Opportunities and challenges of healthcare digital entrepreneurship focused on AI systems in enhancing health equity

Final Report

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Introduction

Advances in technological development are ever-increasing at all times; consequently, a rapid increase and changes in digital technology have revolutionized healthcare delivery globally (Mohammed-Nasir et al., 2023). Digital health through artificial Intelligence, telemedicine, genomics, robotics and many other innovative technologies, is already changing in many ways how medicine is being practised around the world. They have simplified access to health, lower cost of diagnosis and treatments, and improved communication between doctors and patients in the areas of electronic health (eHealth), storage of and access to medical information and data, generating and storing of big data, improving lines of communication between patients and their doctors, electronic health records (EHRs), telemedicine and telehealth, mobile health (mHealth), online learning (eLearning), health applications, and drones. (Mohammed-Nasir et al., 2023)

Given the transformative impact of digital technologies on healthcare, particularly the rise of AI systems, our guiding question is what opportunities and challenges do healthcare digital entrepreneurs encounter in their efforts to enhance health equity?

Digital Health Entrepreneurship

Digital health entrepreneurship is the pursuit of opportunity within healthcare characterized by scarce and uncontrolled resources, with the goal of creating user-defined value through the design, development, roll or launch, and harvesting of digital health innovative products, services, platforms, and models (Zajicek & Meyers, 2018). Healthcare, encompassing the prevention, treatment, and management of medical conditions, aims to enhance mental and physical well-being. Health equity, as defined by the US Department of Health and Human Services, aims to eradicate avoidable health disparities among socioeconomic, demographic, and geographic groups, particularly concerning access to diagnosis and treatment across various health conditions. With the rapid advancement of digital health technologies and AI/ML-enabled medical devices in recent years, the integration of AI into healthcare presents both promise and challenges. AI, whether used alone or in conjunction with healthcare providers, presents opportunities to improve outcomes for patients and populations.

Ethical frameworks are vital for assessing the potential positive and negative implications of extensive data collection, analysis, and utilization in healthcare processes. Bioethical principles like beneficence, autonomy, and equity, are sought to determine a process's ethical balance. Illustratively, sensitivity, specificity, and clinical

outcomes can measure beneficence, while metrics for equity may include sensitivity disaggregated by demographic subgroup or population-achieved sensitivity (Abràmoff et al., 2023). These considerations focus on determining how well a healthcare process, potentially involving AI, aligns with the equity principle. Despite improvements in average healthcare outcomes, the integration of AI may unevenly distribute benefits across demographic groups, leading to substantially worse outcomes for some.

Scope

Health disparities or inequalities are not merely differences in health outcomes but represent a specific category of variance in health status or the primary determinants of health that could potentially be influenced by policies. These disparities manifest as systematic differences wherein marginalized social groups, such as those who are economically disadvantaged, racial or ethnic minorities, women, or others facing persistent social disadvantages or discrimination, consistently encounter inferior health outcomes or heightened health risks compared to more privileged social groups. The term "social advantage" denotes an individual's relative standing within a social hierarchy determined by factors like wealth, power, and prestige. Health disparities encompass variations between the most advantaged subgroup within a given category, such as the wealthiest or most powerful racial/ethnic group, and all other subgroups, rather than solely between the most and least privileged groups. The pursuit of health equity involves striving to eliminate such health disparities and inequalities (Braveman, 2006).

In the context of our exploration into AI-related initiatives undertaken by entrepreneurs, it is crucial to understand the underlying dynamics of health disparities and the imperative of addressing them to achieve meaningful progress towards health equity. Innovations should prioritize the promotion of equitable access to healthcare services and treatments for all societal groups. This necessitates a conscientious effort to ensure that health applications developed by entrepreneurs do not exacerbate existing disparities but rather strive to bridge the gap by providing equitable access and treatment options to underserved populations.

Ethical considerations should guide the development and deployment of AI-driven health technologies to safeguard against potential biases or discriminatory practices that could further marginalize vulnerable groups. Entrepreneurs in the healthcare sector have a responsibility to design and implement solutions that are inclusive and sensitive to the diverse needs of communities, thereby contributing to the advancement of health equity. Additionally, efforts should be made to actively involve

representatives from marginalized groups in the development process to ensure that their perspectives and experiences are adequately represented. Such initiatives have the potential not only to improve health outcomes for underserved populations but also to contribute to the broader goal of achieving health equity for all.

Vulnerability Space

While innovative technologies such as AI, learning algorithms, and decision support hold promise in overcoming existing barriers, the ultimate success of startups hinges on their ability to effect behavioral change (Kazgan, 2020). In this rapidly evolving landscape, the emergence of a new cadre of medical professionals is imminent, with those embracing digital health technologies poised to outpace their counterparts (Rivas, 2020).

The COVID-19 pandemic has accelerated the digital health transformation, catapulting it into the forefront of healthcare delivery (Mohammed-Nasir et al., 2023b). While the proliferation of technological tools holds promise for addressing various healthcare challenges, it also brings forth a host of societal, ethical, and regulatory complexities. Kulkov et al. (2023) shed light on the hurdles encountered by entrepreneurs in the digital healthcare sector, with navigating the intricate regulatory landscape emerging as a significant vulnerability. Particularly concerning are issues surrounding data security and privacy, where striking a delicate balance between innovation and patient safety is paramount to upholding trust within the healthcare ecosystem.

Furthermore, Kelley et al. (2020) delve into the intricacies of developing scalable business models for digital health innovation within public healthcare systems. Bureaucratic barriers and regulatory constraints loom large, impeding the seamless integration of digital healthcare solutions. The scarcity of human resources, infrastructure, and funding further compounds these challenges, underscoring the need for innovative approaches to overcome systemic barriers to accessibility and development in the digital health space.

Among the challenges, bureaucratic barriers and regulatory constraints stand out as major obstacles that restrict the development and implementation of digital healthcare solutions in public institutions. In addition, the research discusses more vulnerabilities, such as resource limitations, that present significant obstacles to entrepreneurship in the field of digital healthcare, including limited funding and expertise. The authors also examine the integration challenges with current public health systems, highlighting the difficulties entrepreneurs encounter when seeking to scale their innovations.

In light of the COVID-19 pandemic, addressing critical issues in healthcare management has become increasingly urgent. Challenges such as patient flow management, resource allocation, and accurate patient predictions have been brought to the forefront (Zimmerman et al., 2023). One significant problem is the precise estimation of required emergency room beds for patients, both with and without suspected COVID-19, leading to inefficient prediction models and the wastage of valuable time and resources. From the perspective of patients, vulnerabilities arise from potential care delays and the pandemic's broader impact on overall wellness.

Moreover, the unavailability of data for digital applications can lead to contextual inaccuracies and misinterpretations, prompting governments to consider investing in their applications, albeit with significant effort (Zimmerman et al., 2023). Additionally, biases may arise from a lack of user-based perspective, potentially hindering the adaptability and operational effectiveness of interventions designed primarily from a health-worker perspective.

Recognizing and addressing these interconnected challenges is paramount in striving towards a more inclusive, fair, and equitable healthcare system for all patients. Systematic review and reporting of individual clinician data are essential to identify areas where disparate care occurs, ensuring that no patient is left behind (Valdez & Park, 2023). Furthermore, diversifying the emergency healthcare workforce is advocated by Valdez & Park (2023) to improve communication with patients from diverse backgrounds, enhance cultural competency, and mitigate biases that could affect treatment decisions and clinical judgments.

In their study, Hogg et al. (2023) examine Stakeholder Perspectives on Clinical Artificial Intelligence Implementation, gathering insights from various stakeholders ranging from developers to patients. Their findings highlight challenges related to

patient-centeredness, knowledge gaps among healthcare professionals, and concerns surrounding the complexity versus simplicity of AI systems. Furthermore, stakeholder discussions are crucial for addressing framework limitations in the practical application of surveillance implementation, ensuring that technologies prioritize fairness, inclusivity, and accessibility in healthcare delivery (Abràmoff et al., 2023). Gathering insights from diverse stakeholders is vital for digital entrepreneurs in fostering equitable AI and navigating the complex landscape of healthcare delivery.

