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COMMENTARY

# Assessing Equitable Development and Implementation of Artificial Intelligence-Enabled Patient Engagement Technologies: A Sociotechnical Systems Approach

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Patient engagement is the practice of ensuring that patients are active in their care decisions and condition(s) management through personalization, access, commitment, and therapeutic alliance between patient and providers. Increased patient engagement may improve health outcomes, patient satisfaction, and provider productivity.[1-5] For example, a recent scoping review summarized that whereas low patient engagement is correlated with more expensive hospital costs, higher patient engagement is correlated with health-improving behaviors that then relate to better outcomes and lower long-term costs.[1] Given current health care staffing shortages, artificial intelligence (AI)-enabled patient engagement technologies (PET) may provide additional engagement capacity for more consistent, personalized communications and information delivery, earlier responses to patient queries, and scheduling, telehealth services, and general support.[5]

However, a paradox emerges regarding the equitable development and implementation of AI-enabled PET. On the one hand, such solutions may increase access to care for underserved populations by addressing social determinants of health, eg, decreasing the need to travel to a provider office and increasing the capability of delivering multilingual care. On the other hand, if such technologies are trained on nondiverse or biased datasets or are deployed in neighborhoods with limited broadband and without alternative engagement options, then their underlying algorithms and deployment plans risk exacerbating disparities.[6,7] Domestic and international legislative bodies, such as NHS England (Digital Inclusion Framework)[8] and the United States Agency for Healthcare Research and Quality and the National Institute for Minority Health and Health Disparities,[9] call for consideration of these factors. These challenges and calls for further consideration lead us to ask: How is AI-enabled PET being developed and implemented in health care settings to mitigate bias and inequity? After a qualitative study of 12 organizations around the world—including health systems, AI-enabled PET developers, and health technology scholars from Brazil, Canada, Nigeria, Spain, the United Kingdom, and the United States—we find that a sociotechnical systems approach—ie, considering both technical and social factors during the development, assessment, and implementation stages—surfaces new factors and practices that are less commonly identified with a singular, technical lens. We highlight 6 specific examples that contribute new best practices to the development and implementation of AI-enabled PET. Collectively, these factors may mitigate further disparities and reduce existing ones.

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## Dissatisfaction With the Status Quo: Technical Concerns and Patient Expectations

AI-enabled PET includes communication platforms, health literacy applications, remote monitoring platforms, patient portals, virtual assistants, and chatbots. They can be a cost-effective, scalable and efficient approach to handling simpler, automatable, asynchronous tasks to increase physicians' availability to utilize a more complete range of their practice and skills, particularly to handle more complex cases.[5,10,11] However, these technologies are not without risks. Virtual assistants and chatbots pose data security and privacy risks,[12] on top of the concerns like exacerbating disparities or spreading misinformation. Although using Large Language Models (LLMs) to craft responses to patient queries through patient portals has the potential to save clinicians time, and they tend to have more of a patient education orientation than provider-drafted responses, according to one study, the LLM-generated responses posed a risk of harm in 7.1% of cases, so human review is needed before sending LLM-generated content to patients.[13] All of these technologies face some data interoperability challenges with other sources of health information.[14]

The AI-enabled PET tools are also falling short of patients' needs and expectations. One study reported that, whereas two-thirds of patients would like to be able to manage their own appointment scheduling through a digital tool, only 37% currently can do so.[15] The rising use of digital solutions may also increase the digital divide and prevent already-vulnerable people from accessing care.[6] Unaddressed concerns about biased datasets and algorithms may dissuade some providers from introducing such technologies to their patients; it is responsible to delay rollout until transparency and co-design principles can be satisfied.[9] Furthermore, there is limited evidence of the clinical or operational outcomes from implementing AI-enabled PET to date.[16]

## A Sociotechnical Systems Approach

Given the multidisciplinary nature of AI-enabled PET and the multiple domains in which it can have an impact, we recommend that organizations adopt a sociotechnical perspective when developing or procuring AI-enabled PET. A sociotechnical systems view seeks to jointly optimize the technical environment and the social system relevant for the organization.[17−20] Some of the earliest studies for AI-enabled medical diagnosis solutions make note that technical component that concerns the task domain and the knowledge engineering process and a social dimension of how users and managers relate to the system.[20] We broaden this social dimension of users to also include the patients served by and analyzed within the system. In the following sections, we provide examples from the 12 organizations (see Table 1) of the technical and social factors that should be considered when developing and deploying AI-enabled PET. The 12 organizations were examined by a broader qualitative study that of examined the definitions of patient engagement and current best practices of AI-enabled PET. Methods employed included a literature scan, reviews of published articles, websites, and other reports from the organizations, semi-structured interviews, and inductive analysis of the interview responses by NVivo Version 14.

