



Supporting Mothers through Digital Health: The Role of Artificial Intelligence and Machine Learning to Advance Maternal Health

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Digital capabilities to support health are poised for exponential growth with the rise of new tools and interest from the global health field demonstrated by the \$13.2 billion total investment in digital health solutions globally in 2023.² There is excitement globally and across stakeholders for the opportunities that Artificial Intelligence (AI) and Machine Learning (ML) can bring to achieve the [Sustainable Development Goals](#) (SDG), especially SDG 3: Good Health and Well Being.

[Merck for Mothers](#) - our company's global initiative to help create a world where no woman has to die while giving life - and our grantees and collaborators recognize the potential of AI/ML to close gaps in health care access and ultimately reduce maternal mortality and improve maternal health outcomes. The equitable and ethical use of AI/ML has the potential to not only improve the quality and accessibility of maternal health care, but to transform how women seek care, enabling them to achieve their health goals while better equipping all health care stakeholders (from providers to supply chain actors to policymakers) to do the work they are meant to - deliver high quality, person-centered care.

Together we - Merck for Mothers and our grantees and collaborators - are supporting the sustainable development, testing and implementation of equitable and ethical AI/ML digital health tools that respond to women's needs and concerns across sub-Saharan Africa and southeast Asia. These efforts complement others in the field that are advancing health care using AI/ML, such as Google's collaborations to validate the use of AI in conducting ultrasounds and helping providers interpret the images³ and Microsoft's AI platform, Azure, to provide health care professionals with a diagnostic test for pre-eclampsia.⁴

We believe that AI/ML will revolutionize the health field and are eager to learn from implementors and experts to deploy these tools responsibly.

Artificial Intelligence (AI): The ability for computers to imitate cognitive human functions such as learning and problem-solving.

Machine Learning: A subset of artificial intelligence to teach computers to extract patterns from collected data and apply them to new tasks that they may not have completed before.

Source: [Artificial Intelligence vs Machine Learning: What's the difference?](#)

The use of AI/ML builds upon grantees' and collaborators' existing work to address the digital divide. The digital divide makes the distinction between those who have internet and/or mobile access and are able to make use of digital communications services and those who are excluded from using these services as discussed in the flagship report, "[How maternal health innovations are closing the digital divide](#)". Examples of how Merck for Mothers grantees and collaborators are tackling the digital divide include:

- Addressing persistent gender disparities in access to internet and smartphone ownership
- Designing and implementing digital tools and innovations to provide contraception education to women and their families
- Supporting mothers to track and attend their healthcare visits
- Empowering women to demand quality maternity care in LMICs

Ethical Considerations of Artificial Intelligence and Machine Learning

More than one in four social innovators leveraging AI/ML are doing so within the health sector and the majority are working throughout low- and middle-income countries (LMICs), according to a recent World Economic Forum (WEF) white paper, "[AI for Impact: The Role of Artificial Intelligence in Social Innovation](#)."⁵ Along with the rapid growth and innovation of AI/ML within the health sector, there are increasing concerns regarding its ethical application. For example, there is fear that AI/ML may compromise the sensitivity of health data or the reliability of health information. The ethical obligation to ensure patients receive accurate health information and that their information is secure will require additional safeguards as AI/ML is more widely deployed.

Ethical concerns include exacerbating existing biases within the health care system (e.g., using biased data sets to train AI/ML) and providing inaccurate and unverified recommendations – a particular challenge with generative AI, a type of AI that can create new content and ideas mimicking human intelligence.⁶ To mitigate these risks, in 2021, the World Health Organization (WHO) published, "[Ethics & Governance of Artificial Intelligence for Health](#)", identifying key risks of AI/ML in health care settings and aligning on core principles and recommendations to ensure its equitable and ethical use.⁷ The six principles outlined offer support to policy makers, end-users and implementers as they navigate adopting, testing and implementing AI/ML tools.⁶

In 2023, the WHO followed up with further caution on the risks of unethical deployment as the pace of AI accelerates.⁸ At the same time, countries like Kenya⁹ and Nigeria¹⁰ are developing national artificial intelligence strategies to define priorities and opportunities for AI/ML aligned with country-specific and global goals, such as the SDGs, and to outline critical considerations for the public and private sector to ensure equitable and ethical research, governance, innovation and implementation of AI/ML across sectors.⁵

A recently published WHO technical brief, "[The role of artificial intelligence in sexual and reproductive health and rights](#)", explores the application of AI in sexual and reproductive health and rights (SRHR) and outlines considerations, risks and opportunities that Merck for Mothers and our grantees and collaborators have also identified, including: concerns about data governance and bodily autonomy, risks of data breaches, misinformation and targeted disinformation, bias, worsening the digital divide and difficulty providing culturally-relevant and context-specific information or health advice.¹¹ Merck for Mothers' grantees and collaborators are responding to these challenges and are innovating responsibly as they put AI/ML tools into practice.

