds significant commercialisation potential as healthcare organisations increasingly seek AI solutions that enhance trust and facilitate effective collaboration between humans and AI.*

Keywords: Perceived Usefulness, Perceived Ease of Use, Trust in AI, Cognitive Load, Huma-AI Interaction, Healthcare

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1. INTRODUCTION

The integration of Artificial Intelligence (AI) into healthcare offers transformative potential by enhancing clinical decision-making, improving patient outcomes and healthcare deliveries (Olawade et al., 2024)). A key element in the effective deployment of AI in healthcare lies in Human-AI Interaction, where healthcare professionals actively engage with AI systems, overseeing AI-driven recommendations and ultimately making final decisions (Esmaeilzadeh, 2024). This collaborative interaction allows AI to function as a supportive tool while enabling human oversight, particularly crucial in high-risk, life-critical tasks (Salloch & Eriksen, 2024).

Although AI systems offer predictive accuracy and decision support, many clinicians approach them with scepticism, often viewing these technologies as complex, difficult to use, or potentially unreliable (Chandio et al., 2024). Trust is, therefore, essential in establishing effective Human-AI Interaction, as it influences whether healthcare providers are willing to incorporate AI insights confidently into their

clinical workflow. While previous studies have established the direct effects of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) on trust in AI within healthcare, their broader influence on Human-AI Interaction is less understood (Başar & Erkul, 2024). Specifically, little research has examined how trust, shaped by PU and PEOU, impacts healthcare professionals' engagement with AI-driven decisions (Roy et al., 2024).

Additionally, the cognitive demands on healthcare professionals interacting with AI further complicate Human-AI Interaction (Zhang et al., 2024). High Cognitive Load, resulting from overly complex or cumbersome AI interfaces, can reduce a clinician's ability to monitor and respond effectively to AI-generated insights (Kumar et al., 2024). This study seeks to address whether Cognitive Load weakens the positive effect of trust on Human-AI Interaction in healthcare, potentially hindering AI adoption in clinical practice.

Thus, this study seeks to address the following research objectives:

1) To examine the impact of Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) on healthcare professionals' trust in AI.
2) To assess the role of trust in AI as a mediator between PU, PEOU, and Human-AI Interaction in healthcare settings.
3) To investigate the moderating effect of Cognitive Load on the relationship between trust in AI and Human-AI Interaction.

2. THEORETICEL PERSPECTIVES

The study is based on the Technology Acceptance Model (TAM), which suggests that perceptions of a technology's usefulness (PU) and ease of use (PEOU) shape users' attitudes toward its adoption (Taherdoost et al., 2024). Here, PU is the degree to which AI enhances job performance, while PEOU reflects how effortless AI is to use. Both PU and PEOU are expected to foster trust in AI, a critical factor in whether healthcare professionals adopt and rely on AI systems. Trust acts as a mediator between PU, PEOU, and human-AI interaction, enabling healthcare providers to engage with AI in clinical workflows more confidently. Trust is seen as essential, especially in scenarios requiring human oversight of AI outputs to ensure safety and reliability.

Additionally, Cognitive Load Theory (CLT) enlightens the role of cognitive load, or the mental effort required to use AI, as a moderating factor (Szulewski et al., 2020). High cognitive load from complex AI systems can undermine trust and user engagement in human-AI processes, even if trust is initially high. Conversely, when cognitive load is low, human-AI interactions become more effective and streamlined. This study posits that balancing cognitive load is crucial to optimising human-AI interaction in healthcare.

2.1 HYPOTHESIS DEVELOPMENT

In this study, Perceived Usefulness (PU) refers to the degree to which healthcare professionals believe that AI systems will enhance their clinical performance and decision-making capabilities. Studies have shown that when healthcare professionals feel that AI helps them make more accurate or quicker diagnoses, they are more likely to find the system useful (Hua et al., 2023). Research on AI implementation in healthcare institutions, such as automated medical record analysis, has found that faster task completion correlates with increased adoption due to the usefulness perceived by the healthcare staff (Ismatullaev & Kim, 2022). AI systems that assist with managing large volumes of

patient data, predicting patient outcomes, or streamlining administrative tasks (like scheduling or follow-ups) are seen as improving overall productivity (Wysocki et al., 2022).

