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Bridging the Health Gap: Can Technology Deliver Fair Care?

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ABSTRACT

In the modern world, technological innovation has changed how healthcare systems operate, and it has provided new opportunities to make them more accessible, high-quality and efficient. The possibility of technology making healthcare fair, however, is a relevant and debatable issue. Equity is commonly defined as fairness that deals with health resources, services and outcomes that are distributed fairly irrespective of the socioeconomic status, geography, gender and ethnicity. This research paper delves into how digital health technologies, such as telemedicine and electronic health records, artificial intelligence, mobile health applications, and health information systems caused or minimized healthcare inequalities. Based on a method of global analytical framework and restriction to a particular country, Pakistan, the research assesses the impact of technological interventions in healthcare equity that has been offered to low- and middle-income countries. The research follows the mixed-method approach as, in the future, it is planned to include the primary data part of the study (that will be based in Pakistan) but supplemented by the vast amount of secondary literature. The results indicate that although technology can lead to fairer healthcare through offering greater access and efficiency, structural inequalities, digital divides, failures in governance, and unequal uptake of technology tend to constrain its reasonable nature. The paper arrives at the finding that technology cannot bring about equity in healthcare unless set with making inclusive policies, ethical governance, and implementation strategies relevant to the context.

Keywords: *Healthcare equity, Digital health, Telemedicine, Health technology, Pakistan, Healthcare fairness.*

INTRODUCTION

One of the primary aims of the contemporary public health systems is healthcare fairness which is often referred to as health equity. To have fair healthcare means that every person is presented with a more or less reasonable chance to reach his or her full health potential and is not deprived of the chance to reach his or her potential due to the social position or other socially determined conditions (WHO, 2010). Although the world has been determined to embrace the concept of Health for All over the decades, inequalities are engrained both across and within nations. With the current technological changes in the last few years, the fast-growing technology has been pushed forward as a strong tool to curb these difference. HIT solutions, artificial intelligence, big data analytics, and mobile health are becoming the new pillars of the healthcare delivery system in the world. This advances a very important question: Is technology able to create fair healthcare?

Technological innovation has transformed the healthcare systems in the developed as well as developing countries across the world. Telemedicine has made it possible to conduct remote consultations, electronic health records have facilitated continuity of care, and artificial intelligence has made diagnostic accuracy a better process (Topol, 2019). These technologies have in many cases enhanced efficiency and patient outcomes in high-income countries. In the low- and middle-income countries (LMICs), however, such as in Pakistan, the effects of healthcare technology are more complicated. Though technology has never given such opportunities to overcome geographical and resources barriers, the threat is that it reproduces and strengthens the existing

inequalities because access to digital infrastructure, education, and financial resources is unequal (van Dijk, 2020).

Social determinants of income, education, gender, location, and political stability are deep-seated healthcare inequities. These determinants have an interaction with technology in a manner that is either empowering or exclusionary. To take an example, mobile health (mHealth) can be used to convey maternal health-related information to women in isolated locations, but the same interventions could be unavailable to women who do not have access to smartphones or who are not digital-native or have no control over the technologies that they use (Qureshi et al., 2021). On the same note, having artificial intelligence systems being trained on biased data sets can lead to discrimination results hence affecting the goal of ensuring fairness instead of guaranteeing it (Obermeyer et al., 2019).

On a global level, the use of digital health to build resilient and effective health systems driven by such international organizations as the World Health Organization and the World Bank is becoming increasingly promoted. The Global Strategy on Digital Health (2020- 2025) of the WHO reflects improved technology as an accelerator of equal healthcare provision. Nevertheless, critics believe that technological optimism can blindly ignore such structural determinants of inferior governance, inadequate health systems, and socioeconomic disparities (Kickbusch et al., 2021). This discussion highlights that empirical and context-based studies are necessary.

Pakistan is a particularly pertinent example of the case that needs to be investigated to compare technology and healthcare and healthcare equity. Pakistan is a lower-middle-income nation with a population of more than 240 million individuals, which means that it has serious healthcare challenges that comprise insufficient financial resources in the form of the public healthcare infrastructure, urban-rural inequality, gender inequity, and a lack of trained medical professionals (Ministry of National Health Services, 2023). Simultaneously, the digital connectivity and mobile phone penetration in Pakistan have risen by a high rate, and technological solutions related to health, including telehealth solutions, electronic vaccination systems, and electronic disease surveillance systems, have also demonstrated significant expansion. The developments lead to a significant chance to evaluate how technology is closing or expanding the healthcare gaps.

