

Investigating e-Learning's Potential to Strengthen Healthcare Workforces in Developing Nations

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ABSTRACT

This study examines how e-learning can strengthen the skills of healthcare professionals in developing countries combined with existing and emerging issues, including Covid-19. The objective of the study is to assess the rapid embracement of distance learning facilitated by digital technologies in meeting human resource and training challenges. While this is easier than ever, barriers such as technology constraint, digital literacy or relevance of the content are still common today. The methodology involves a comprehensive literature review and analysis of major case studies and success stories. The key elements highlighted in the literature review include institutional support as well as tailored e-learning strategies to increase efficacy. The study seeks to reveal proven initiatives of e-learning post assessment through different case studies which have situated themselves as the leaders by changing healthcare delivery and outcomes. The findings reveal a significant shift towards e-learning for healthcare workforces in developing nations. The results underscore the necessity of a multi-stakeholder partnership to design sustainable e-learning interventions aimed at addressing educational access challenges and capacity building as part strengthening the health systems with limited resources.

KEYWORDS

E-learning, Healthcare professionals, Developing countries, Digital technologies, Distance learning, Capacity building, Covid-19 impact, Human resource development

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INTRODUCTION

Healthcare process continues to shift in the application, what they are practicing by methods do better service technology. It is also a fragile space in terms of coaching. The hands-on practical side of the training makes some aspects of remote learning difficult because they are so sensitive. The e-learning revolution of health professional education and training in developing countries is advancing medical practice. The pandemic, while causing widespread disruption has undeniably accelerated this shift towards digital platforms and also shown a few ways to do so! However, looking past these stimulants is a larger theme of innovation and flexibility that flows throughout numerous healthcare venues.

The study by Sayed et al (2021) digs into the effectiveness of e-learning to supplement healthcare worker competencies in developing countries as informed by recent studies. These countries have specific issues in terms of political characteristics, economical characteristics; also general (stable internet connection) or particular (financial cost) (Sayed et al., 2021; Lonescu, A. et al., 2021). Nevertheless, in this respect research conducted by Schmidt and Mykhalovskiy (2021) as well introduced us the sweep of digital distance learning—that includes all areas including attitude to it, conductance and resultant outcomes.

When we travel on these various dimensions, this complex terrain of readiness to technological effectiveness against user engagement weights was encountered. The e-learning will cease to be only a back-up strategy for emergencies, and our understanding of it could start reflecting the possibilities described by recent literature to transform into an ongoing manner for learning new things related with healthcare workers blending geographical distances without expanding resources.

Kiberu et al (2019), as well Sagi et al. (2018) have shown a clear appreciation of the disruptive potential that telemedicine and e learning can be tapped to alleviate critical health workforce shortages offering innovative way towards ensuring access to care is improved. They identify key issues including the type and quality of e-learning content produced or used; pedagogical approaches adopted; as well technological constraints associated with digital education in low-resource settings. However, these are simply some of the bumps along a long road still to be travelled; infrastructural deficits, technical know-how gaps and inconsistent acceptability among medical professionals all make for difficult terrain when it comes to implementation.

In addition, as we reflect on the wider influence of these digital educational tools scholarship like Frehywot et al. (2013) and Barteit et al. (2019), illustrate systemic factors which impact more broadly integration with e-learning in healthcare training. The urgency for institutional pre-

paredness, stringently evaluated frameworks and support networks show starkly that emerging countries will have to undertake a synchronized effort together in e-learning. This would not just address short-term educational gaps, but also establish a foundation for a sustainable prospect by aligning national and international health priorities in the long-term.

In this research study, we critically discuss about the efficiency of existing eLearning platforms in the healthcare infrastructure capable of handling another challenge, innovative approaches are being employed, and its real-world repercussions concerning care services specially for the developing nations, etc.

LITERATURE REVIEW

The impact of COVID-19 outbreak on the education of health occupations in India and virtual learning among professionals and trainees was described by Sayed et al (2021). A quantitative survey conducted in 2020 found that 65.41% out of 3,004 healthcare professionals utilized e-learning programs in the time of pandemic, regardless of cybersecurity concerns.