H1: Perceived Usefulness (PU) positively affects Trust in AI.

PEOU emphasises how easily users can interact with AI systems. In the context of AI in healthcare, ease of use is essential because healthcare professionals often work in high-pressure environments and need systems that are intuitive and efficient. Mouloudj et al. (2023) study shows that technologies perceived as easy to use are more likely to be trusted and adopted. Kim et al. (2024) highlighted that if the AI system is user-friendly, professionals are more likely to integrate it into their daily routines. Wang & Wang (2024) findings demonstrated that AI tools designed with simple, intuitive interfaces can increase clinicians' confidence in using them for critical tasks like diagnosis and treatment recommendations. If a healthcare professional perceives AI systems as difficult or cumbersome to use, this negatively impacts their willingness to adopt the technology, even if the system is perceived as useful (Zhan et al., 2024).

H2: Perceived Ease of Use (PEOU) positively affects Trust in AI.

Trust in AI is a prerequisite for Human-AI interaction, where human oversight is essential to ensure ethical and effective decision-making. Prior studies have shown that when trust in AI is high, healthcare professionals are more likely to engage in AI-assisted processes, overseeing and validating AI recommendations (Esmaeilzadeh, 2024; Jeyakumar et al., 2023). Healthcare-specific studies, such as Lukkien et al. (2024), indicate that professionals tend to trust AI when it delivers consistent, accurate, and explainable results. Studies like Smith et al. (2023) have found that when clinicians feel confident in AI's decision-making process, they are more likely to rely on the system, highlighting trust as a central factor in Human-AI engagement.

H3: Trust in AI positively affects Human AI interaction in healthcare settings.

When PU is high, healthcare professionals see the AI as valuable, thus fostering trust. This trust, in turn, facilitates a more seamless Human-AI interaction because professionals are more inclined to actively engage with and rely on AI-driven insights (Hua et al., 2023; Wysocki et al., 2022). Trust thus acts as a bridge between recognising AI's utility and integrating it into clinical workflows. Meanwhile, PEOU increases trust by minimising the friction involved in using AI (Nertinger et al., 2022; Nie et al., 2022). When trust is in place, professionals are more willing to engage with AI systems, accepting them as part of their decision-making process (Dlugatch et al., 2023; Jones et al., 2023). Here, trust intervenes by translating the ease of use into a stronger commitment to engage with AI systems.

H4: **Trust in AI mediates the relationship between Perceived Usefulness (PU)** and **Human-AI interaction in healthcare settings.**

H5: **Trust in AI mediates the relationship between Perceived Ease of Use (PEOU)** and **Human-AI interaction in healthcare settings.**

Cognitive Load refers to the mental effort required to process information and make decisions, which can vary significantly depending on the complexity and design of the AI interface (Shamszare & Choudhury, 2023). Low cognitive load allows professionals to engage actively with AI systems without feeling overwhelmed (Lee & Chew, 2023). The mental resources required are minimal, so if professionals already trust the AI, they are more likely to rely on it confidently, actively participating in AI processes. High Cognitive Load, on the other hand, imposes a significant mental strain on healthcare professionals, requiring them to allocate more cognitive resources to interpret and oversee AI-driven insights (Lee & Chew, 2023). Even if the healthcare professionals trust the AI system, the

increased mental effort needed to interact with it may cause them to rely less on the AI, as the interaction becomes too demanding (Choudhury & Asan, 2022; Ramaswamy et al., 2024).

H6: Cognitive Load moderates the relationship between Trust in AI and Human AI interaction in healthcare settings.

Figure 1 depicts the conceptual framework developed for this based on the hypothesis development.