Stakeholders

Potential Stakeholders can be defined as individuals or a group holding the capability or an interest to be influenced by or influence a particular implementation process, or the dynamics of an organization.

Stakeholder mapping is a tool for the implementation team, for them to gain deep insights and diverse perspectives of stakeholders and how they interact or influence each other. This method facilitates the identification of stakeholders' affiliations and the specific sectors or areas they represent, providing a comprehensive overview of their roles within the broader context of the project. Furthermore, it helps discover the unique viewpoints they bring to the table for the process of implementation. Through this process, the team can thoroughly understand the complexities of stakeholder relationships and leverage this knowledge to foster collaboration, address concerns and align the integration efforts with the expectations and needs of all that are involved.

The first step for stakeholder mapping involves pinpointing various stakeholders involved in healthcare. This lays the foundation for a structured approach to stakeholder engagement and management throughout the process. Once identified these stakeholders are divided into 3 major groups according to their influence and their involvement

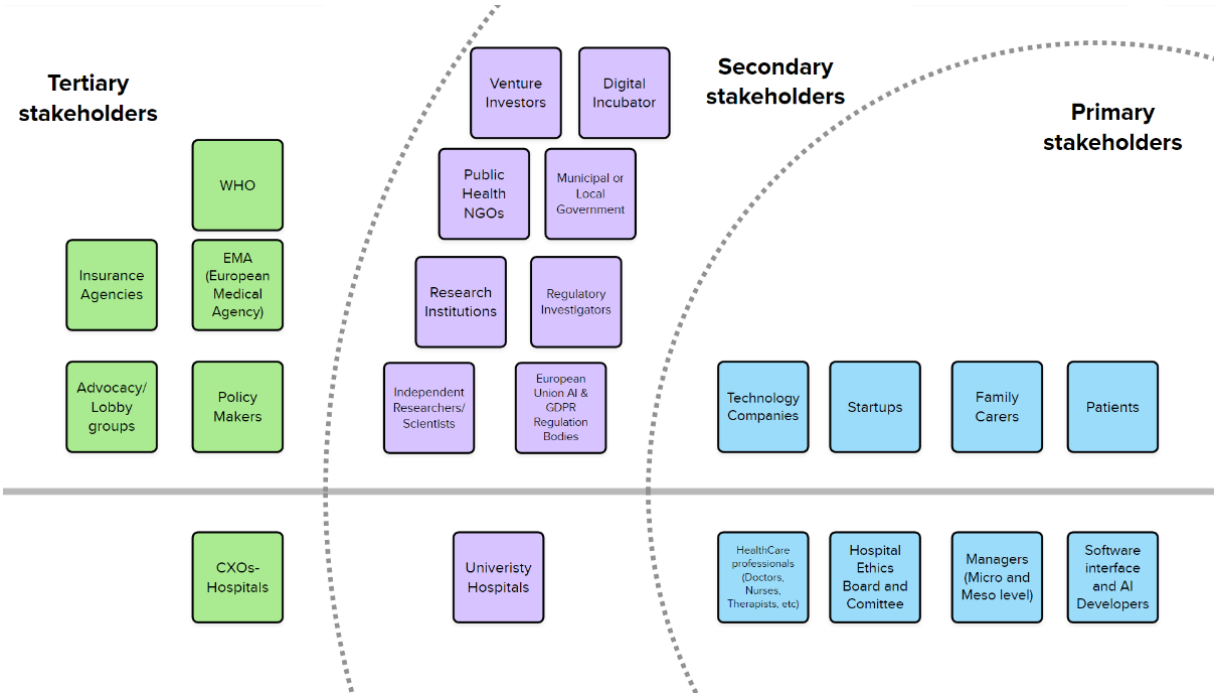
Primary Stakeholder
Primary stakeholders are those who are directly affected by the project or whose actions have a direct impact on the project's success, they are often the most invested and have a significant interest in the project and their outcomes. In the current context of healthcare, players such as patients and doctors are considered one of many primary stakeholders.

Secondary Stakeholder
Secondary stakeholders are the players who have an indirect relationship with the process, they might be influenced by the project and its outcomes but not as direct as

that of primary stakeholders. These include players like research institutions who are involved in the process but aren't directly affected by the outcomes.

Tertiary Stakeholder

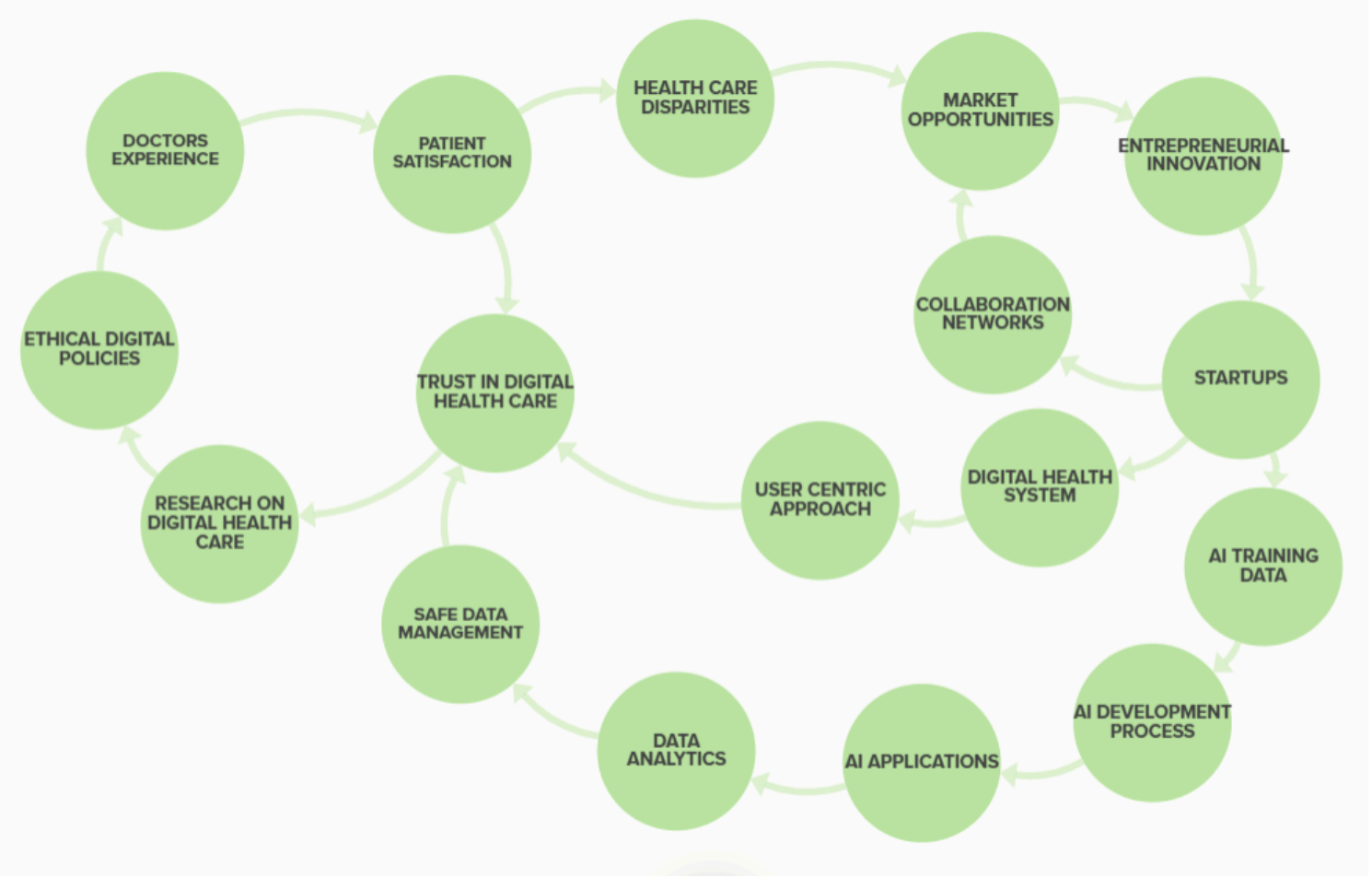
Tertiary stakeholders are those who are peripherally involved in or affected by the project. Their influence and interest are the most distant compared to primary and secondary stakeholders, their impact doesn't directly concern the process but rather they might be connected to the long-term effects of the project. In the context of healthcare, this encompasses players such as policymakers and Insurance companies.