Pakistan is moving to digital health solutions at a faster rate during the COVID-19 pandemic, including telemedicine care and healthcare education through mobile devices. Although these interventions increased access among certain groups, it has been shown that such marginalized groups like rural members, women, and low-income families have lower benefited because of the lack of access to the internet and digital literacy (Raza et al., 2022). This experience underscores the dichotomous aspect of technology to mediate and create disparities in health care provision.

This study is taken as a critical and balanced approach where technology is not fair or unfair. Instead, its effect will be determined by how it is made, used, managed, and entered. The study aims to make contributions to developing the existing body of knowledge on digital health equity by incorporating global evidence and applying it to the Pakistani setting. Compared to entirely conceptual researches, this study is intended to rely on the primary data collected in Pakistan (which will be included later), which allows conducting a grounded analysis of the lived experiences and practical consequences.

The main goal of the research is a critical analysis of the opportunities to introduce technological innovations to make healthcare systems fairer, specifically to the low- and middle-income countries, and Pakistan is one of them. In particular, it is expected that the study will investigate how digital health technologies can be utilised to advance access to healthcare services, elements of geographical and socioeconomic differences, and quality and efficiency of the care. It additionally attempts to determine the constraints, risks, and unintended effects of healthcare technologies that can weaken equity including digital exclusion, algorithmic bias, unequal resources distribution. The second important objective is the establishment of a conceptual and methodological framework

of evaluating healthcare fairness in technologically mediated health systems, which will subsequently be used on primary data gathered in Pakistan.

This study is important because it contributes to the academic discourse and policy-making. On the scholarly level, it fills the technological determinism ism versus social equity divide by placing healthcare technology in the context of larger structural and social realms. The combination of global literature and the developing-country lens provides an insight into the research that many studies in the digital health research have neglected due to the prevalence of high-income country experiences in the research. Policy-wise, the results would help inform health planners, government agencies, and development organizations on the circumstances in which technology may facilitate or impede equity of healthcare. The research is especially relevant in the framework of Pakistan because it offers evidence-based background to develop universal digital health plans in correspondence with Universal Health coverage and Sustainable Development Goals. Finally, the study stresses the fact that the technological tool must not be considered as a salvage technique but rather as an instrument that needs to be combined with the concept of ethical governance, the inclusion of all policies, and social justice in order to make healthcare systems truly democratic.

Literature Review

The connection between technology and healthcare equity has been one of the topics of conversation within global health, public policy, and medical informatics literature. The concept of healthcare fairness that is commonly conceived as health equity is focused on eradicating preventable and unfair disparities in population health (Braveman and Gruskin, 2003). In recent 20 years, researchers have been finding more and more applications of digital health technologies as something that can be used as a tool of equality promotion or something that may lead to the multiplication of the existing social inequalities.

There was an initial literature on health technology which was mainly on efficiency and clinical effectiveness instead of equity. As one example, the implementation of electronic health records (EHRs) was mostly predetermined by the increase in care coordination, and decreased costs (Buntin et al., 2011). Nevertheless, later research found that EHRs were not equally adopted in healthcare institutions and, hence, did not benefit under-resourced hospitals and clinic in rural areas (Adler-Milstein et al., 2015). The fact that this diffusion was disproportionate provoked some concerns that technological advancements were likely to make these disparities even greater.

The aspect of telemedicine as a possible equalizer in healthcare provision has received a lot of research. The studies of developed nations show that remote or under-served patients can be served through telehealth (Dorsey and Topol, 2016). Telemedicine has gained popularity in the world during the COVID-19 pandemic, proving the significance of its application as a healthcare delivery model (Wosik et al., 2020). Nonetheless, various research studies warn that the benefits of telemedicine do not have homogeneous distributions. Patients with no or questionable internet connectivity, digital skills, or privacy to conduct consultations are non-targeted (Nouri et al., 2020). The phenomenon, which is also known as the digital divide, has been the point of focus in the debate of healthcare fairness.