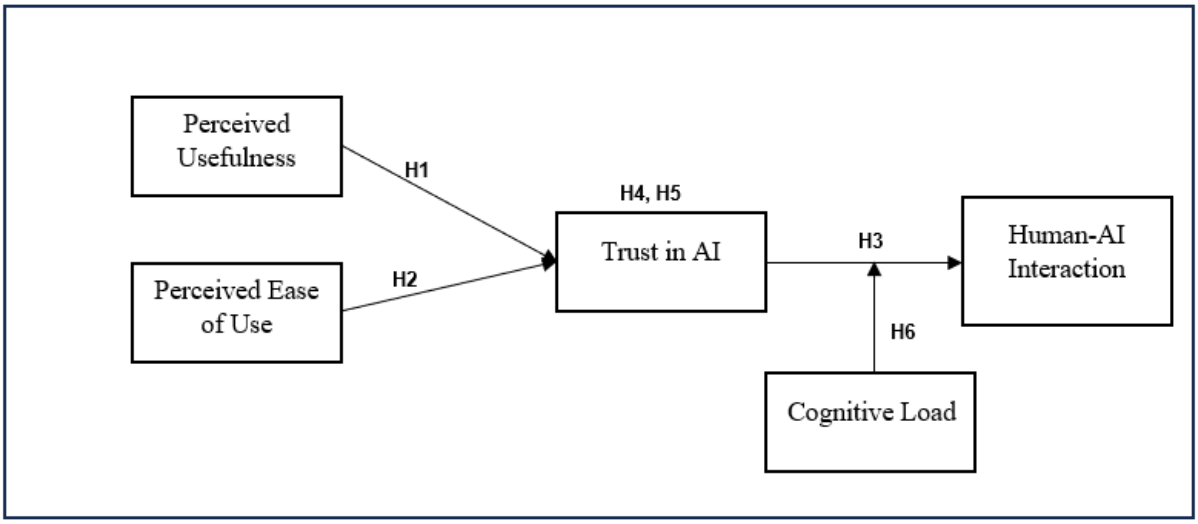

Figure 1: Conceptual Framework

3. METHODOLOGY

The study will target healthcare professionals, including doctors, nurses, and medical technicians who engage with AI-based decision-making tools in healthcare institutions in Malaysia. A sample of 300 respondents will be selected through purposive sampling to ensure the respondents have relevant experience with AI in clinical contexts, better representing the study's focus. Respondents will complete a structured survey using a Likert scale to assess Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Trust in AI, Cognitive Load, and Human-AI Interaction. Each variable will be measured with items adapted from validated sources, as shown in Table 2.

Table 2: Measurements for Variables

Variables	No of items	Sources
Perceived Usefulness (PU)	5	Choudhury & Asan (2022)
Perceived Ease of Use (PEOU)	5	Choudhury & Asan (2022)
Trust in AI	5	Asan et al. (2020)
Cognitive Load	7	Nazar et al. (2021)
Human-AI Interaction	5	Nazar et al. (2021)

The data analysis will be conducted through Partial Least Squares SEM (PLS-SEM) using Smart PLS 4. Following a two-step process (Anderson & Gerbing, 1988), the measurement model will first assess the

reliability and validity of instruments, based on Hair et al. (2022). The structural model will then test the formulated hypotheses.

5. EXPECTED OUTCOMES

Firstly, it is anticipated that Perceived Usefulness (PU) will positively affect Trust in AI (H1), suggesting healthcare professionals who see AI as beneficial for their clinical tasks are likely to trust it more. AI that demonstrates clear benefits, such as enhancing accuracy, efficiency, and decision support, fosters increased trust, which is essential for healthcare professionals to feel comfortable relying on the technology. This outcome implies that AI systems must be designed to provide demonstrable value to earn clinicians' trust and drive adoption, especially in high-stakes healthcare environments.

Furthermore, Perceived Ease of Use (PEOU) is expected to positively affect Trust in AI (H2). Healthcare professionals are more likely to trust AI systems perceived as user-friendly and intuitive. Simplified designs and streamlined interfaces reduce the cognitive burden on users, making interactions smoother and less error-prone, which bolsters trust. This outcome suggests that AI developers should prioritise ease of use in AI system design to facilitate trust, leading to greater acceptance and more effective integration of AI in clinical workflows.

As for Trust in AI affecting Human-AI Interaction in healthcare AI systems (H3), the study expects that higher levels of trust in AI will encourage active collaboration between healthcare professionals and AI systems. When clinicians have confidence in AI's reliability, they are more likely to engage with and incorporate AI-driven insights into their decision-making processes. This outcome underlines the importance of establishing trust as a foundation for effective, enabling healthcare professionals to leverage AI insights in patient care confidently.