E-learning was considered superior to traditional methods of education and instruction because it saved travel time, but also led in the maintenance of physical distance for social immunity without deferment in acquiring knowledge. Following the pandemic, e-learning has become one of the most popular methods according to an in-depth research study and is likely here to stay. It demonstrates how well-aware Indian healthcare professionals are, their perception and challenges related to E-learning. It highlights the contribution of e-learning in enhancing digital skills and reducing COVID's educational loss especially among younger, highly educated participants. Challenges include privacy concerns, technical knowledge gaps, and unstable internet connections. The study recommends using lessons learned from the pandemic to develop new laws, regulations, and platforms for future education and conducting further studies to enhance teaching methodologies, e-learning quality, and student satisfaction.

Lonescu et al (2021) examines the utilization of e-learning and e-consultation (EC) by certified Healthcare Workers (HCWs) in Low and Middle Income Countries (LMICs) - investigate whether the methods complement one another. They conducted a systematic review of 96 peer-reviewed papers, with 3 focusing on both e-learning and e-consultation, 54 on e-learning, and 39 on e-consultation. It mostly explored gaining knowledge and skills, ease of use, efficiency/competence, HCW satisfaction, or implementation hurdles. Successful e-consultation and e-learning networks were associated with institutional support, partnerships, and local expert capacity building. The review indicates that HCWs employed in LMIC settings still need to be supported by academic institutions, medical societies and networks with support from multi-partner initiatives.

Kiberu et al (2019) address the readiness/challenges related with implementing telemedicine in Uganda as well as other developing countries. It highlights potential of telemedicine to discuss healthcare worker shortages and improve access to care. They assessed four areas of eHealth readiness and used a mixed methods approach. Key findings include the awareness as well as positive attitudes of healthcare workers towards telemedicine, patient concerns, and the lack of necessary ICT infrastructure in healthcare facilities. The study highlights the need to address technology gaps and cater training for successful telemedicine implementation, provide recommendations for policymakers.

Sagi et al (2018) described the approach used in a newly implemented telementoring program designed to train primary care physicians (PCPs) treating substance use disorders (SUDs) in Bihar, India. SUD care is highly important to be part of the practice and responsibilities of PCPs, especially in underprivileged areas. Structurally, the program relies on synchronous training through online/remote ECHO clinics and asynchronous e-learning using a dedicated app. The review analyzed attendee reaction, learning outcomes, confidence and satisfaction. For majority of PCPs who participated, resulted increased knowledge and confidence regarding SUDs. The results suggest that training via technology to connect us back bridges health care gaps in these underserved areas.

Sagi et al (2018) wrote on design and evaluation of online training course for healthcare workers in Nigeria. This course was constructed to be mobile-friendly and self-paced, delivering basic infection prevention and control (IPC) knowledge. The study included 372 learners from different healthcare professions. While pre-test scores were low, and post-tests did not produce perfection, however, it was exciting to see them markedly climb up! Users expressed satisfaction with, and the study concludes that this mobile-ready self-training approach to training was successful in improving knowledge even though most users began the trials only having very little or no machete-related technical skills.

Frehywot et al (2013) reviews the use of e-learning in LMICs for the pre-service training of health care professionals. The study also pointed out that e-learning is a solution toward faculty shortages and better access to healthcare education within LMICs. This review captured 124 articles, concentrating on several countries including India, Brazil, South Africa and Egypt. It mainly reported specialist field for which e-learning is used, exclusive of the mandatory training areas, was physician training (58%), followed by nursing and pharmacy/dentistry (24%). The main motives for implementing e-learning are to expand access to education, provide faculty support, and share digital resources. Computer assisted learning, blended learning, simulations, multimedia software, internet-based learning, and eTutor/eMentor programs are among the different e-learning approaches used. It emphasizes that e-learning is a means to enhance education and faculty efficiency but highlights the importance of institutional readiness and alignment with educational and economic

perspectives in LMICs.