**Technical Factors.** Technical considerations that may influence the successful and rigorous development and implementation of AI-enabled PET includes (1) information sharing agreements; (2) training data on diverse datasets; and (3) validation through clinician and patient testing. Although there are other technical factors that may be relevant for development in general, eg, interoperability and security standards, the highlighted factors

**TABLE 1. Interviewed Organizations**

| Organization | Country |
|---|---|
| Hospital Israelita Albert Einstein | Brazil |
| Hospital of the University of Pennsylvania | United States |
| Imperial College Healthcare NHS Trust | United Kingdom |
| Kaiser Permanente | United States |
| mDoc Healthcare | Nigeria |
| National Health Inequalities Improvement Programme | United Kingdom |
| NHS England | United Kingdom |
| PurpleLab | United States |
| Ribera Salud | Spain |
| SHI International Corp. | United States |
| Suffolk University Business School | United States |
| University of Toronto | Canada |

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were salient across the interviewed organizations and were discussed as uniquely positioned to support patient engagement with such tools.

First, to take an ethical and patient-centered approach to AI-enabled PET, patient data must be accessed in a way that protects the patient's identity. For example, Imperial College Healthcare, a 5 hospital, London-based NHS trust with more than 15,000 staff members[21] and the affiliated Paddington Life Sciences has a unique information sharing agreement—the digital collaboration space—to utilize patient data in a deidentified form for research and development in a secure data environment that adheres to national standards.[22] This provides an environment for other researchers to access it, provided the research has a direct benefit to the public.[22] Information sharing agreements can ensure the responsible and ethical stewardship of patient data.

Second, developers and health care professionals alike are becoming more aware of the biases within datasets[23] and biases within the algorithms themselves, eg, through inaccurate modeling related to ethnicity and other social determinants of health.[24] Solutions are ideally trained on diverse datasets to mitigate such biases.[25,26] For example, mDoc's CompleteHealth is an evidence-based, person-centered platform based in Nigeria supporting over 122,000 members living with or at risk for chronic diseases such as diabetes, hypertension, obesity, and cancer, as well as pregnancy with health coaching and personalized care. The early phases of the solution focused on SMS messaging with members. Now, it has a member portal and chatbot named Kem that is available on the web and a mobile application allowing members to track and manage their health metrics. Kem is integrated with ChatGPT and designed to address women's health questions. Kem is trained on questions from the SMS message data and data from their omnichannel health support (including application-based coaching and Telegram chats) in multiple languages between members and mDoc health coaches. In other words, by training Kem on user data that is analogous to the target patient population, they aimed to strengthen data quality and reduce algorithmic bias.

Third, the importance of testing solutions early and often with clinicians and patients cannot be overemphasized in this context. For example, researchers at the University of Pennsylvania Perelman School of Medicine found that a text message-based postpartum blood pressure monitoring program reduced disparities in postpartum blood pressure ascertainment between White and Black patients by about 50%.[27] Furthermore, at Penn Medicine, a team developed a chatbot (Penny) to correspond with newly postpartum mothers to help triage inquiries related to common postpartum concerns. The bot has human oversight and was not launched until it reached more than 95% accuracy. Nurses and other care providers pressure-tested the bot, and the development process factored in different vernacular ways users might communicate the same information (in English at present).

**Social Factors.** Key social factors include (1) multimodel engagement, including low technology and no technology options, (2) customized engagement options based on patient profile, and (3) public and private health sector deployment.

First, multimodel engagement, including low technology and no technology options is critical for the successful implementation of AI-enabled PET. Although AI-enabled PET is a high-technology solution, technologies represent a spectrum of solutions, from simple tools to complex systems.[14] Accounting for this spectrum during implementation can increase overall patient engagement. For example, Kaiser Permanente has devoted considerable effort both to procuring AI-enabled PET for its members and to studying nuanced implementation challenges. While studying applications for adolescents and teenagers, they recognized that a technology geared to this age group might be a good fit for a generation of digital natives, but it might require their using a parent's smartphone, thereby limiting their access to the platform and potentially impeding their willingness to share intimate details honestly. Therefore, a solution that is designed for tablets may be more ideal. In another example, mDoc has designed the product to be technology literacy-agnostic. If members do not have a smartphone, they are provided with an Unstructured Supplementary Service Data code to use on a basic mobile smartphone to communicate with a health coach. They also employ telephone calls, text messaging, online chatting, in-person NudgeHubs, and roving community ambassadors, where members can get in-person support to learn basic digital skills and build digital literacy, and social media, to provide multiple paths into the model.