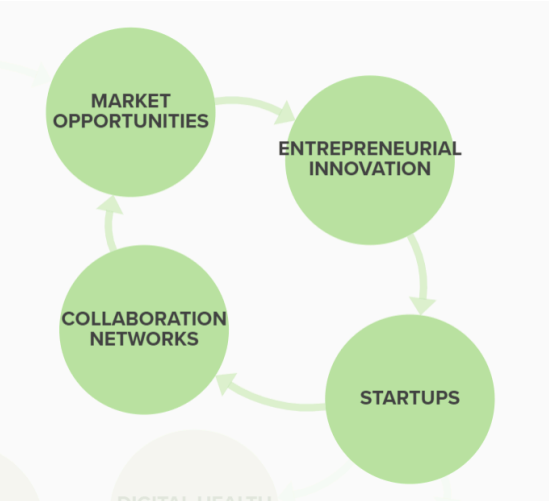
The interpretation of this map is not merely for the purpose of highlighting the direct and indirect relationships between stakeholders but also aids in tailoring the engagement when planning as well as implementing strategies throughout the process.

System Model 1.0

Considering the various elements and actors in the research area of: Opportunities and challenges of healthcare digital entrepreneurship focused on AI systems in enhancing health equity. The System Model can create a positive impact through a user-centric approach, and safe data management, that has an impact on the trust of digital health care. Further, AI development can generate a positive impact for the system improving the data management for health information systems.



Loop 1

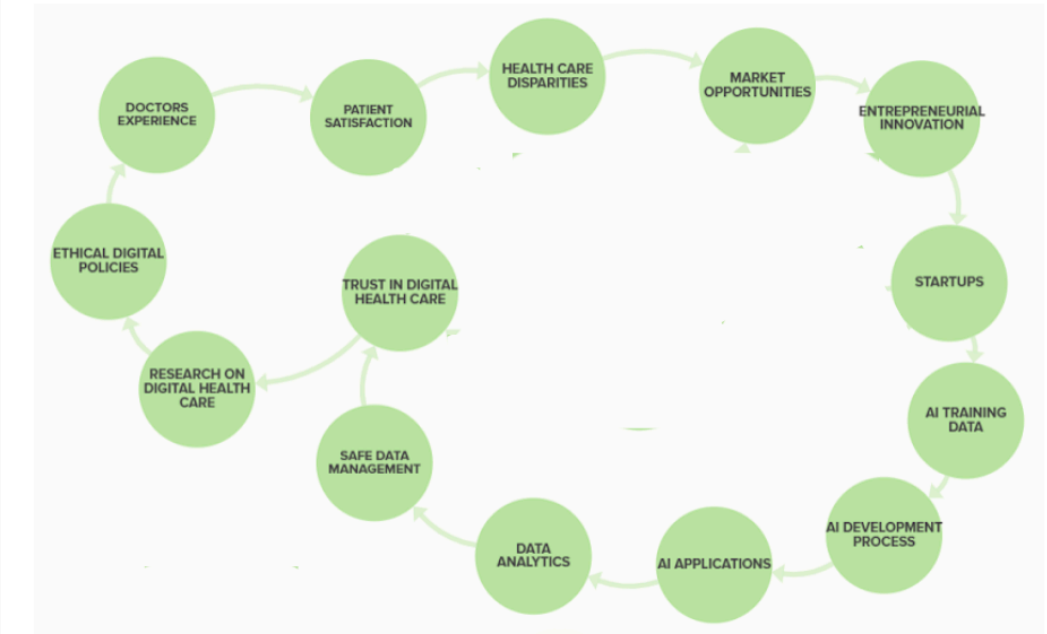


In the digital healthcare entrepreneurship ecosystem, entrepreneurs identify market opportunities driven by unmet needs or technological advancements, fostering innovative solutions to address healthcare challenges. These entrepreneurial innovations often lead to the establishment of startups focused on developing AI-driven healthcare solutions. By collaborating with diverse networks, including healthcare providers, researchers, and investors, startups further enhance their offerings, contributing to the expansion of market opportunities and the advancement of digital healthcare innovation.

Loop 2

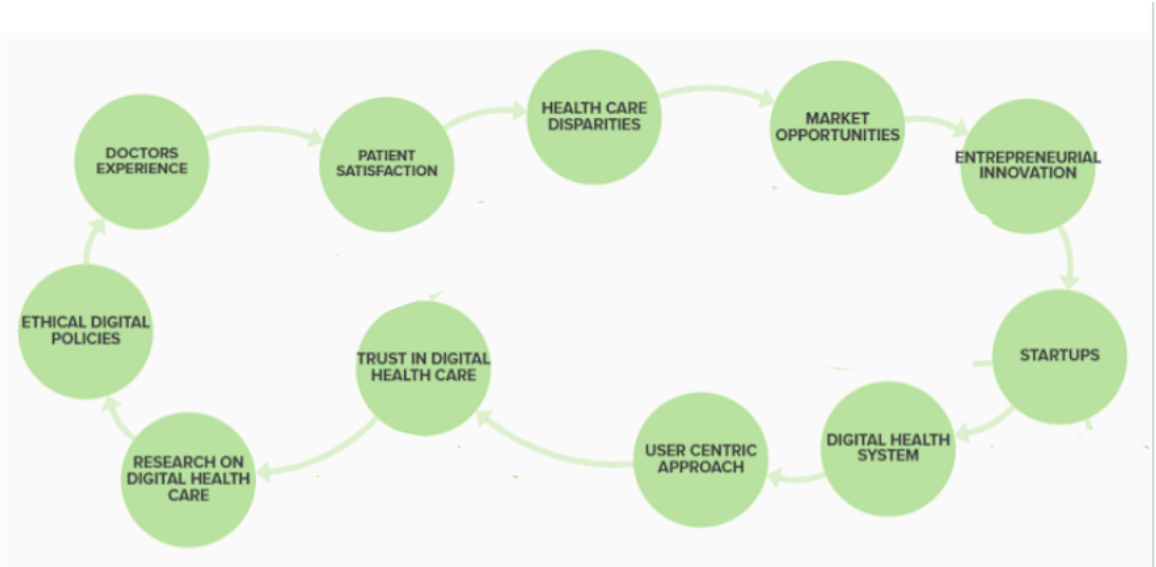
Moreover, in the second loop, enhanced doctor-patient experiences in digital healthcare foster patient trust and satisfaction, driving research and development efforts in digital health care. This research, in turn, informs the development of ethical digital policies, ultimately improving the overall experience for healthcare professionals and patients alike.

Loop 3



The third loop highlights the complexity of using digital entrepreneurship to address healthcare concerns. Digital healthcare patient satisfaction has the ability to reveal existing disparities in health and identify opportunities for entrepreneurial innovation and start-ups. To develop AI applications, startups generate AI training data, requiring an AI development process. To establish trust in digital healthcare, these applications enable data analytics, demanding appropriate data management procedures. A greater level of trust encourages further research into digital healthcare, which in turn leads to the creation of ethical policies that improve the experience of doctors, influence patient satisfaction, and ultimately contribute to the reduction of market disparities.

Loop 4



The fourth loop centres on a user-centric approach, exerting influence on the trustworthiness of digital healthcare among diverse stakeholders engaged in the

system. Startups play a pivotal role in advancing the digitization of healthcare systems, akin to the third loop, thereby shaping both the healthcare system itself and the prospects for novel business concepts.

Methodology

The academic methodology for exploring the opportunities and challenges of healthcare digital entrepreneurship, particularly focusing on AI systems to enhance health equity, incorporates a comprehensive approach involving both qualitative and quantitative research methods. The methodology consists of two main components: a stakeholder survey and a focus group discussion.

Stakeholders Survey

The stakeholder survey aims to gather diverse perspectives from individuals and groups involved in healthcare digital entrepreneurship, including policymakers, healthcare providers, researchers, and patients. The survey includes questions designed to assess stakeholders' experiences, perceptions, and insights regarding healthcare technology, AI systems, and health equity (Roopa, 2012). Questions are structured to explore stakeholders' professional fields, engagement with the healthcare industry, familiarity with healthcare technologies, perceptions of health equity, and attitudes towards the impact of digital health technologies on reducing healthcare disparities.