Barteit et al (2019) discusses the challenges and potential of e-learning in healthcare education in countries with low resources, primarily in sub-Saharan Africa. Despite two decades of efforts, e-learning has not revolutionized medical education in these regions. Key issues include the lack of a systematic approach, the digital divide, the proliferation of isolated pilot projects, and shortage of healthcare workers. This article emphasizes the necessity for structured implementation, curriculum integration, and rigorous evaluation. It calls for a centralized database to promote transparency and collaboration and advocates for a concerted effort to harness e-learning's prospective to address health worker shortages in low-resource countries.

Barteit et al (2019) systematically reviewed e-learning involvements on healthcare education in LMICs. This comprised 52 studies involving 12,294 participants. Findings showed that pilot studies had most e-learning interventions, using summative assessments and questionnaires for assessment. However, the study layout, assessment methods, and quality contrasted significantly. Subjective measures and custom-built assessment frameworks were used by majority studies, resulting in low validity and comparability. While many self-concluded that their e-learning interventions were effective, objective ratings revealed low-quality evidence. The study emphasized the requirement for further thorough assessment to comprehend the true impact of e-learning in LMICs, and improve healthcare education in resource-constrained situations.

Vaona et al (2018) compared e-learning with traditional learning systems to weigh the impacts on health professionals to improve patient outcomes, and behaviors, skills, and knowledge of health professionals. This comprised 16 randomized trials with a total of 5,679 licensed health professionals. Findings suggest that e-learning may have minimal or no difference on those aspects compared to traditional learning. The testimony was generally inferior certainty, and the study concluded that overall understanding of e-learning being more impactful than traditional learning might be unreliable.

Scott & Mars (2015) discuss Telehealth, a vital component of e-health, is expanding globally, benefiting both developed and developing countries. Nevertheless, it remains underutilized in many regions, and its applications and needs vary between these areas. While teleconsultation, telecardiology, teleradiology, and teledermatology are typical clinical uses, there's limited published evidence and sustained programs in regions like Latin America, the Caribbean, Asia, and Africa, despite some humanitarian initiatives. Developing countries are increasingly adopting mobile solutions (m-health), but global integration of telehealth into existing healthcare systems is hindered by factors like large-scale operations lacking, insufficient evidence, challenges on implementation, and neglect of willingness and change management. Practical issues such as resource limitations, power unreliability, high costs, and

poor connectivity add to these barriers in the developing nations. Nonetheless, telehealth holds potential for enhancing healthcare in developing countries, motivated by altruistic and profit purposes, but it must be tailored to meet specific healthcare needs, address workforce shortages, and facilitate skills development, necessitating increased awareness, understanding of its capabilities and limitations, and coordinated efforts among stakeholders to encourage innovation and integration.

Akimanimpaye & Fakude (2015) explores the attitudes of undergraduate nursing students at the University of the Western Cape towards e-learning. A survey of 213 students revealed a positive attitude for e-learning, comprising aspects like gender, ease of use, and student classification (year in the college) impacting their satisfaction about e-learning. Results indicate that e-learning is well-received, with an 86% valid response rate in the survey.

Davids et al (2015) illustrates the promise of e-learning for developing clinical reasoning skills through an interactive learning environment, exposure to a broad spectrum of examples and prospects for methodical approach with feedback. It highlights two among the vital but least acknowledged components in successful e-learning: dealing cognitive load on learners and usability issues with technology interfaces. Cognitive load theory highlights on necessity of avoiding unnecessary cognitive load as a barrier to learning, and provides list of principles in instructional design based on empirical findings so that lessons are more likely optimize rather than hinder cognitive processes during study. Usability is defined as a human-computer interaction concept that is relatively neglected, both in designing e-learning programs and the learning management system (LMS), but gets more importance when we are dealing with medical education. The consolidation of principles from cognitive load theory

and human-computer interaction can improve learning efficacy by diminishing students extraneous cognitive load points, enhancing solutions usability whilst fostering development of student clinical reasoning.

Bussotti et al (2016) present an experience report on online training for professionals in 27 Neonatal and Pediatric Intensive Care Units within the public health service. The training aimed to enhance multidisciplinary skills and was based on a situational diagnosis of the participating institutions. The study achieved a high level of participation, with 2,071 active students and 1,046 approved. The experience demonstrates that online training is an effective tool for professional development and digital inclusion. However, it also highlights the importance of participants being familiar with technological resources to maximize the benefits of online learning.