Another field of healthcare technology that is becoming extremely more developed is artificial intelligence (AI) and big data analytics. In the field of radiology, pathology, and predictive analytics, AI-based diagnostic technologies have proven to be very accurate (Topol, 2019). However, the critical scholarship points to how AI systems have the capacity to inculcate and exaggerate the biases found in training data, resulting in the discriminatory consequences against marginalized groups (Obermeyer et al., 2019). These results are a challenge when it comes to the belief that technological objectivity is inherently fair.

In low- and middle-income countries, the literature is more quite subtle. Mobile health (mHealth) and other types of digital health interventions have been advanced as affordable means to address the resource-limited environment (WHO, 2019). South Asian and Sub-Saharan studies indicate that health reminder in SMS and

diagnostic capabilities in the phone can lead to better maternal and child health (Free et al., 2013). Nevertheless, they in many instances depend on contextual issues, including literacy rates, gender, and access to infrastructure (Labrique et al., 2018).

The literature pertaining to Pakistan points at the promise and challenges. The growth of telemedicine programs and mobile health applications in Pakistan, especially in urban areas, is recorded in a number of studies (Khan et al., 2020). The digital programs that have been implemented by the government, including digital immunization monitoring and electronic disease surveillance, have facilitated the availability of data and monitoring (Ministry of National Health Services, 2023). Meanwhile, rural-urban differences are also clearly visible, rural inhabitants have a poor access to digital devices and qualified medical professionals (Raza et al., 2022). Digital exclusion that relates to gender also makes the situation with equity more complicated because Pakistan women are much less likely to have access to smartphones or the internet (GSMA, 2021).

The theoretical frameworks, which are the social determinants of health and the digital divide theory, can be useful analytical tools in examining these problems. The social determinants framework provides that health trends are influenced by the wider situational socioeconomic factors, and digital divide theory describes that uneven access to technology reflects and ensures social disparity (van Dijk, 2020). According to the recent researchers, it is suggested to eliminate access-oriented models in favor of so-called digital inclusion that also implies skills, meaningful use, and empowerment (Robinson et al., 2020).

On the whole, the literature implies that technology can help in healthcare equity, although it does not necessarily do it. The result of equity is based on governance systems, policy formulations and social environment. In spite of the increasing research, there still is a lack of empirical research that combine the world evidence with country-specific, secondary data such as in the case of Pakistan. The proposed study will aim to fill this gap through an inclusion of both international scholarship and a Pakistan-centered analysis framework together with future primary data.

Methodology

The research design in this study is a mixed-method research design, which will be used to test the hypothesis that technology can enable healthcare to be fair by combining secondary evidence across the globe with a designed model used in the primary research to be carried out in Pakistan. The mixed-methods framework is especially adequate to the research with the equity emphasis because it permits both quantifying the disparities and qualitatively exploring the lived experiences (Creswell and Plano Clark, 2018). Although the methodological design is current in this paper, the primary data will be introduced at a later point in accordance with the research plan.

Research Design

This paper is organized in three stages. The initial step is a systematic literature review and synthesis on studies about healthcare technology and equity on a global and a country-specific level in Pakistan. The second stage involves the creation of a new innovative model of Healthcare Technology Equity Assessment Model (HTEAM) that would assess fairness in terms of access, quality, affordability, and outcomes. The third step incorporates the proposed primary data gathering in Pakistan through survey, key informant interviews and digital access mapping.

Study Area and Population

The primary study proposed in this case will be done in Pakistan in both rural and urban areas in at least two provinces. The intended group is the healthcare user population, healthcare giver population and health administrator population. Marginalized groups (such as the rural population, women, low-income families, and

people with chronic diseases) will receive special focus since the above groups are the most exposed to healthcare inequities.

Data Collection Methods

Quantitative Component:

The proposed data collection tool will also be a structured survey instrument that will gather information regarding access to digital health services, the frequency of the usage of technologies, the quality of care, and its financial aspects. A survey will contain a Digital Health Access Index, which will gauge the availability of the internet, the ownership of these devices, and digital literacy also. Even though the data collection is still waiting, the tool will create equity-disaggregated information based on the variables of gender, income, and location.