Additionally, stakeholders are asked to rate the extent to which they perceive various barriers to entrepreneurship in the healthcare sector and barriers to the implementation of healthcare technology. The survey concludes by soliciting stakeholders' confidence levels in the ability of healthcare digital entrepreneurs to address biases and inaccuracies in AI algorithms to promote health equity.

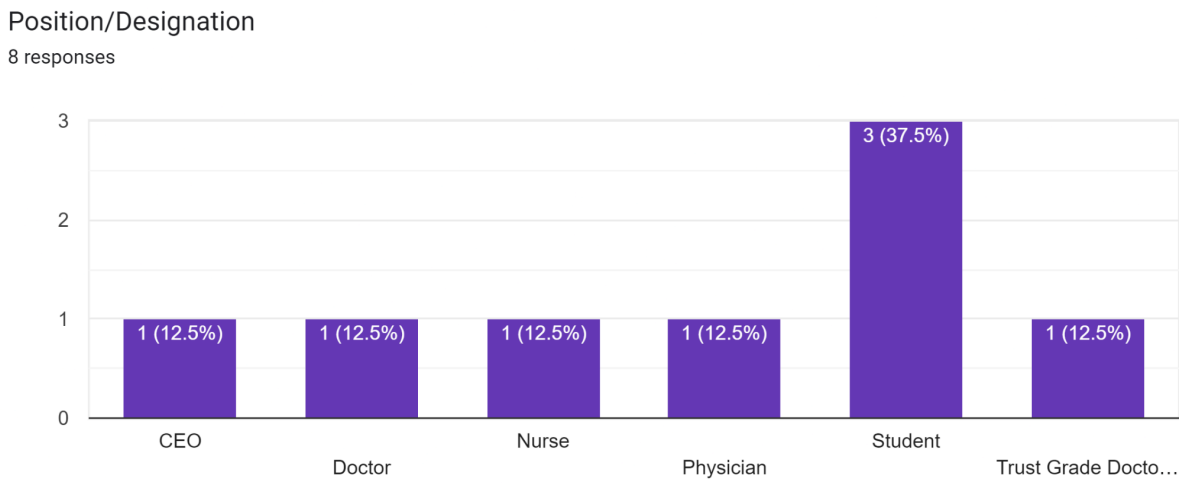
This questionnaire seeks to gather diverse perspectives from stakeholders including the medical workforce, healthcare providers, researchers, and patients (Roopa, 2012). By delving into their insights, we aim to uncover the underlying dynamics of healthcare disparities and the critical role of digital innovation in addressing them. Moreover, we seek to understand the ethical considerations, regulatory constraints, and practical challenges that impact the development and implementation of AI-driven healthcare solutions, particularly in public healthcare systems.

Through this exploration, we aspire to foster a deeper understanding of the opportunities and obstacles encountered by healthcare digital entrepreneurs and identify strategies to promote inclusivity, fairness, and accessibility in digital health innovation. Your valuable insights will not only inform our understanding of the current landscape but also contribute to the advancement of equitable healthcare solutions for all.

The Results

For the next step of our study, a number of stakeholders were shortlisted based across 4 continents, and a questionnaire was sent to the aforementioned personnel that caters to the needs of our study. A total of 8 responses were received as of 7th of April 2024.

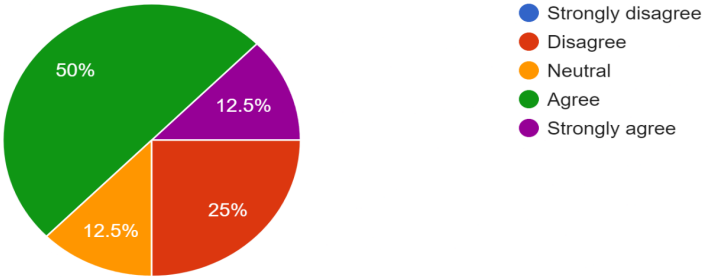
1. Designation of Stakeholders



- 62.5% of the respondents were employed as medical professionals
- 12.5% executive of a Healthcare startup
- 12.5% social workers associated with Public health
- 12.5% a patients extensively involved with healthcare processes

2. Initial perception of our research question

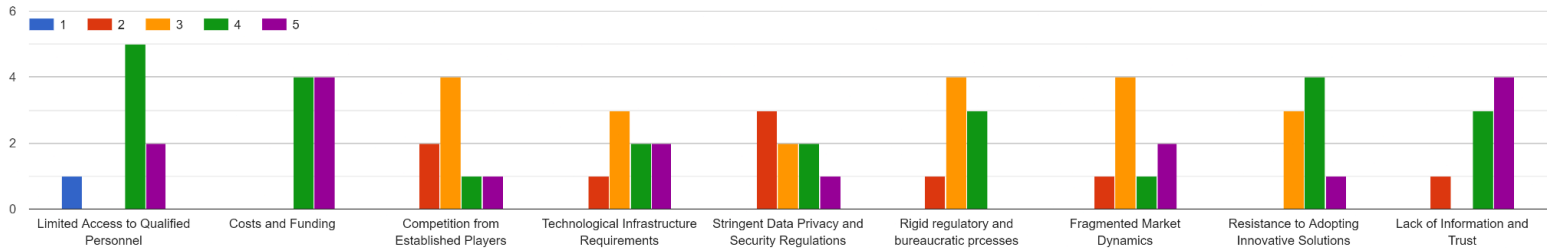
6. How strongly do you agree or disagree with the statement: "Digital health technologies, including AI systems, have the potential to significantly reduce disparities in healthcare access and outcomes"?
8 responses



- The majority of the respondents approve of the idea of implementing of AI health systems to reduce existing disparities in the healthcare industry.

3. Factors acting as barriers pt. 1

7. Please rate the extent to which you perceive each of the following factors as barriers to entrepreneurship in the healthcare sector, where 1 represents "Not a Barrier" and 5 represents "Significant Barrier":

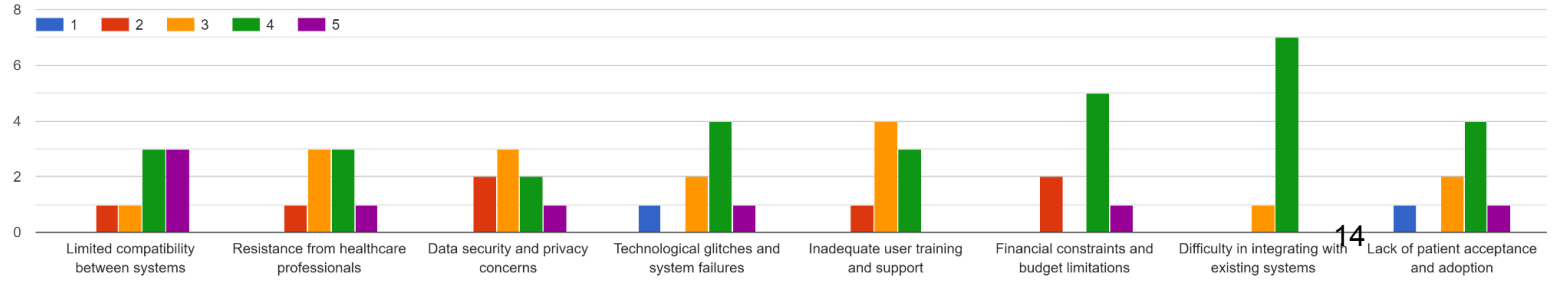


- Respondents overwhelmingly show their views about “Lack of information and trust” is a major barrier whereas the same opinion for “Limited access to qualified personnel” and “Costs and Funding”
- Whereas diverse responses were received for the remainder of our factors.

4. Factors as barriers pt.2

One result that was found on the survey is that the total population that answered the question observed a challenge on the healthcare technology implementation.