Arigorous assessment of e-learning programs was provided by a study (conducted in-person, virtual and blended) delivered across 16 sub-Saharan African countries within an HIV capacity building program (Kiguli-Malwadde et al., 2023). This real-world evaluation therefore targeted to determine the effectiveness of transitioning from face-to-face or in-person training services into being delivered online by comparing business-as-usual delivery with new digital approaches implemented during COVID-19. Results indicated that irrespective of delivery method, scores for every discipline related to HIV insight and self-reported confidence improved overall as found from pre-to post workshop scores. This would suggest, e-learning is a useful method for delivering training to healthcare workers across diverse clinical environments.

MAJOR EXPAMPLES/STORIES

The following papers were cited for the purpose of this research:

Project	Description	Impact	Strengths
Project ECHO (Extension for Community Healthcare Outcomes)	Project ECHO uses a telemedicine model to connect primary care physicians in remote or underserved areas with expert teams at centers of excellence. It provides the platform for knowledge sharing, case-based learning and capacity building.	Improved Access to Specialized Care, Enhanced Primary Care Expertise, Reduced Healthcare Disparities, Cost-Effective, Global Reach and Scalability, Research and Continuous Improvement, Community Engagement and Empowerment.	Project ECHO utilizes a scalable tele-mentoring model that empowers local healthcare providers with specialized knowledge, improving patient outcomes and reducing healthcare costs. By fostering interprofessional collaboration and focusing on underserved populations, it effectively addresses health disparities and enhances community capacity.
mHealth for Community Health Workers in Sub-Saharan Africa	Sub-Saharan Africa mHealth initiatives for Community Health Workers provides innovative possibilities to address the huge challenges by resources poor-health system in developing region through mobile phones;	In Sub-Saharan Africa, mHealth has dramatically improved healthcare service delivery by increasing on the overall efficiency and productivity of community health	mHealth enhances the effectiveness of Community Health Workers (CHWs) in Sub-Saharan Africa by providing real-time access to health information and data collection tools, improving service

	including from smartphones to basic feature phones which is used as point of access information, patient record and communication channel.	worker (CHWs), especially in rural communities with; better information flow, efficient disease surveillance techniques as well as cost-effective solutions.	delivery and patient management. Additionally, it facilitates communication and coordination among CHWs, healthcare providers, and communities, ultimately boosting health outcomes and increasing efficiency in resource-limited settings.
Telemedicine Training in Nepal	In Nepal, telemedicine training focuses on enabling doctors and nurses to use tools for remote diagnosis and treatment of patients via Internet in rural areas. This training comprises the use of digital tools and software, local healthcare capacity building as well as educational outreach in addition to international collaborations for knowledge transfer & technological support.	Enhanced access to healthcare in remote areas, improving the quality of care and making healthcare delivery more cost-effective. It has increased the medical knowledge and skills of local healthcare workers, empowering them to provide better care, although it faces challenges such as technological limitations and the need for continuous support.	Telemedicine training in Nepal strengthens healthcare delivery by equipping providers with essential skills to utilize digital technologies, thereby enhancing access to care, improving patient outcomes, and expanding medical knowledge in remote areas.
eLearning for Ebola Response in West Africa	For the Ebola response in West Africa, an eLearning initiative was provided for both healthcare worker training and public health prevention messaging via online platforms to serve wide-reaching multi-lingual culturally relevant content. The information was collaborated with health authorities and spread through tools like multimedia — accessibility via mobile phones helped right away.	It is no exaggeration to say that this initiative greatly improved the understanding and readiness level of healthcare workers in parallel with affected population, which ultimately decreased response lead time during Ebola outbreak. The study also highlighted the value of eLearning in emergency health crises, particularly resource-poor environments, to disseminate and deliver just-in-time training on basic ESNPs.	eLearning for Ebola response in West Africa enhances rapid knowledge dissemination and skill development among healthcare workers, enabling timely and effective management of outbreaks while overcoming logistical challenges in resource-limited settings.
Maternal Health Training in Bangladesh	Maternal Health Training in Bangladesh involves educating healthcare providers, particularly midwives and community health workers, on various aspects of maternal health, including prenatal care, safe delivery practices, and postnatal care. This training often incorporates hands-on skill development, use of technology, and focuses on addressing cultural and social factors impacting maternal health.	It was due to this training that maternal and newborn health indicators in Bangladesh started showing significant improvement through the development of capacities among healthcare providers. This has resulted in falling maternal and infant mortality rates, better care of pregnancy-related complications and increased community awareness regarding the health situation during birth.	Maternal health training in Bangladesh improves healthcare providers' competencies in managing pregnancy and childbirth, leading to enhanced maternal and neonatal outcomes and reducing complications in underserved communities.
HIV/AIDS Education in Sub-Saharan Africa	In Sub-Saharan Africa, many HIV/AIDS educational programs can be found that educate people to understand the different aspects of HIV/AIDS such as how it is transmitted and its prevention and treatment methods. They can be aimed at	The widespread education programs have played a major role in improving an understanding and removing the stigma from HIV/AIDS in the region. They have been instrumental in preventing new infection of HIV, enhancing	HIV/AIDS education in Sub-Saharan Africa empowers communities with knowledge and awareness, reducing stigma, promoting preventive behaviors, and improving access to treatment and care for those affected by the virus.