- Protect autonomy
- Promote human well-being, human safety and the public interest
- Ensure transparency, explainability, and intelligibility
- Foster responsibility and accountability
- Ensure inclusiveness and equitably
- Promote AI that is responsive and sustainable

Case Studies

The rapid pace of AI/ML innovation and deployment in the health sector, and in parallel the ethics and equity concerns, need to be met with increased support of organizations who are leading this work to identify and disseminate learnings from implementation. In 2024, we sought to understand how our grantees and collaborators are currently utilizing AI/ML to improve maternal health. We interviewed nine grantees and collaborators spanning Africa and southeast Asia to explore their current and future use of AI/ML. These discussions highlighted the unique and creative ways these diverse organizations are leveraging AI/ML to address maternal health challenges and promote equitable access to health in their communities. Merck for Mothers' grantees and collaborators are currently testing how to measure impact as they deploy AI/ML tools to respond to their communities' needs. These interviews revealed challenges, opportunities and key insights relevant for the maternal health field and the broader global health community related to the ethical, effective and efficient use of AI/ML in practice.

Nivi | India, Kenya, Nigeria

Category: Chatbot



Problem

The complexity of the health care landscape often leaves women frustrated, disengaged from the health care system and lacking the knowledge to make informed health decisions. At the same time, the lack of data into demand, intent and care-seeking barriers undermines the ability of health systems to proactively solve for patient needs.

Solution

The Nivi team aims to support women throughout their health journey and ultimately improve health outcomes. The Nivi team developed an AI-chatbot to provide a space for women to ask and receive personalized health-related information and content about SRHR via an accessible platform.¹² AskNivi, an AI-enabled chatbot accessible through the messaging platform WhatsApp, aims to use AI and large language models (LLMs) to provide users a natural conversation, in their native language, to offer relevant health-related content and coaching that positively impacts their current and future health journeys through behaviour change and referrals within the health system.¹² Aggregating these health journeys, Nivi produces insights that policymakers, supply chain actors and other health system stakeholders can use to anticipate demand and intent, identify barriers and enablers in care-seeking and design solutions to optimize access to health care.



Avegen | India

Category: Chatbot

avegen

Problem

There is a persistent knowledge gap among pregnant women in India in which women in low socioeconomic levels experience poor access to relevant health information.

Solution

The Avegen team developed the Together for Her Health digital solution to provide targeted resources, knowledge and guidance to the end-user utilizing AI. They address the challenge of inequitable access to health information by using AI to accurately identify the income status and stage of pregnancy of the end-user to provide relevant health information based on these indicators.¹³ As part of Avegen's effort to promote health equity, they followed standard ethics guidelines to mitigate bias, address issues of fairness and provide data transparency at each stage of their AI testing and implementation process. Avegen is prioritizing accuracy of the system to deliver accessible, reliable and culturally relevant information and resources to reach women in low-resource settings as they make health decisions throughout their pregnancy.

Girl Effect | Kenya

Category: Chatbot

Girl Effect

Problem

For young and adolescent girls, finding trustworthy and engaging sexual and reproductive health information and resources can be a challenge.

Solution

Girl Effect - a nonprofit organization - aims to connect girls to the resources they need, overcoming existing obstacles to access health information. Across Girl Effect's three chatbots, AI/ML are leveraged to provide appropriate and accurate sexual and reproductive information in age- and culturally-appropriate ways. As part of Girl Effect's efforts to ensure equitable use of AI/ML, they aim to be "girl-focused" throughout the work cycle - designing and co-creating with teens, utilizing women-led content and technology teams and training the AI with data collected from individuals within the focus communities and the sexual and reproductive health sector. Girl Effect's "paranoid, but optimistic" approach to developing and integrating AI is providing teens and young women culturally appropriate essential health information while building safeguards that promote transparency and accountability such as only collecting minimal amount of data required and complying with national and international data protection laws required.¹⁴



mDoc | Nigeria

Category: Chatbots, case triage, provider training



Problem

During the COVID pandemic there was an increased demand for remote health advice and insufficient resources to answer women's health questions with evidence-based data to meet this demand.