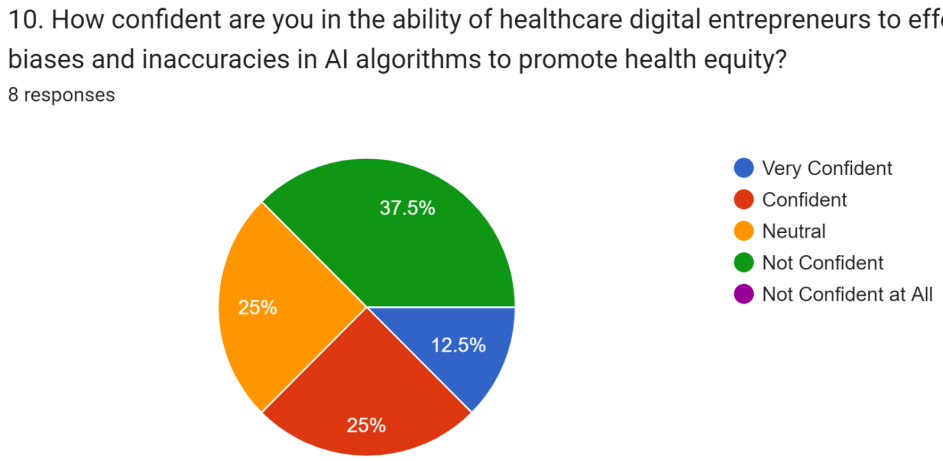
9. Please rate the extent to which you perceive each of the following barriers to the implementation of healthcare technology, where 1 represents "Not a Barrier" and 5 represents "Significant Barrier":



The three principal variables that was found as the challenges by the respondents were:

- Difficulty in integrating with existing systems.
- Financial constraints and budget limitations
- Limited compatibility between systems

5. Confidence in AI algorithms



As a final result 37.5% of the respondents are confident or very confident in the ability of healthcare digital entrepreneurs to effectively address biases and inaccuracies in AI algorithms to promote health equity. With the same percentage of 37.5% are not confident of AI as a healthcare digital tool to effectively address biases and inaccuracies in promoting health equity. Finally 25% of the answer is neutral in AI promoting health equity.

STAKEHOLDER SURVEY CONCLUSIONS

The transformative potential of digital technologies in healthcare delivery is undeniable, with innovations such as AI systems promising to address longstanding challenges and disparities within the healthcare landscape. As digital health entrepreneurship emerges as a key driver of innovation, understanding the opportunities and challenges faced by healthcare entrepreneurs is paramount. Through a recent survey encompassing diverse stakeholders involved in healthcare digital entrepreneurship, valuable insights have been gleaned regarding the barriers to implementation, trust and information dynamics, financial challenges, compatibility issues, and perceptions of AI algorithms. These findings shed light on the

complexities of navigating the digital health ecosystem and offer critical insights for promoting the effective deployment of AI-driven healthcare solutions to enhance health equity.

- Barriers to Implementation: The survey highlights significant barriers to the implementation of AI-driven healthcare solutions, including limited access to qualified personnel, financial constraints, and challenges integrating with existing systems. Addressing these barriers is essential for overcoming obstacles to innovation and promoting the effective deployment of digital health technologies.

- Trust and Information: Lack of information and trust emerged as major concerns among respondents, indicating a need for transparent communication and education about the benefits and risks of AI in healthcare. Building trust among stakeholders and ensuring access to accurate information is critical for fostering confidence in AI-driven healthcare solutions.

- Financial Challenges: Financial constraints and budget limitations were identified as significant barriers by survey respondents. Overcoming these challenges requires innovative funding mechanisms and strategic resource allocation to support the development and implementation of AI-driven healthcare innovations.

- Compatibility Issues: Limited compatibility between systems poses a challenge to the seamless integration of digital health technologies. Addressing interoperability issues and promoting standardisation in healthcare IT infrastructure is essential for facilitating the adoption and scalability of AI-driven solutions across healthcare settings.

- Confidence in AI Algorithms: The survey results highlight mixed perceptions regarding the ability of AI algorithms to effectively address biases and inaccuracies in promoting health equity. Enhancing transparency, accountability, and validation processes for AI algorithms is crucial for building confidence among stakeholders and ensuring equitable healthcare outcomes.

The survey results underscore the urgent need for collaborative efforts to address barriers hindering the implementation of AI-driven healthcare solutions. From overcoming financial constraints to fostering trust and transparency, stakeholders must work together to create an environment conducive to digital health innovation. By addressing compatibility issues, improving stakeholder confidence in AI algorithms, and prioritising inclusivity and accessibility, healthcare entrepreneurs can

pave the way for a more equitable healthcare system. Moving forward, concerted action is needed to leverage the transformative potential of digital technologies and ensure that all individuals, regardless of socioeconomic status or demographic background, have access to high-quality healthcare services and treatments.

System Model 2.0

Focus Group

Discussion process

The focus group discussion complements the stakeholder survey by providing an opportunity for in-depth exploration of key themes and issues identified in the survey responses. Participants in the focus group discussion include a diverse range of stakeholders representing different perspectives within the healthcare digital entrepreneurship ecosystem (Ruff, 2005). The discussion is guided by the findings from the stakeholder survey and aims to delve deeper into topics such as ethical considerations, regulatory constraints, practical challenges, and strategies for promoting inclusivity and accessibility in digital health innovation. Through facilitated dialogue and interactive exchange, the focus group seeks to generate rich qualitative

data that can offer deeper insights into the complex dynamics of healthcare digital entrepreneurship and its impact on health equity.

Process for the focus group (Ruff, 2005):

- Participant Selection: Participants are selected based on their relevance to the research topic and their stakeholder roles within the healthcare digital entrepreneurship ecosystem. Diversity in participant backgrounds and perspectives is sought to ensure a comprehensive exploration of the research topic. Stakeholder groups represented in the focus group may include policymakers, healthcare providers, researchers, entrepreneurs, and patients.
- Moderation: The focus group discussion is facilitated by a moderator who guides the conversation, encourages participation, and ensures that all participants have the opportunity to contribute. A semi-structured discussion guide is used to explore key topics and themes related to healthcare digital entrepreneurship, AI systems, and health equity.The moderator employs probing follow-up questions to delve deeper into specific areas of interest and facilitate a rich discussion.
- Topics of Discussion: The focus group covers a range of topics relevant to the research objectives, including ethical considerations, regulatory constraints, practical challenges, and strategies for promoting inclusivity and accessibility in digital health innovation. Participants are encouraged to share their perspectives, experiences, and insights on these topics, drawing from their professional expertise and personal experiences.
- Data Collection: The focus group session is audio or video recorded to capture all participant contributions accurately. Detailed notes may also be taken during the discussion to document key points, quotes, and observations. The recorded audio or video, along with any supplementary notes, serves as the primary data source for analysis.
- Data Analysis: The data collected from the focus group session are transcribed and analyzed using qualitative analysis techniques. Thematic analysis is employed to identify patterns, themes, and insights emerging from the participant discussions. The themes and findings from the focus group analysis are compared and triangulated with the results of the stakeholder survey to provide a comprehensive understanding of the research topic.

By combining the stakeholder survey and focus group discussion, this academic methodology aims to provide a comprehensive understanding of the opportunities and challenges facing healthcare digital entrepreneurs in leveraging AI systems to enhance health equity. The insights gathered from both research components will contribute to advancing knowledge in the field and informing strategies for promoting equitable healthcare solutions for all.

AI-Powered Diagnostic Disparity Scenario

Participants are presented with a healthcare startup that has developed IoT devices powered by AI algorithms aimed at early detection of emergency situations for elderly individuals living alone or in assisted living facilities. These devices, which may include wearable sensors, smart home devices, and remote monitoring systems, are designed to monitor vital signs, activity levels, and environmental conditions in real time. By analyzing data collected from these devices, the AI algorithms can identify potential emergencies such as falls, abnormal vital signs, or environmental hazards, allowing for timely intervention and assistance.

Challenges

Funding for Development and Deployment:

- The startup requires funding to develop and deploy IoT devices and AI algorithms, as well as to establish partnerships with healthcare providers and senior care facilities.
- Limited access to capital presents a barrier to launching and scaling up the startup's operations.