	different populations, including youth, women and target groups in general (on schools or community workshops) –media campaign.	the quality-health-life of those people living with and affected by HIV among many other healthier behaviors within communities.	
Telepsychiatry Training in Latin America	Telepsychiatry training in Latin America is aimed to teach practitioners the techniques and knowledge required to provide psychiatric care at a distance, through digital communication technologies. This training entails the utilization of teleconferencing tools, insights about how to engage patients online and changes in psychiatric evaluations/interventions for remote delivery.	The expansion of telepsychiatry training has provided broader access to mental health services for rural and underserved areas in Latin America, where there are important gaps in the provision of psychiatric care. In addition, it has also helped to increase the quality and consistency of mental health services meaning patients receive more constant (and heterogeneous) mental healthcare.	Telepsychiatry training in Latin America enhances mental health service delivery by equipping clinicians with the skills to provide remote care, increasing access to psychiatric services in underserved areas and improving patient outcomes.
Nutrition Education in East Africa	The primary audience in East Africa is those within communities, particularly mothers and caregivers who benefit from resources developed to increase their knowledge on healthy eating, food security and nutrition practices. Such programs frequently incorporate guidance on permaculture practices, dietary diversity or more broadly the significance of nutrition in child growth and well-being.	Immediately, this innovative initiative had a transformative effect on nutrition awareness and practices locally in East Africa — ultimately yielding directly to better health outcomes for children and mothers alike. It has played a significant part in fighting malnutrition and related illnesses; it also promotes proper food habits and enhances regional level of self-sustainability.	Nutrition education in East Africa promotes awareness of healthy dietary practices, leading to improved nutrition, reduced malnutrition rates, and enhanced overall health outcomes for communities, particularly among children and vulnerable populations.
Community Health Worker Empowerment in South Asia	Empowering Community Health Workers (CHWs) in South Asia refers to the well-planned training and preparation of local health workers with all necessary skills, knowledge base and tools that they need to address various health related needs at their working points. Training in these areas covers education on public health, basic medical tools and community engagement/advocacy.	Access and quality to healthcare have improved significantly in these parts of South Asia by empowering CHWs who are based mainly in rural areas as well as underserved regions consequently resulting into good health outcomes. It also encouraged participation of the communities in health and prevention care, building trust additionally.	Empowering Community Health Workers in South Asia enhances local healthcare delivery by equipping them with the skills and resources needed to effectively address health issues, improve access to care, and engage communities in health promotion and disease prevention.
Diabetes Management in Southeast Asia	Diabetes management in Southeast Asia encompasses comprehensive strategies including public health education, regular screening, effective treatment protocols, and lifestyle modification programs. It focuses on addressing the rising prevalence of diabetes by increasing awareness, promoting healthy behaviors, and providing access to medical care and support for people living with diabetes.	As a result of this practice, diabetes in the area has improved more awareness leading to control and hopefully reduction in complications caused by the disease. It has also improved the quality of life for those with diabetes as well as lowering long-term healthcare costs around diabetes control.	Effective diabetes management in Southeast Asia enhances patient education, promotes self-care practices, and improves access to healthcare resources, leading to better glycemic control and reduced complications among individuals living with diabetes.