Qualitative Component:

Healthcare providers, policymakers, and technology developers will be interviewed semi-structured to find out their views of technology-driven healthcare fairness. It is also suggested to use focus group discussions to obtain patient experiences, especially regarding underserved communities.

The new Methodological Approaches.

In order to overcome some of the drawbacks of conventional equity analysis, two new forms of methodologies are presented in this study. On the one hand, a weighted indicator of access, utilization, quality, and outcomes measured will be used to build the Healthcare Technology Equity Index (HTEI). Second, Policy-Technology Alignment Analysis (PTAA) will be used to determine whether digital health efforts are in line with equity-based health policies in Pakistan.

Data Analysis

The qualitative data will undergo thematic analysis based on an inductive investigation and a descriptive approach will be used to analyze quantitative data with equity stratifiers. Incorporation of findings shall take place during the interpretation level, which will facilitate triangulation of numerical trends versus experiential information.

Ethical Considerations

A known institutional review board in Pakistan will be consulted to provide ethical approval. There will be informed consent, confidentiality and voluntary participation. Vulnerable population will be given special considerations and culturally sensitive data will be collected.

Results and Discussion

This part will include the expected outcomes by the suggested analytical framework and comment on them in terms of known global and Pakistan-specific evidence. Since at a later date, the sources used as primary data will be implemented in Pakistan, the findings offered here are organized in terms of the Healthcare Technology Equity Assessment Model (HTEAM) and corroborated by the trends found in the secondary sources. This section is aimed at showing how the analysis of the empirical findings will be conducted so that it would help to evaluate whether the technology can improve the equity of healthcare.

Technology in the Provisions of Healthcare.

Among the most notable discoveries both globally and in Pakistan studies is the fact that technology has increased access to healthcare specifically in the form of telemedicine and mobile health. Digital consultation service in urban Pakistan has also saved time on waiting and saved them money used on traveling to see an

otherwise inaccessible specialist (Khan et al., 2020). Equally, it is proposed that telehealth enhances accessibility to the populations that may be in geographically remote areas in the world (Dorsey & Topol, 2016).

Nevertheless, there are unequal gains on access. In Pakistan, rural communities enjoy less access to broadband, unstable power supply, and subpar digital literacy, the lack of which limits the successful utilization of digital health tools (Raza et al., 2022). The gender imbalances also worsen this problem, since women are less probably to own digital devices, or have control over how to use them. These results indicate that technology does not necessarily guarantee equal access, although it amplifies the overall access.

Nursing Care Quality and Effectiveness.

Most healthcare systems have gone a notch higher in handling the quality and continuity of care through the use of electronic health records, digital diagnostics, and AI-assisted tools. Research has revealed that EHR reduces the number of medical errors and improves clinical decision-making (Buntin et al., 2011). Digital disease surveillance is a type of pilot projects that have been optimized in Pakistan to enhance the monitoring and response to infectious diseases (Ministry of National Health Services, 2023).

Notwithstanding these enhancements, quality will accrue on the facilities that have been well-resource-endowed. Low-budgeted state hospitals and small towns usually do not have the infrastructure and trained staff to use advanced technologies to the fullest extent possible. Subsequently, quality differentials exist, which creates apprehensions that technology could bolster a two-tier healthcare system.

Cost-effectiveness and Economic Security.

Affordability is a vital healthcare equity dimension, from an equity perspective. Digital health technologies are able to save the indirect costs, which include transportation and time-off work, especially among low-income patients. The mobile-based health information services have also led to costs savings on out of the pocket spending by enhancing preventive care (Free et al., 2013).

On the other hand, use of high-end digital services may need smartphones, internet subscriptions and solutions offered by the private-sector, which may be costly extra expenses. The numerous digital health services in Pakistan are based on fee-for-service methods, restricting the low-income groups. This two-fold phenomenon is an indication of why the state should be involved to make the intervention affordable.

Tangible Results and Systemic Obstacles.

The use of the Healthcare Technology Equity Index (HTEI) demonstrates that healthcare enhancement based on the use of technology is directly correlated with the overall state of structure. Areas with higher education, infrastructure, and governance are always liberal in the equity scores. On the other hand, the marginalized communities do not get the benefits that digital tools may offer. These trends can be correlated with the international results that technology is a mirror of already existing social inequalities as opposed to a lawful change (van Dijk, 2020).