Additionally, trust is predicted to play a mediating role in translating the effects of PU and PEOU on AI engagement. Trust in AI is anticipated to mediate the relationship between PU and Human-AI interaction (H4), meaning that perceived usefulness leads to increased Human-AI interaction through the pathway of trust. Similarly, Trust is expected to mediate the relationship between PEOU and Human-AI interaction (H5), wherein ease of use fosters trust, which, in turn, enhances Human-AI involvement. These outcomes emphasise that, while perceived usefulness and ease of use independently affect healthcare professionals' willingness to work with AI, trust is the central element that ultimately drives engagement in AI processes. This reinforces the need for healthcare AI systems to demonstrate both utility and ease of use to cultivate trust, ultimately enhancing collaboration.

Finally, the study proposes that Cognitive Load will moderate the relationship between Trust in AI and Human-AI interaction (H6). Higher cognitive load is expected to weaken the positive effect of trust on Human-AI interaction, as excessive mental demands could limit healthcare professionals' ability to engage meaningfully with AI systems. This outcome implies that even if AI systems are trusted, an overly complex or cognitively taxing interface may hinder Human-AI interaction effectiveness. Therefore, minimising cognitive load in AI systems is essential to ensuring that trust can fully enable collaborative and impactful human-AI interactions.

5. LIMITATIONS & RECOMMEDNATIONS

This study has two main limitations that point to future research directions. First, the cross-sectional design limits insight into how trust and Human-AI interaction evolve over time; a longitudinal study could capture changes in engagement as professionals become more familiar with AI. Additionally, this study does not account for role-specific differences. Future research could explore unique needs

across roles, such as doctors, nurses, or technicians, to design AI tools more effectively tailored to each group.

6. CONCLUSION

In summary, this study highlights trust, perceived usefulness, perceived ease of use, and cognitive load as key factors influencing human-AI interaction in healthcare. Trust acts as a mediator, driving healthcare professionals' engagement with AI systems, while perceived usefulness and ease of use positively contribute to trust. However, the moderating role of cognitive load introduces a critical dimension; high cognitive demands may hinder effective AI utilisation, even when trust is present.

Expected findings will underscore the importance of designing AI systems that are intuitive, beneficial, and low in cognitive demand to optimise healthcare outcomes and clinician support. This research offers actionable insights for AI developers and healthcare stakeholders, enhancing understanding of the dynamics in human-AI collaboration within healthcare settings.

References

Asan, O., Bayrak, A. E., & Choudhury, A. (2020). Artificial intelligence and human trust in healthcare: Focus on clinicians. *Journal of Medical Internet Research*, *22*(6), e15154. https://doi.org/10.2196/15154

Başar, E. E., & Erkul, A. K. (2024). Factors Affecting the Attitude of Medical Doctors in Turkey towards Using Artificial Intelligence Applications in Healthcare Services. *Bezmialem Science*, 297–308. https://doi.org/10.14235/bas.galenos.2024.26879

Chandio, S. A., Rehman, A. U., Bano, S., Hammed, A., & Hussain, A. (2024). Enhancing trust in Healthcare: The role of AI explainability and professional familiarity. *Deleted Journal*, *4*(1). https://doi.org/10.62019/abbdm.v4i1.100

Choudhury, A., & Asan, O. (2022). Impact of cognitive workload and situation awareness on clinicians' willingness to use an artificial intelligence system in clinical practice. *IISE Transactions on Healthcare Systems Engineering*, *13*(2), 89–100. https://doi.org/10.1080/24725579.2022.2127035

Dlugatch, R., Georgieva, A., & Kerasidou, A. (2023). Trustworthy artificial intelligence and ethical design: public perceptions of trustworthiness of an AI-based decision-support tool in the context of intrapartum care. *BMC Medical Ethics*, *24*(1). https://doi.org/10.1186/s12910-023-00917-w

Esmaeilzadeh, P. (2024). Challenges and strategies for wide-scale artificial intelligence (AI) deployment in healthcare practices: A perspective for healthcare organizations. *Artificial Intelligence in Medicine*, *151*, 102861. https://doi.org/10.1016/j.artmed.2024.102861

Hair, J. F., Thomas, G., Hult, M., Ringle, C. M., & Sarstedt, M. (2022). *A Primer on Partial Least Squares Structural Equation Modeling* (3rd ed.). Thousand Oakes, CA: Sage.