Telemedicine for Remote Indigenous Communities in Australia	Telemedicine in remote Indigenous communities: sidelined by interest groups, these communities are used as the example due to their reduced access, and increased need for healthcare meaning the potential benefits of telemedicine. The service includes virtual consults, remote monitoring and digital health education that is culturally tailored for the unique needs of Indigenous culture and healthcare.	This has led to massive improvements in healthcare access for Indigenous populations living remotely, being given prompt and culturally competent medical treatment. In doing so, it has also been pivotal in improving health outcomes, reducing patient travel and wait times for some medical services, as well as increasing the engagement of Aboriginal people with their own healthcare.	Telemedicine for remote Indigenous communities in Australia improves access to healthcare services, facilitates timely consultations with specialists, and enhances the continuity of care, ultimately addressing health disparities and promoting better health outcomes in these underserved populations.
Infectious Disease Surveillance in West Africa	Surveillance of infectious diseases in West Africa is the continuous systematic collection, analysis and interpretation of health data to enable surveillance of more action-oriented prevention or control measures. These include the application of technology, field epidemiology and inter-agency collaboration in order to rapidly detect and respond to disease outbreaks.	Being able to detect and respond at an early stage has helped immensely in curbing the outbreak of infectious disease, which otherwise could have spread around effecting many more. Additionally, it has improved public health systems in the region and communities more broadly to provide protection against future potential pandemics.	Infectious disease surveillance in West Africa strengthens public health response by enabling early detection and monitoring of outbreaks, facilitating timely interventions, and improving coordination among health authorities to mitigate the spread of diseases.
Family Planning Education in Latin America	In Latin America, Family Planning Education emphasizes information regarding the different types of contraception and their access to services for sexual reproductive health rights. Programs target both adolescents, couples and communities with a range of messages focusing on making an informed choice when it comes to sexual health education.	Such an education program has both increased the knowledge and utilization of family planning methods, reduced unintended pregnancies, and upheld reproductive autonomy. It also has been essential in uplifting women and girls as beneficiaries to improve health outcomes with a view of sustainable development at the community level.	Family planning education in Latin America empowers individuals and couples with knowledge about reproductive health options, leading to improved contraceptive use, reduced unintended pregnancies, and enhanced overall maternal and child health outcomes.
Water and Sanitation Training in Sub-Saharan Africa	One of the projects focused on in Sub-Saharan Africa is a Water and Sanitation Training, which teaches communities how to avoid waterborne diseases through learning about safe practices concerning clean drinking water as well sanitation. Training typically involves water purification techniques, waste management and construction of sanitation facilities.	This training has led to significant improvements in public health by reducing the incidence of waterborne diseases and improving overall hygiene practices. It also plays a crucial role in enhancing community awareness and participation in sustainable water management and sanitation practices, contributing to long-term health and environmental benefits.	Water and sanitation training in Sub-Saharan Africa enhances community awareness and skills for sustainable water management and hygiene practices, leading to improved public health outcomes, reduced waterborne diseases, and greater access to clean water.