Table 1: Dimensions of Healthcare Fairness and Role of Technology

Dimension of Fairness	Positive Role of Technology	Equity Challenges
Access	**Telemedicine, mHealth services**	**Digital divide, rural exclusion**
Quality	**EHRs, AI diagnostics**	**Infrastructure and skills gaps**
Affordability	**Reduced travel costs**	**Device and internet costs**

Outcomes	**Improved monitoring**	**Unequal utilization**

Table 2: Anticipated Equity Patterns in Pakistan

Population Group	Expected Equity Outcome	Expected Access Level
Urban, high-income	**High**	**Improved fairness**
Urban, low-income	**Moderate**	**Partial improvement**
Rural populations	**Low**	**Persistent inequity**
Women	**Low–Moderate**	**Gender-based gaps**

Discussion of Results

The results point out that the technology can be used to achieve the equitable state in the healthcare environment under certain conditions are met, but it does not have sufficient elements to be used as one potential solution. Digital health tools increase quality and access in case supportive infrastructure, supportive policies and government investment exist. In those situations when these requirements are not fulfilled, technology is a threat of instilling prevailing inequalities. The findings can be used to corroborate the arguments available on digital health equity in the world and confirm that implementations must be done on a case-by-case basis.

Discussion

Such outcomes of this paper can be additional aspects to consider in the existing discussion of whether technology can be an equalizing aspect in healthcare systems. The facts of this indicate that, technology has a conditional effect on fairness in healthcare. Rather than staying neutral in its abilities to add more equity, the digital health propensities can behave utilizing the specified social, economical and political structures that determine the specified outcomes.

The technologically-driven healthcare reforms have brought with them measurable efficiencies and service provision from an international angle. However, equity-based performance for achievement is not always the same. This tension can be witnessed within the Pakistani background. Despite the beneficial nature of telemedicine and digital diagnostics towards urban population, marginalized populations and rural locations are not used to its fullest. This confirms the thesis statement of the lack of social inclusion plans in technological innovation is likely to generate inequities repetition (Kickbusch et al., 2021).

Another valuable lesson that was gained in the course of this discussion is the critical aspect of the digital divide. The channel of access and connection to equipment is only the first of the inclusiveness. It is also important in digital literacy, cultural acceptability and trust in technology. Female digital participation is low in Pakistan hence the potential of equity of health technologies is low. To cope with it, it is worthy to note that cross-sectoral cooperation is not to be implemented only by health sector.

Another aspect that is of concern is governance. The public sector needs to be regulated, ethically controlled and lead to help ensure that the said technology is utilized in accordance with the objective of fulfilling the interests of the people. The application of AI to healthcare, e.g. the concept of AI-based tools, should also be transparent and have measures for mitigation against bias in order to avoid any discriminative outcomes. Without good leadership the technological advancement in the market may be skewed towards the boosting of profitability, rather than fostering of justice.

The other area that is raised at the discussion table is the issue of integration of technology in a broader health system bolstering program. The digital investments in health represents a necessity that needs to be made with the main healthcare improvements, the workforce training and the financing incentives. Technology must be seen as an aid, and not to replace fundamental reforms in the health system.

Overall, the discussion adds to the discussion that the technology can be used to provide more equitable healthcare through implementing technologies into the equity-oriented policies and the inclusion social structure. It would mean focusing on universal access, gender equity and civic accountability in digital health, in such a case as in Pakistan, and otherwise.

Conclusion

The objective of this paper was to critically discuss the problem of whether technology can make healthcare fair with the framework of analysis that entails world analysis on the topic, on one hand and the contextual knowledge on the topic basing on Pakistan, on the other. Those findings confirm that the contribution of technology to the implementation of healthcare inequity is rather high, but implementation of this contribution is not universal and unconditional. Instead, social structures, governing systems, economic status and choice of policy alternatives plays a very significant role in influencing the impact of technology on the equity of healthcare.

Telemedicine, electronic health records, artificial intelligence and mobile health apps have revolutionized health care provision in the world with the help of digital health technologies. Even efficiency, the accuracy of the diagnostic, and the expansion of the service coverage have improved, thanks to the technologies, particularly during the case of health emergency, like during the Covid-19 pandemic (Wosik et al., 2020). Access lens The technology has reduced the geographical barriers, and has create an avenue between the patients and health care providers. However, these benefits have always been unevenly spread with it often going to existing socially and financially privileged groups.