Hua, D., Petrina, N., Young, N., Cho, J., & Poon, S. K. (2023). Understanding the factors influencing acceptability of AI in medical imaging domains among healthcare professionals: A scoping review. *Artificial Intelligence in Medicine*, *147*, 102698. https://doi.org/10.1016/j.artmed.2023.102698

Huo, W., Zhang, Z., Qu, J., Yan, J., Yan, S., Yan, J., & Shi, B. (2023). Speciesism and Preference of Human–Artificial Intelligence Interaction: A Study on Medical Artificial Intelligence. *International Journal of Human-Computer Interaction*, *40*(11), 2925–2937. https://doi.org/10.1080/10447318.2023.2176985

Ismatullaev, U. V. U., & Kim, S. (2022). Review of the factors affecting acceptance of AI-Infused Systems. *Human Factors the Journal of the Human Factors and Ergonomics Society*, *66*(1), 126–144. https://doi.org/10.1177/00187208211064707

Jeyakumar, T., Younus, S., Zhang, M., Clare, M., Charow, R., Karsan, I., Dhalla, A., Al-Mouaswas, D., Scandiffio, J., Aling, J., Salhia, M., Lalani, N., Overholt, S., & Wiljer, D. (2023). Preparing for an Artificial Intelligence–Enabled Future: Patient perspectives on engagement and health care professional training for adopting artificial intelligence technologies in health care settings. *JMIR AI*, *2*, e40973. https://doi.org/10.2196/40973

Jones, C., Thornton, J., & Wyatt, J. C. (2023). Artificial intelligence and clinical decision support: clinicians' perspectives on trust, trustworthiness, and liability. *Medical Law Review*, *31*(4), 501–520. https://doi.org/10.1093/medlaw/fwad013

Kim, Y. J., Choi, J. H., & Fotso, G. M. N. (2024). Medical Professionals' Adoption of AI-based Medical Devices: UTAUT Model with Trust Mediation. *Journal of Open Innovation Technology Market and Complexity*, *10*(1), 100220. https://doi.org/10.1016/j.joitmc.2024.100220

Kumar, P., Vrontis, D., & Pallonetto, F. (2023). Cognitive engagement with AI-enabled technologies and value creation in healthcare. *Journal of Consumer Behaviour*, *23*(2), 389–404. https://doi.org/10.1002/cb.2196

Lee, M. H., & Chew, C. J. (2023). Understanding the effect of counterfactual explanations on trust and reliance on AI for Human-AI collaborative clinical decision making. *Proceedings of the ACM on Human-Computer Interaction*, *7*(CSCW2), 1–22. https://doi.org/10.1145/3610218

Lukkien, D. R. M., Stolwijk, N. E., Askari, S. I., Hofstede, B. M., Nap, H. H., Boon, W. P. C., Peine, A., Moors, E. H. M., & Minkman, M. M. N. (2024). Artificial intelligence-assisted decision making in long-term care: qualitative study on prerequisites for responsible innovation (Preprint). *JMIR Nursing*, *7*, e55962. https://doi.org/10.2196/55962

Mouloudj, K., Le, V. L. O., Bouarar, A., Bouarar, A. C., Asanza, D. M., & Srivastava, M. (2023). Adopting artificial intelligence in healthcare. In *Advances in marketing, customer relationship management, and e-services book series* (pp. 1–20). https://doi.org/10.4018/978-1-6684-9324-3.ch001

Naiseh, M., Al-Thani, D., Jiang, N., & Ali, R. (2022). How the different explanation classes impact trust calibration: The case of clinical decision support systems. *International Journal of Human-Computer Studies*, *169*, 102941. https://doi.org/10.1016/j.ijhcs.2022.102941

Nazar, M., Alam, M. M., Yafi, E., & Su'ud, M. M. (2021). A Systematic Review of Human–Computer Interaction and Explainable Artificial intelligence in Healthcare with Artificial Intelligence techniques. *IEEE Access*, *9*, 153316–153348. https://doi.org/10.1109/access.2021.3127881