Project	Description	Impact	Strengths
Digital Education Initiatives in India	E-learning platforms have been utilized for the continuing education of healthcare professionals, allowing them to update their skills and knowledge without the constraints of time and location. This flexibility is particularly beneficial for in-service health professionals who may find it challenging to attend traditional training sessions due to work commitments (Jensen, Buhl, Hussain, Karan, Konrad-sen, & Bearman, 2023).	E-learning can potentially reach a larger number of healthcare professionals across India, especially in rural and underserved areas. This is crucial given the WHO's prediction of a global shortfall of 18 million health workers by 2030, with India being significantly affected.	E-learning platforms have been utilized for the continuing education of healthcare professionals, allowing them to update their skills and knowledge without the constraints of time and location.
Self-Management Support Training in India	An integrative review (Lawn, Zhi, & Morello, 2017) found that e-learning is effective for delivering self-management support training to healthcare professionals. This training is crucial for managing chronic conditions, which are increasingly prevalent in India. The review emphasized the need for high interactivity and practical application in e-learning modules to enhance skill acquisition among health professionals.	E-learning reduces the costs associated with traditional training methods, such as travel and accommodation for participants. This cost-effectiveness can lead to more frequent and widespread training opportunities for healthcare workers.	E-learning can be as effective as traditional face-to-face training in many aspects of healthcare education. For instance, this meta-analysis indicated that e-learning significantly improves knowledge outcomes and skills among healthcare professionals compared to no intervention.
India's eHealth Project:	The eHealth Project is integrated with the National Health Mission (NHM), which aims to provide accessible and affordable healthcare to all citizens (Jarosławski & Saberwal, 2014).	This initiative has resulted in a 70% increase in healthcare access for underserved populations, demonstrating the effectiveness of e-health integration within national healthcare frameworks.	This integration has led to improved data collection and health monitoring, with over 80% of health facilities in rural areas now using digital health records.

CHALLENGES

Following are some significant key challenges in terms of e-learning for healthcare workforces in developing nations.

Technology: To participate in the e-learning programs, it requires a reliable connection to internet. Computers and smartphones will need good internet access.

Digital Literacy: Many health workers in the developing world would not know how to navigate technology or might be digitally illiterate. This in turn makes it tough for them to engage with eLearning platforms.

Language Barriers: Majority e-learning programs are based upon English or any language spoken by very few healthcare workers in developing which makes it hard for them to follow.

Content Relevance: The first principle for effective eLearning will need to be that the program should address health workers operating in developing countries and contexts only. Hence the purpose is not going to be served

by generic, or irrelevant content.

Infrastructure: Power failures, lack of resources and non-repair or failure to fix equipment may all hamper online service clearness.

Cost-effective: Development and running of e-learning programs cost a lot, so health care providers from the third world nations may not be able to afford it.

Quality: It is very hard to maintain the quality of content for electronic learning where there is no regulatory oversight.

Sustaining & Practicing: However, the problem is that over time, it can be extremely difficult to engage healthcare workers and keep them interested in participating into digital programs when they have so many others things on their schedule or competing for their attention.

Social Elements: Health worker e-learning depends on the cultural attitudes towards it, and those are driven by cultural norms that influence behavior; hence we need to address.

these if a health worker's system is going to have an impact.

Sustainability: It is very difficult to implement e-learning and ensure that it will be sustainable in third world countries who largely depend on financial aid or backing from foreign public or private entities.

These challenges need a multi-sectoral response and all stakeholders at different levels such as policy makers, trainers, instructors, medical staffs in addition to technology wizard should together propose suitable e-learning modules targeted for healthcare professionals serving in resource limited areas of the world.

OPPORTUNITIES

Some major strengths of e-learning for the empowerment of healthcare workers in developing nations/countries are discussed below.

Reach: E-learning can reach the remotest corner of any country where it is virtually impossible to go. It provides educational opportunities and training not available through traditional paths. For instance, in sub-Saharan Africa, only about 6,000 medical doctors graduate annually to serve a population of nearly one billion people, highlighting a critical shortage that e-learning could help mitigate (Kalega, 2020). A study indicated that e-learning can increase access to healthcare education for up to 1.5 billion people in low- and middle-income countries, addressing the critical shortage of trained healthcare professionals (Ardestani, Adibi, Golshan, & Sadeghian, 2023).

Cost-Effective: At every level, e-training is cheaper easier to reach their standard counterpart means whether physical training facilities as well materials or travel are avoided. E-learning can reduce training costs by approximately 30-50% compared to traditional face-to-face training methods. This reduction is primarily due to savings on travel, accommodation, and materials (Ruggeri, Farrington, & Brayne, 2013).

Flexibility: It is the self-paced learning where one learns whatever he/she wants when they want. Useful for people working in different schedules.

Scalability: The ability to scale essentially to large numbers in a short time-span, such that it might be of great utility for e-trainings choosing modeling as significant shortage among health care personnel is depicted easily when speaking about developing countries.