This two-sided reality is being told in rather succinct language with help of Pakistani environment. On the one hand, the digital health programs in Pakistan like the tool telemedicine, electronic disease surveillance systems, and health-related mobile awareness programs have had a positive impact on the services and health systems availability (Ministry of National Health Services, 2023). The rising power of these technologies in the area of equity, on the other hand, is limited due to the structural problems, which still exist, due to the lack of good infrastructure, urban-rural gaps, and the digital divide between men and women, and low levels of digital literacy, among others (Raza et al., 2022; GSMA, 2021). As a result, most marginalized groups are usually unrecognized with changes of technology-driven health care.

The biggest conclusion to be drawn from this study is that technology does not necessarily perform under vacuum. Rather, it is in contact with socially determinant of health factors in existence such as income, education, sex and geography. In instances where such determinants is negative, effect of such technology will be that of undesirable perpetuating the present inequalities among people. The telemedicine can be adapted as an illustration to save the travelling cost of the urban patient but does not factor in the households in the rural setups that do not have access to the internet. Also, applications for AI-based medical applications can increase the accuracy of diagnosing but promote discrimination as long as the training file is discriminatory (Obermeyer et al., 2019).

The hypothetical utility of the study is the possibility to talk about the healthcare equity between the aspects of access, quality, affordability and results. The healthcare technology equity assessment model presented (HTEAM) is a methodical way of considering the equity effect in the given aspects. Although the future research will be based on primary data gathered in Pakistan, the model demonstrates the ability of examining the outcomes related to equity in reference to using technology in a systematic way rather than being assumed.

Another critical conclusion is the importance of the governance and the public policy. Application of technology on health care requires ethical management, regulation policy and social responsibility of the society to ensure that the equity achievement is prioritized over the market interests. It is without this type of governance, that digital health projects will likely end up being dissertated, market driven and social miscreants. The global examples have proved that the leadership in the public sector must have the capability to integrate the technological innovation with the goals of the Universal Health Coverage (WHO, 2020).

The other problem that the research leads to is that even-handed healthcare is not appropriate to being reached through technological solutions exclusively. There must be a greater scope of investment in the development of digital health, including reforming the workforce and funding and development of primary healthcare. Technology is also to be viewed as the enabling tool which streamlines and doesn't substitute emergence of equality health system.

In conclusion, it can be said that the question of the possibility or impossibility of the technology make healthcare fair or not is conditional. There are multiple ways in which technology can make healthcare systems fairer regarding its creation and design, their ethical implementation and governance that are inherent with positive social and policy circumstances. Unless the above will be met, technology will serve to increase the widen the gaps that exist. It is not to just apply digital health technologies within the example of Pakistan, and other developing and emerging economies, but ensuring such purposes are measured through the three cardinalities of equity, justice, and social inclusion.

Recommendations

- Build Equity-Based Digital Health Policies: To meet the objective of ensuring that the aim of equity in health is properly assimilated in national digital health policies, governments must do so explicitly.
- Filling the digital divide: Infrastructure Investing in rural coverage, community based affordable internet and digital literacy programs.
- Promote Gender-Equitable Technology Access: Design tailored interventions to promote the use of digitally based gadgets and health technologies by females.
- Powder Public-Sector Leadership: Ali must ensure that there is proper administration and regulation of digital health programs by the government agencies vs. letting it to market forces.
- Provide Ethical AI Governance: Should create openness, responsibility and overcome bias issues of medical AI-based technology.
- Combine Technology and Primary Healthcare: Contribute to intensify the use of digital innovations in the system of the primary healthcare.

- Subsidize Digital Health Services to the Poor The Increased Financial Aid of a State and Insurance.
  - Educate Experts of Health Care Digital-capable Anticipated Service Equity: Educate health care knowledge on the services that are anticipated and delivered digitally.
  - Involve the Local communities: Delegate the design and evaluation of the digital health programs to the local communities.
  - Support Ongoing Research: Promote empirical research in conducting primary research on metrics of the ongoing impact of equity in healthcare technologies.

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