Algorithm Accuracy and Reliability:

- Ensuring the accuracy and reliability of the AI algorithms used for early detection of emergency situations is critical to the success of IoT devices.
- Challenges may arise in training the algorithms to accurately identify and differentiate between normal and emergency events, particularly in diverse and dynamic environments.

Acceptance and Adoption by Elders and Caregivers:

- Elders and their caregivers may be sceptical or hesitant to adopt new IoT devices for monitoring and early detection, citing concerns about privacy, autonomy, and usability.
- Overcoming resistance and gaining acceptance for IoT devices among elderly individuals and their caregivers poses a significant challenge.

Specific Questions for Overcoming Challenges:

Funding Challenge:

- How can the startup identify potential sources of funding to support the development and deployment of their IoT devices and AI algorithms for early detection of emergency situations for elders?
- What strategies can be employed to attract investors, secure grants, or establish partnerships to finance the startup's operations and scale-up efforts?

Algorithm Accuracy and Reliability Challenge:

- What steps can the startup take to ensure the accuracy and reliability of the AI algorithms used for early detection of emergency situations?
- How can they validate the performance of the algorithms in real-world settings and iterate on their development to improve accuracy and reduce false positives?

Acceptance and Adoption Challenge:

- What approaches can the startup use to address concerns about privacy, autonomy, and usability among elderly individuals and their caregivers?
- How can they engage with potential users to understand their needs and preferences, and design IoT devices that are user-friendly, non-intrusive, and respectful of individual autonomy?

By addressing these specific questions, participants can develop practical strategies to overcome the funding, algorithm accuracy, and acceptance challenges faced by healthcare startups in developing and deploying IoT devices for the early detection of emergency situations for elders.

Results

After analysis of the survey results, we started the design for the Focus Group.

Our approach was to create scenarios to facilitate empathy and practical recommendations.
The presentation prepared for the Focus Group can be accessed here - Canva

We mailed all the potential participants in advance with a SavvyCal link to decide on the best time slot to conduct the activity.

The slot finalized was 16 April, Tuesday - 7.30 PM CEST

We recorded the session on Zoom (Access code: %$UW8$Bm) and used Otter AI (Part 1, Part 2, Part 3) for transcription in real-time.

Profiles and backgrounds of the speakers

A diverse set of professionals chose to be part of the focus group discussion bringing in different sets of perspectives. In this section, we'll go through a brief overview of our participants.

- Isabel Uribe

Uribe is a dedicated medical student at Bosque University in Bogota, Colombia, currently in her third year of study. Driven by her unwavering commitment to improving healthcare accessibility and quality, Isabel stands out as a passionate and determined individual.

Isabel's journey into the medical field was inspired by her upbringing in a family deeply rooted in healthcare professions. Growing up surrounded by healthcare professionals, she developed a profound appreciation for the impact that compassionate and comprehensive healthcare can have on individuals and communities.

Throughout her academic career, Isabel has demonstrated a strong interest in exploring the intersection of medicine and technology. With her strong academic foundation, passion for technology, and commitment to serving

others, she is poised to make a meaningful difference in healthcare delivery both locally and globally.

- Luka Lamaj

Lamaj is the Co-Founder and CEO of “Docere Health” an app focused on healthcare professionals and AI-powered tools for diagnosis as well as treatment based in Toronto (Canada). Recognized as the Young Entrepreneur of the Year in 2023 by the League of Innovators, Luka's commitment to innovation and leadership is evident in his numerous awards and accolades.

Lamaj is a strong believer in the potential of AI for healthcare, which also comes from his previous experience at Harvard Medical School and his Undergraduate degree in Science from Brock University. Lamaj is a well-rounded professional with a track record in business, technology, and healthcare.

- Maria Paula Leyva

Maria Paula Leyva is a Medical Doctor specializing in Occupational Health and Safety. With a background in medical sciences, clinical practice, and research from Universidad El Bosque, Currently Maria serves as a Medical Coordinator at 1DOC3, where she applies her expertise to coordinate healthcare services effectively.

Her work also includes a role as a Medical Consultant at AYLA CONSULTORES, focusing on occupational health, safety management systems, accident analysis, absenteeism analysis, and the development of epidemiological surveillance programs contributing well as a part of the discussion.

- Nino Samsonidze

Nino Samsonidze is an Erasmus Mundus Scholar currently majoring in Transition Innovation and Sustainability Environments with her background being in Political Science and Internation Relations. Her professional experience includes Project Researcher at the Civil Society Institute and a Research Assistant at University College Dublin.

In her role at the Civil Society Institute, Nino has been involved in various research projects aimed at fostering social change and advancing sustainable development. She has demonstrated proficiency in organizing activities, communicating with stakeholders, writing reports, and providing technical support. Nino's commitment to social impact is evident in their dedication to projects related to the environment, democracy, government, and civil action. Nino's educational background and professional experience reflect her passion for addressing global challenges through interdisciplinary approaches. With a strong foundation in transition innovation and sustainability, Nino is well-equipped to contribute meaningfully to initiatives aimed at creating positive societal change.

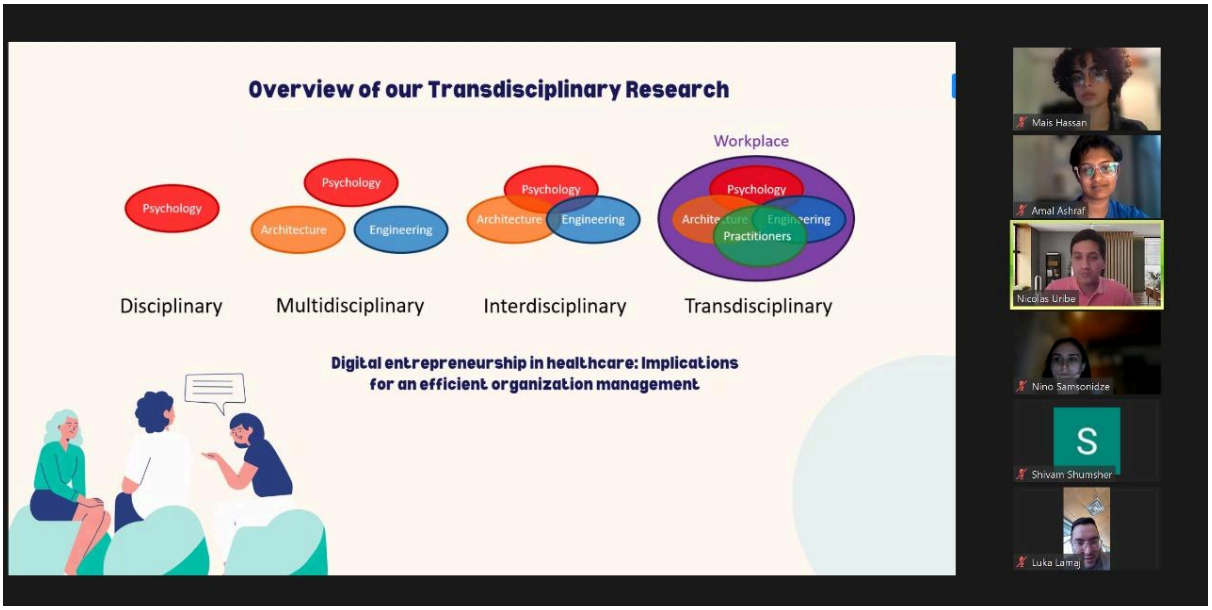
- Shivam Shumsher

Shivam Shumsher is an Erasmus Mundus Scholar currently pursuing a Master's degree in Transition, Innovation, and Sustainability Environments (TISE) with a background in social work and a strong focus on public health, responsible business, and design thinking. He has been trained to work with vulnerable and marginalized groups through a behavioural and rights-based lens. He brings this expertise to his work as a social researcher and development practitioner, where he advocates for strengthening participation, sustainability, and promoting innovation.

Shivam's professional journey has been marked by a commitment to various genres, including ICT4D, gender, public health, responsible business, and

human rights. He has gained extensive experience in program implementation, research, and communication, collaborating with multiple stakeholders to support and inform public policies. Throughout his career, He's held impactful roles at organizations such as the International Planned Parenthood Federation (IPPF), American India Foundation, Indian Institute of Corporate Affairs, and Nazdeek, where he has demonstrated his ability to drive change and foster collaboration across diverse teams.