In addition to having multiple modes of engagement, AI-enabled PET can be used to account for the social characteristics and clinical needs of a patient to present the most ideal engagement and treatment modalities to them. With so many AI-enabled PET solutions on the market,[28] patients may have a difficult time selecting the right mode of engagement for them. Organizations like Ribera Salud, a health care network in Spain that serves over 1 million patients per year, with over 1775 beds and more than 9200 professionals, uses an AI-enabled health assessment bot to provide an initial diagnosis, including social determinants of health. Based on that assessment, the technology classifies patients based on different opportunities to treatment within the system, eg, through application, health portal, WhatsApp, or a blended approach of telemedicine blended with physical visits. If a patient has 3 or more comorbidities and the health assessment suggests in-person treatment is needed, additional possibilities, such as hospital or hospital at home, are suggested. Providing customized suggestions for engagement provides a patient-centered approach that can also help to address staffing and space capacity concerns.[5]

Finally, having public and private health sector deployment built into AI-enabled PET deployment can help to achieve equitable outcomes. Organizations may address socioeconomic disparities by ensuring that AI-enabled PETs are financially accessible and available not only to patients on commercial health plans but also to patients in safety net hospitals and participating in government health plans.[6] For example, Albert Einstein Hospital, the largest International Patient Center in Brazil that services 95% of its procedures through the unified, publicly available health plan (Sistema Único de Saúde), aims to choose solutions that can be deployed not only in the fastest way but also in a more accessible and affordable way and seek solutions that can be deployed in both the private and public sectors. Their reasoning: they believe technology can be used as a tool for health equity. Although the legal and

**TABLE 2. Questions for Health System Leaders to Ask Before Adopting Novel Technologies**

| Accessibility | Development | Implementation |
|---|---|---|
| 1. Will this technology make members of our patient population more or less likely to seek care with us?<br>2. What alternative means of accessing high-quality care do we have for patients who cannot or do not want to use this technology?<br>3. What are the main barriers to accessing this technology? Eg, is it only available in one language; does it rely on having a certain device; if patients communicate using dialects or slang, will they be understood?<br>4. What is the feasibility and acceptability of this technology among the patients we serve? | 1. Was a diverse team involved in developing the technology?<br>2. Do we have access to information around the data sets that were involved in training these models (validated, age, and review frequency)? What due diligence are developers doing around them?<br>3. What accessibility or other assistive design principles are incorporated into this technology (eg for visually impaired or arthritic patients)? | 1. What is our target population for this intervention (eg, do we choose to focus on low-acuity patients)?<br>2. Is our technology selection committee diverse?<br>3. If we are procuring technology from a third party company, what usage and outcomes data can we access so that we can perform our own quality analyses before implementation?<br>4. What is the feasibility and acceptability of this technology among the members of the workforce implementing it?<br>5. What measures can we use to assess equitable implementation? |



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information technology (IT) processes may be the same for an AI-enabled PET deployment, the funding structures are often different, so they may seek a third party to fund such initiatives. They are also designing a health government technology acceleration program to find the technologies that are specifically for the public sector in concert with the appropriate funding mechanisms.

### Considerations for Health System Leaders

We hope that the technical and social considerations outlined in this commentary are taken on board by individuals in decision-making roles in health systems regarding technology procurement. Most health system leaders collaborate with their IT departments to ensure that the interoperability and security features of a new technology align with institutional standards, but there is no current universally accepted assessment of the extent to which a new technology meets equity standards for a target patient population. Our research indicated that the prominent barriers to patient engagement, such as culturally sensitive communication, health literacy, trust in the health care system, language barriers, and power dynamics, all have equity implications, and those should be considered at a level equal to IT governance. Table 2 lists our recommended questions for technology decision-makers and equity advocates to put to the technology selection committee before adopting a new technology.

## CONCLUSION

These findings provide new considerations to improve the implementation of AI-enabled PET. Specifically, AI-enabled PET may help to mitigate inequities when developed and implemented with a sociotechnical systems view in mind, accounting for both the technical factors (eg, information sharing agreements, training data on diverse datasets, and validation through clinician and patient testing) and the social factors needed to mitigate disparities (eg, multimodel engagement, customized engagement options, and public and private health sector deployment). This commentary summarizes findings from qualitative research, so the findings may not be generalizable; however, it provides promising directions for future quantitative and longitudinal studies and suggests that, when thoughtfully deployed, AI-enabled PET development and implementation can contribute to health systems' pursuit of the quintuple aim—the value proposition includes improved quality with greater efficiency, and therefore lower cost.


## POTENTIAL COMPETING INTERESTS

No conflicts of interest to disclose.

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