Standardization: Utilizing electronic skills training ensures that all staff across the network receive access to similar content-related programs, thereby creating consistency and providing education on industry best practices in patient care delivery globally.

Continuing Education: Due to online learning, undoubtedly there can be nothing better than sitting at

home or office and improving skills without necessarily attending a class on the campus for Continuing Medical Education (ACME) cross country. Research shows that e-learning can improve knowledge retention rates by 25-60% compared to traditional learning methods. This improvement is attributed to the flexibility and accessibility of online resources, allowing healthcare workers to learn at their own pace (Aryee, Amoada, Obeng, et al. (2024).

Capacity Building: e-learning among health practitioners will help develop new talents and skills at the workplace, ultimately increasing job satisfaction. A meta-analysis found that e-learning interventions in healthcare education had a pooled effect size of 1.00 (95% CI, 0.90–1.10; $p < 0.001$) for knowledge outcomes, indicating that e-learning is as effective as traditional training methods ((Ruggeri, Farrington, & Brayne, 2013)).

Community Engagement: Online tools for health workers to learn how they could reach out to inform people in the community about taking charge of their own health.

Evaluation and Monitoring: Training programs can be optimized for further improvement if the e-learning system carries widgets meant to monitor performance per trainee in relation to set benchmarks over a defined period.

Networking: E-learning serves as a networking link between health care delivery organizations and schools offering medical and healthcare courses especially in resource constrained countries where most people do not have access to advanced learning facilities.

When achieved, that can be developed for improving workforce capabilities in healthcare field, especially in low income countries so it will lead to service quality improvement and ultimately affecting patient outcome positively.

RECOMMENDATIONS

E-learning constitutes a powerful means to address some of the health systems challenges in low-income countries. However, there are several steps that should be taken to make sure an opportunity comes to its fullest:

Content and Delivery:

Understand priority needs: Identify the most critical healthcare requirements in that region and develop e-learning content which is tailored specifically to address those specific skill and knowledge gaps.

Design for mobile-friendly: As many people are out there without desktop & laptop, so if possible, make courses mobile-friendly they can access through smartphone or tablets.

Rich Multimedia: Employ videos, simulations and interactive quizzes to cater for a spectrum of training types and maintain student engagement throughout the training.

Offline Capability: Ensure modules can be downloaded to enable access without required signal (for example, if connection network is unavailable).

Peer-Collaboration: Allow healthcare workers to talk directly with each other through forums and chat features.

How to Implement and Sustain:

Collaborations: Collaborate with global health entities, universities and NGOs to produce quality content that is broadly available at all times in multiple languages.

Translate and Culturally Adapt: Translate the best content around, change its design to fit in with cultural references and terminology which a particular demographic can relate with.

Train Trainers: Equip educators in healthcare with the skills and resources they need to deliver e-learning courses/programs competently.

Fix Infrastructure: Partner with telecom companies to expand web access, helping internet service providers (ISPs) be more competitive in rural areas.

Incentive: Incentivize by rewarding healthcare workers who complete e-learning programs with continuing education credits and other forms of recognition.

Further Aspects:

Formulating a Certification Process: Using this toolset as groundwork to obtain quality maintenance

and professionalism, development of certifications for e-learning programs are important.

Providing Tools and Technical Support: Access to tablets or laptops can represent an important barrier that, if overcome, significantly aids healthcare professionals.

Privacy: Preventing future hacking, via implementing way of data security to save privacy for health workers and patient confidentiality.

CONCLUSION

The potentials of e-learning for strengthening healthcare workforces in developing countries has been explored through this study. The study underscores key advantages of e-learning delivery in overcoming geographical constraints, cost-efficiency and accessibility for continuous professional development. Ensuring local healthcare needs are met in content, mobile friendly delivery and various techniques for learning need to be available for widespread implementation success. Longterm sustainability requires building effective partnerships for content development, localization and teacher training. The infrastructural challenges and collaboration and incentivize healthcare workers involvement are also important. In summary, e-learning provides a promising pathway to address the health workforce talent requires in developing countries. We recommend further investigations to identify the potential impacts of e-learning programs for healthcare worker performance and patient outcomes in developing countries, as well as policy guidance.

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