Screenshot of the discussion



Scenario analysis

The scenario methodology was employed to enhance understanding and develop foresight concerning potential future states. This exercise aimed to cultivate a deeper insight into practical innovative solutions. Participants were tasked with role-playing as entrepreneurs at a company that provides AI-powered telementoring Internet of Things devices to the elderly living alone or in assisted facilities. Based on preliminary desk research, three scenarios highlighting challenges in achieving health equality in AI entrepreneurship were presented. Participants were instructed to propose solutions and engage in constructive, hypothetical discussions while assuming the role of an entrepreneur. The participants were encouraged to immerse themselves in the role, drawing upon their expertise and working together on how to navigate the challenges presented and capitalise on the opportunities identified to promote health equity effectively.

First Scenario

The first challenge addressed the accessibility and affordability challenges in achieving health equality in AI entrepreneurship. The scenario proposed that a community health worker has highlighted that low-income families and elderly homes in their area urgently need but cannot afford our devices.

The participants in the scenario analysis broadly agreed on the essential goal of making AI-powered telementoring devices accessible and affordable for elderly individuals, especially those in low-income settings or assisted living facilities. They recognized the importance of addressing health equity through innovative business models and partnerships. The participants suggested multiple approaches to achieve this goal, reflecting different perspectives on the feasibility and effectiveness of various strategies.

Nino Samsonidze highlighted that affordability is paramount for the target demographic, suggesting partnerships with pharmacies to distribute devices as a value-add for purchasing specific medicines. This strategy leverages corporate social responsibility but might be constrained by the financial limitations of startups versus larger corporations. This approach assumes that pharmacies would be willing to participate in such a program without significant financial incentives.

Luka Lamaj proposed a shift from a business-to-business (B2B) to a business-to-government (B2G) model, where the government purchases the devices and provides them to users at no cost. This model capitalizes on government interest in health promotion but relies heavily on the assumption that sufficient government funding is available and that the government is willing to prioritize this expenditure.

Shivam Shumsher questioned the sustainability of relying on government and corporate funding without a direct revenue model from consumers. He suggested starting with a proof of concept integrated into local public health systems to demonstrate value before scaling up. This method faces the challenge of securing initial funding and support for a pilot program, which can be particularly daunting in low-resource settings.

Proposed Solutions:

1. Partner with pharmacies to offer devices as incentives or rewards for purchasing specific medical products.
2. Use corporate social responsibility initiatives to subsidize the cost to end-users.

3. Shift from a B2B to a B2G model, where the government purchases the devices and provides them to the elderly for free.
4. Leverage public health budgets and government interest in promoting health care equity.
5. Develop a pilot project within the local public health system to prove the concept and demonstrate the device's value before attempting to scale.
6. This approach may help in gaining government support and funding for broader implementation.
7. Offer discounts to customers who purchase devices for multiple family members, enhancing perceived value and customer loyalty.

Second Scenario

For the second scenario, the focus shifts to the practical challenges faced during the integration of innovative healthcare technologies into real-world settings. The company has successfully introduced its AI-powered devices to elderly care facilities, aiming to enhance the quality of care and support for residents. However, despite the initial success, a new set of obstacles emerges as staff members express difficulties in handling the devices effectively. As the discussion unfolds, participants explore strategies to address these challenges, emphasising the importance of user feedback, adherence to quality standards, and innovative design solutions.

Their insights shed light on the complexities of integrating new technologies into established healthcare workflows and underscore the importance of proactive engagement and collaboration in overcoming implementation barriers. This are the principal takeaways of this scenario:

- Feedback Mechanism: Participants emphasised the importance of establishing a robust feedback mechanism where users can provide input and suggestions for improving the product. This mechanism fosters a collaborative relationship between the company and its users, ensuring that the product evolves to meet their needs effectively.
- Quality of Care Standards: Integrating quality of care standards into the product evaluation process was suggested as a means to identify and address issues efficiently. By adhering to established standards, the company can ensure that the product meets the necessary criteria for effective and safe use in healthcare settings.
- Mitigating Pain Points: Addressing pain points in the operation of the technology was highlighted as crucial. Identifying and mitigating these issues

not only improves user experience but also enhances the effectiveness and efficiency of the product in healthcare facilities.

- Capacity Building through Resources: Participants suggested providing resources, such as instructional materials or automated support systems, to aid healthcare providers in interacting with the devices effectively. This approach facilitates capacity building and troubleshooting, enabling smoother integration of the technology into healthcare settings.
- Design Solutions: Designing solutions to streamline interaction with the devices, such as creating informational materials or using AI for capacity building, emerged as a key strategy. These design solutions aim to empower healthcare providers and alleviate concerns about the additional workload associated with the technology.

Overall, the discussion underscored the importance of proactive engagement with users, adherence to quality standards, and innovative design approaches to ensure a smoother integration process for the company's technologies in diverse healthcare settings.

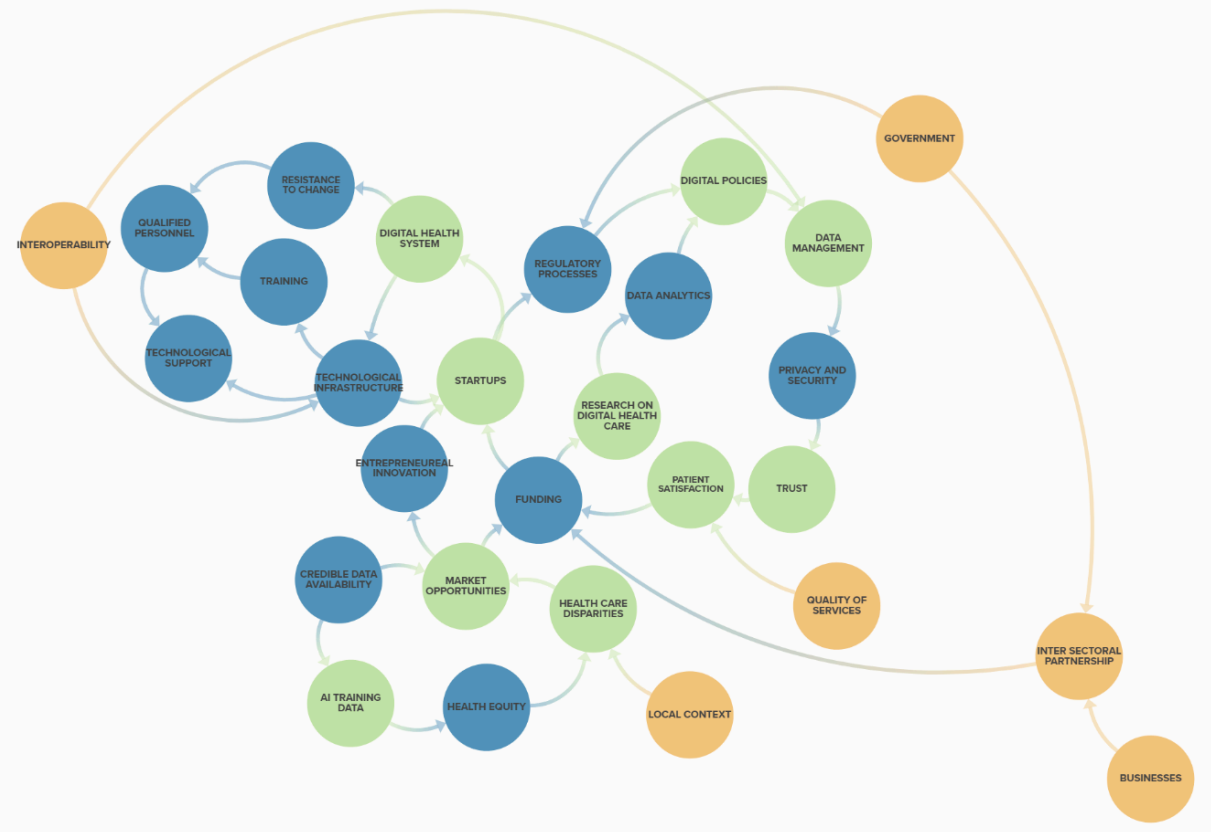
Third Scenario

For the third scenario, we encouraged the group to come up with solutions to address algorithm biases. The discussion revolves around algorithm biases in technology, particularly in AI systems, where sensors are programmed to work better with lighter skin tones than darker ones. This bias stems from the data on which the algorithms are trained, reflecting existing societal biases. Suggestions include retraining algorithms with data from the specific populations they serve and redesigning technologies to be inclusive. The conversation emphasizes the need for socio-technical solutions and highlights the importance of considering diverse populations in technology design. Additionally, there's a discussion on the importance of localized design and data collection for scaling up technologies, particularly in diverse regions like Africa, ensuring inclusivity and addressing biases. Finally, the participants explore the implications of these discussions on system models and propose actions to address biases, improve data credibility, and secure funding for equitable technology development.