Nertinger, S., Kirschner, R. J., Naceri, A., & Haddadin, S. (2022). Acceptance of Remote Assistive Robots with and without Human-in-the-Loop for Healthcare Applications. *International Journal of Social Robotics*. https://doi.org/10.1007/s12369-022-00931-9

Nie, J. X., Heidebrecht, C., Zettler, A., Pearce, J., Cunha, R., Quan, S., Mansfield, E., & Tang, T. (2022). The Perceived Ease of use and Perceived Usefulness of a Web-Based Interprofessional Communication and Collaboration platform in the hospital setting: Interview study with health care providers. *JMIR Human Factors*, *10*, e39051. https://doi.org/10.2196/39051

Olawade, D. B., David-Olawade, A. C., Wada, O. Z., Asaolu, A. J., Adereni, T., & Ling, J. (2024). Artificial intelligence in healthcare delivery: Prospects and pitfalls. *Journal of Medicine Surgery and Public Health*, *3*, 100108. https://doi.org/10.1016/j.glmedi.2024.100108

Ramaswamy, T., Sparling, J. L., Chang, M. G., & Bittner, E. A. (2024). Ten misconceptions regarding decision-making in critical care. *World Journal of Critical Care Medicine*, *13*(2). https://doi.org/10.5492/wjccm.v13.i2.89644

Roy, M., Jamwal, M., Vasudeva, S., & Singh, M. (2024). Physicians behavioural intentions towards AI-based diabetes diagnostic interventions in India. *Journal of Public Health*. https://doi.org/10.1007/s10389-024-02235-w

Salloch, S., & Eriksen, A. (2024). What are humans doing in the loop? Co-Reasoning and practical judgment when using Machine Learning-Driven Decision Aids. *The American Journal of Bioethics*, *24*(9), 67–78. https://doi.org/10.1080/15265161.2024.2353800

Shamszare, H., & Choudhury, A. (2023). Clinicians' perceptions of artificial intelligence: focus on workload, risk, trust, clinical decision making, and clinical integration. *Healthcare*, *11*(16), 2308. https://doi.org/10.3390/healthcare11162308

Smith, H., Downer, J., & Ives, J. (2023). Clinicians and AI use: where is the professional guidance? *Journal of Medical Ethics*, jme-108831. https://doi.org/10.1136/jme-2022-108831

Sujood, N., Bano, N., & Siddiqui, S. (2022). Consumers' intention towards the use of smart technologies in tourism and hospitality (T&H) industry: a deeper insight into the integration of TAM, TPB and trust. *Journal of Hospitality and Tourism Insights*. https://doi.org/10.1108/jhti-06-2022-0267

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive science*, *12*(2), 257-285.

Taherdoost, H., Mohamed, N., & Madanchian, M. (2024). Navigating Technology Adoption/Acceptance Models. *Procedia Computer Science*, *237*, 833–840. https://doi.org/10.1016/j.procs.2024.05.172

Wang, X., & Wang, Y. (2024). Analysis of trust factors for AI-assisted diagnosis in intelligent Healthcare: Personalized management strategies in chronic disease management. *Expert Systems With Applications*, *255*, 124499. https://doi.org/10.1016/j.eswa.2024.124499

Wysocki, O., Davies, J. K., Vigo, M., Armstrong, A. C., Landers, D., Lee, R., & Freitas, A. (2022). Assessing the communication gap between AI models and healthcare professionals: Explainability, utility and trust in AI-driven clinical decision-making. *Artificial Intelligence*, *316*, 103839. https://doi.org/10.1016/j.artint.2022.103839

Zhan, X., Abdi, N., Seymour, W., & Such, J. (2024). Healthcare Voice AI Assistants: Factors influencing trust and Intention to use. *Proceedings of the ACM on Human-Computer Interaction*, *8*(CSCW1), 1–37. https://doi.org/10.1145/3637339

Zhang, S., Yu, J., Xu, X., Yin, C., Lu, Y., Yao, B., Tory, M., Padilla, L. M., Caterino, J., Zhang, P., & Wang, D. (2024). Rethinking Human-AI Collaboration in Complex Medical Decision Making: A Case Study in Sepsis Diagnosis. *CHI '24: Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems Ar*, *3*, 1–18. https://doi.org/10.1145/3613904.3642343