Solution

mDoc is an innovation company focused on bringing tools to promote self-care across the continent. mDoc introduced a rule-based, health-coach chatbot - Kem - into their app, CompleteHealth™, to help take pressure off mDoc's human coaches during the COVID-19 pandemic but soon learned that it was insufficient to address the expansive inquiries of mDoc's members or the high human capital costs of scaling reach and impact. mDoc turned to generative AI and integrated LLMs into Kem to train it to address women's questions on maternal health, neonatal health, family planning and sexual health and help them assess their pregnancy risk. Kem was co-created through numerous iterative rapid cycle user tests with over 400 women engaged in conversational coaching. Kem has succeeded in providing accurate, empathetic, safe and contextualized responses that improve the health literacy and trust of the women mDoc serves. Additionally, Kem leverages ML to triage women and to provide women with the most appropriate information, resources and referrals, taking into consideration the urgency and risk levels of each situation. In developing these AI tools, mDoc has centered on the needs and experiences of women to better support their health journeys.

Jacaranda Health | Kenya

Category: chatbot, case triage



Problem

Many women in Kenya do not have the information, resources or confidence to seek appropriate and timely maternal health care.¹⁵

Solution

Jacaranda Health - as part of their mission to deploy affordable and scalable solutions to improve maternal and newborn health outcomes - developed PROMPTs, an AI-enabled digital health service that uses short message service. PROMPTs nudges women to seek care and have agency within the health system by addressing women's concerns, triaging users based on their questions and creating connections to appropriate care and referrals.¹⁵ It generates contextual responses to women's pregnancy and health-related questions, in English and Swahili, which are then sent to the human-staffed helpdesk for review before being sent to the user. Models are trained in the context in which they are deployed and developers are mindful of utilizing existing models that were created for similar low-resource settings as part of their efforts to mitigate bias and promote equitable AI use. As Jacaranda Health works towards future goals of adding more languages and expand into more regions, their work aspires to support women in being more informed and empowered in their health care journey in low-resource settings.

iKure | India

Category: Case triage, optimization



Problem

Shortages in health care staff, resources and knowledge across India are negatively impacting patients' ability to have their health-related needs addressed.

Solution

iKure is a population health management company that aims to address primary health care needs through technological innovation among other solutions. They are leveraging AI to reduce the time it takes to identify women who are at high risk for pregnancy complications and predict the likelihood of health challenges based on vital signs and other indicators.¹⁶ iKure's AI-powered stratification model and other AI-enabled solutions are deployed at the last-mile to support resource optimization and monitoring and evaluation capabilities, helping health care workers prioritize their time where it is most urgently needed. iKure's tools provide data transparency and security through rigorous data protection protocols that align with international standards, in addition to improving maternal health. iKure's efforts to optimize frontline health workers' time and capacity, stratify women by health risk and monitor and track women with high-risk pregnancies are supporting communities with health care worker shortages.

Maternity Foundation | India

Category: chatbots, provider training



Problem

In remote, low-resource settings and/or areas with conflict, midwives and other health care professionals have challenges accessing the latest evidence-based training, information and resources.¹⁷

Solution

The Safe Delivery App (SDA) is a mobile application developed by Maternity Foundation that provides instant access to evidence-based maternal health guidelines. The aim is to support midwives and health care professionals so that births are safer for mothers and newborns. SDA uses AI through two pathways:

Personalized learning experience for midwives and health care professionals

Maternity Foundation recognized that many of their users would go directly to the skills assessment on the app and fail to pass due to spending insufficient time reviewing and learning relevant material. To correct this, the SDA utilizes AI to push smart notifications to users to support them on their learning journey, suggesting more practice in weaker knowledge areas, and when the user is likely to pass the assessment, encouraging them to take a final knowledge assessment. The use of AI is helping midwives and health care professionals not only pass important assessments but also keeps them adequately informed about evidence-based guidelines to improve their capabilities and knowledge base as providers.



NeMa, an AI-enabled smartbot, aims to close the information gap in low-resource settings to provide validated midwifery information to health care professionals.¹⁸

SDA's smartbot, NeMa, works within a closed system, referred to as "Supervised AI" to provide users with accurate and relevant recommendations and information in response to their questions by validating all answers against WHO and local guidelines. Unique to SDA's AI, NeMa can be accessed offline, enabling those in low-resource settings to access personalized health information and answers regardless of internet connection.

The adoption of AI technology within SDA is advancing efforts to provide more equitable learning opportunities to health care workers and supporting vulnerable populations in rural or remote areas with access to validated and trusted maternal health information.

Both the above initiatives are in pilot stages. Based on lessons learned from the pilots, SDA will evaluate how to best leverage AI in their future platform across countries and settings.

PharmAccess | Sub-Saharan Africa

Category: Optimization

PharmAccess
FOUNDATION

Problem

AI tools may not always work together and speak to each other due to the data format potentially leading to further fragmentation of data systems and care delivery in the health care sector.