- Relevant training data: The data set should be trained on the populations it serves, so it has to be rebuilt to remove exclusion by design.
- Local context and legislation: This is a socio-technical issue where flawed coding would follow due to differing parameters and statistics. The service must be adapted to the local context.
- Relevant case: A large-scale project of a UNICEF app for menstrual tracking basic content with similar content was extensively tested with users in Central

Asia. Hyper localization arose as a need when Papua New Guinea's low internet connectivity blocked the app's usage.

System Model 3.0



During the focus group session, participants were given an overview of our system loop and invited to share their insights. The variables highlighted in orange have been incorporated based on the feedback received during the session.

Shivam highlighted the critical relationship between technological infrastructure and data management. The participant emphasized that as technological infrastructure evolves, so do concerns surrounding privacy, security, and data management. Therefore, there should be a clear connection, indicating that advancements in technological infrastructure lead to increased requirements for effective data management.

Another observation from Shivam was establishing a connection between funding and market opportunities within the system loop.

Moreover, Shivam emphasized the importance of incorporating interoperability into our system loop. The participant highlighted interoperability as a key focus for governments, healthcare providers, and stakeholders globally, particularly concerning the scale-up and integration of applications within national healthcare and digital infrastructures.
“Interoperability is becoming a global concern. Every government is working towards interoperable applications.”
Incorporating this into our system loop highlights how interoperability impacts both data management and technological infrastructure.

Luka expressed the same views as Shivam on the relevance of interoperability to our system loop, indicating that interoperability is a major priority for various organizations advocating for healthcare accessibility and digitalization.

Additionally, Nino recommended adding the connection "Inter sectoral partnerships - startups" to the loop. Nino introduced the idea of incorporating intersectoral partnerships into our system loop. The participant referred to prior discussions where Luka proposed government involvement in linking users and startups, while Nino advocated for corporate responsibility (CRS) to improve product affordability.
Nino suggested including inter-sectoral partnerships encompassing businesses, public institutions, and governments as a crucial variable in our model. The participant highlighted the potential of these partnerships to support both startups and users.

Shivam additionally highlighted considering demand, supply, and the enabling environment as core components within public health programming.
The participant emphasized that any intervention design typically involves these three facets: the demand side focusing on end-users and behavioural changes; the supply side encompassing devices and technology provision; and the enabling environment drawing upon partnerships, external support, and funding. Shivam suggested that these components could provide a comprehensive overview, often utilized in national-level development programs. So, incorporating Shivam's suggestion, the loop would include that both government and business interactions influence intersectoral partnerships, which in turn lead to more funding.

Maria Paula, offering her perspective as a doctor, suggested adding another connection to the loop: quality of treatment affects patient satisfaction.
The participant stated that while AI and digital tools are important, we should not overlook the critical role of human connections between patients, doctors, and nurses in the healthcare system. It is about physical interaction and teamwork. We need to prioritize procedures and physical exams alongside digitalization. By optimizing health digital

systems while preserving human connections, we can develop exams or treatments that maintain contact more effectively.

Feedback

https://www.canva.com/design/DAGDhAhkOoA/y8Dui9-PH9wwZvB5spP7Vg/edit

Conclusion

The landscape of healthcare delivery is experiencing a profound shift with the integration of artificial intelligence (AI) systems, offering both opportunities and challenges for healthcare digital entrepreneurship. Our exploration of this dynamic field highlights the need for strategic approaches to capitalize on opportunities while effectively addressing challenges to maximize the impact of digital health innovation on health equity.

The academic methodology employed in exploring the opportunities and challenges of healthcare digital entrepreneurship, particularly focusing on AI systems to enhance health

equity, has provided valuable insights into the complex dynamics of the digital health ecosystem. By integrating both qualitative and quantitative research methods, including a stakeholder survey and focus group discussion, a comprehensive understanding of the barriers, perceptions, and potential solutions in healthcare digital entrepreneurship has been achieved.

The survey results underscore the urgent need for collaborative efforts to address barriers hindering the implementation of AI-driven healthcare solutions. From overcoming financial constraints to fostering trust and transparency, stakeholders must work together to create an environment conducive to digital health innovation. By addressing compatibility issues, improving stakeholder confidence in AI algorithms, and prioritizing inclusivity and accessibility, healthcare entrepreneurs can pave the way for a more equitable healthcare system. Moving forward, concerted action is needed to leverage the transformative potential of digital technologies and ensure that all individuals have access to high-quality healthcare services and treatments, regardless of socioeconomic status or demographic background.

The Focus Group Discussion served as a pivotal component in our exploration of the opportunities and challenges of healthcare digital entrepreneurship, particularly focusing on AI systems to enhance health equity. Through a carefully designed process, involving scenario-based discussions and practical recommendations, we engaged a diverse set of professionals representing various perspectives within the healthcare and innovation ecosystems. Key takeaways from the Focus Group Discussion highlighted critical enhancements to our System Model 3.0. Participants emphasized the importance of technological infrastructure, data management, interoperability, and intersectoral partnerships in shaping the landscape of digital health innovation. Their feedback underscored the need for a holistic approach that integrates technological advancements with human-centric care and fosters collaboration across sectors to drive equitable healthcare outcomes.

The feedback received during the Focus Group Discussion has informed significant refinements to our System Model, enhancing its relevance and applicability in the context of healthcare digital entrepreneurship. By incorporating these insights, we aim to develop more robust strategies for promoting inclusivity, transparency, and accessibility in digital health innovation.

Opportunities

Digital health entrepreneurship presents a promising pathway to bridge the gap in healthcare access and treatment options, particularly for underserved populations. Prioritizing equitable access to healthcare services and treatments can significantly contribute to advancing health equity by ensuring that no individual is left behind in

accessing quality care. Entrepreneurs have the unique opportunity to design and implement healthcare solutions that are inclusive and sensitive to the diverse needs of communities. Actively involving representatives from marginalized groups ensures that their perspectives are considered, fostering the development of equitable healthcare solutions that cater to the specific needs of all individuals. The integration of AI-driven technologies into healthcare offers unprecedented opportunities to improve outcomes for patients and populations. AI systems have the potential to enhance diagnosis, treatment, and management of medical conditions, ultimately contributing to improved health equity by delivering more accurate, efficient, and accessible healthcare services.

Challenges

Navigating the intricate regulatory landscape and addressing issues related to data security, privacy, and compliance pose significant challenges for entrepreneurs in the digital healthcare sector. Overcoming these regulatory and bureaucratic barriers is essential to uphold trust and promote innovation in digital health while ensuring the protection of patient data and privacy. Limited funding, expertise, and infrastructure present obstacles to entrepreneurship in the digital healthcare space, hindering the integration of digital solutions with existing systems and reaching underserved populations. Innovative approaches to resource allocation and integration are needed to overcome these challenges and drive equitable access to digital healthcare solutions. Ethical considerations surrounding AI-driven health technologies, including biases and discriminatory practices, pose critical challenges to ensuring fairness, inclusivity, and accessibility in healthcare delivery. Addressing these concerns is essential to mitigate disparities and promote health equity by ensuring that AI systems prioritise ethical principles and equitable outcomes for all individuals.

Finally, incorporating these insights into our approach to healthcare digital entrepreneurship will be instrumental in driving innovation and advancing health equity in the digital age. By prioritising collaboration, inclusivity, and ethical considerations, we can collectively work towards a future where high-quality healthcare services are accessible to all individuals, regardless of their background or circumstances.

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