Solution

PharmAccess is an entrepreneurial organization that aims to mobilize resources across sectors to improve access to health care across the African continent. They are building an interoperable health data commons that is based on the Open Health Information Exchange specification.¹⁹ While African policymakers have embraced this reference architecture, including standards such as Fast Healthcare Interoperability Resources (FHIR), the current state of affairs in the field is still far removed from having full interoperability. PharmAccess aims to promote secondary use of health data, also for AI/ML, through enabling the primary use and sharing of data in the first place. Through an open exchange, PharmAccess not only creates valuable datasets for training but they also continuously monitor the effect of AI interventions which is often a blind spot. By pushing for open standards, open source, open content and open architectures, PharmAccess aims to enable local entrepreneurs and innovators to play a key role in the digitisation of health care.²⁰



Problem

Limited access to life-saving medical oxygen, especially in rural and low-income communities, can lead to preventable deaths.

Solution

LifeBank is a health care technology and logistics company that launched AirX, an AI-powered predictive tool that provides medical oxygen to health care facilities based on predictions of patient and organizational needs.²¹ To deliver a useful and relevant AI-powered tool, the LifeBank team considered health care provider acceptability, patient needs, and the data available to train the AI model. By leveraging predictive AI, the LifeBank team aims to secure an uninterrupted oxygen supply to health care facilities across Africa using historical data, weather patterns and various other factors.²¹ Looking ahead, the LifeBank team seeks to understand how predictive AI can improve resource management, efficiencies and quality health care in additional areas, such as access to blood, medical consumables, medical equipment, temperature-sensitive medical products and critical drugs.²¹



Advancing Maternal Health through Equitable and Ethical use of AI/ML: A Way Forward

The adoption and scale of AI/ML will play an integral role in supporting progress towards the SDGs, including those focused on maternal health. We believe that our grantees and collaborators' experiences and learnings provide valuable insights to inform the way forward in the equitable use of AI/ML to improve maternal health. As the use of AI/ML quickly evolves, we encourage other innovators to consider the following:

Build solutions with the community: Health solutions should be informed by, accessible to and responsive to the community and their health challenges and should not create burden or increase gaps.

Example: Girl Effect is committed to listening to community members' voices and incorporating their perspectives as they co-design solutions with teenage girls and test solutions with individuals on the ground to deliver an AI-driven health solution that meets their needs.

Collaborating with external players: The rapidly changing environment means that collaborating with organizations, external stakeholders and other experts is critical so that technology and its applications adapt to new challenges, integrate the latest innovations, and expand reach to new populations.

Example: LifeBank, in collaboration with Causal Foundry, a Spanish organization with a platform aimed to democratize AI interventions and experimentation plans to combine its blockchain and data science technologies with Causal Foundry's AI/ML platform to expand LifeBank's supply and service delivery throughout Africa.^{23,24}

Innovate responsibly: AI/ML-powered health solutions are a powerful resource to bridge the health information gaps for patients - especially in settings where providers are stretched. These tools though must be evaluated and validated so that the information provided is both accurate and culturally relevant to the end user.

Example: Using funding awarded through Global Grand Challenges, mDoc tested the accuracy and empathy of Kem's responses to improve its ability to provide appropriate health recommendations and properly triage patients based on patient information and risk factors.²⁴

Promote health equity: AI/ML-enabled health solutions should be designed with those who need it most in mind - driving increased access to health information and resources, advancing health care quality and delivering improved health outcomes.

Example: SDA's smartbot, NeMa, works within a closed system enabling those with poor internet connectivity or users in remote locations to receive personalized and WHO-validated health information.

Reach across the health care spectrum: Dedicated time and attention should be given to how AI/ML can be integrated within existing systems and processes to maximize its capabilities to meet the organization's, community's and patients' needs. From designing AI/ML tools that are interoperable and promote data transparency to creating tools that optimize resource allocation and alleviate burden on health care professionals and staff, to developing patient-facing chatbots that provide relevant and informative health recommendations - organizations should think creatively and broadly about how to leverage AI/ML.

Example: PharmAccess is building a Health Data Commons that standardizes data across publicly available digital resources so stakeholders throughout the health care system can identify valuable insights that can promote innovation across the health care spectrum from more efficient care delivery for patients to the development of new medicines.

It is critical we - funders, researchers, innovators, policymakers, health care providers and other key stakeholders- turn to implementers and the communities they serve to learn how to continuously improve AI/ML to address key maternal health challenges. Innovative organizations, such as those featured, are currently testing and deploying AI/ML and are learning in real-time how to achieve ethical and equitable access and use of these tools to best support women during their health care journeys. It is important that the lessons learned in practice are documented and disseminated to allow those in the field to integrate best practices as AI/ML rapidly evolves and is further integrated into health care journeys around the world.



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