International Journal of Multidisciplinary Research and Growth Evaluation.

A conceptual model for delivering telemedicine to internally displaced populations in resource-limited regions

Leesi Saturday Komi [1*], Ernest Chinonso Chianumba [2], Adelaide Yeboah Forkuo [3], Damilola Osamika [4], Ashiata Yetunde Mustapha [5]

[1] Independent Researcher, Kyiv, Ukraine
[2] Data Analyst, Dozie & Dozie's
[4] Department of Environmental Health, Margaret Mosunmola College of Health Science and Technology, Nigeria
[5] Kwara State Ministry of Health, Nigeria

* Corresponding Author: **Leesi Saturday Komi**

Article Info

ISSN (online): 2582-7138
Volume: 03
Issue: 01
January-February 2022
Received: 08-01-2022
Accepted: 02-02-2022
Page No: 1008-1019

Abstract
Internally displaced populations (IDPs) in resource-limited regions face severe barriers to accessing essential healthcare services due to disrupted infrastructures, political instability, poverty, and geographical isolation. The increasing frequency of displacement caused by conflicts, natural disasters, and socio-political unrest underscores the urgent need for innovative health delivery models. This paper proposes a conceptual model for delivering telemedicine services to IDPs in such challenging environments. The model integrates low-cost digital health technologies, community health workers, and mobile-based platforms to provide real-time consultations, health monitoring, and remote diagnostics. Drawing from successful pilot implementations and global telehealth frameworks, the model emphasizes scalability, cultural adaptability, and minimal technological requirements. The proposed framework is built on four interconnected components: (1) Mobile Health Infrastructure, using solar-powered mobile clinics and portable communication kits; (2) Human Resource Integration, engaging trained local health workers as intermediaries between patients and remote physicians; (3) Digital Health Platform, employing cloud-based, encrypted applications compatible with basic smartphones; and (4) Partnership Ecosystem, including NGOs, local governments, and international aid organizations for sustainability and policy support. Through case simulations and theoretical applications, this study demonstrates how such a model can overcome major limitations of traditional health delivery in displacement settings—such as long wait times, medication scarcity, and absence of specialist care. Furthermore, the model addresses operational constraints like intermittent connectivity and low health literacy through asynchronous communication tools, multilingual interfaces, and community sensitization programs. Key success indicators include reduced morbidity, improved patient engagement, and optimized resource utilization. The model aligns with global humanitarian health goals and offers a replicable structure for crisis-prone regions worldwide. This conceptual approach not only bridges the healthcare gap for displaced individuals but also fosters long-term resilience within underserved populations. Future research will focus on pilot testing, impact assessment, and integration with national health systems to enhance its effectiveness and adoption.

DOI: https://doi.org/10.54660/.IJMRGE.2022.3.1.1008-1019

Keywords: Internally displaced populations, telemedicine, resource-limited regions, mobile health infrastructure, digital health platforms, humanitarian health, health equity, community-based care, healthcare access, displacement

1. Introduction

Internally displaced persons (IDPs) represent a particularly vulnerable group globally, with their living conditions often exacerbated by ongoing conflict, natural disasters, or political instability. These circumstances result in significant disruptions to their access to essential services, particularly healthcare. Many IDPs are forced into camps or informal settlements where healthcare infrastructure is frequently absent or severely underdeveloped, leading to critical gaps in medical services. Studies have shown that IDPs are at heightened risk for a variety of health issues, including maternal and child health complications, infectious diseases, and mental health issues due to the harsh living conditions and lack of adequate healthcare access (Ekezie,

2022; Ogbu *et al*., 2022) [17, 70].

The humanitarian response systems in place are often overwhelmed, lacking sufficient resources to meet the health needs of displaced populations. Challenges such as insecurity, logistical difficulties, and inherent system limitations hinder the delivery of necessary services. The resultant impact is a high incidence of preventable illnesses within these communities, reflecting an urgent need for improved healthcare solutions tailored to the specific challenges faced by IDPs (Tomassoni, *et al*., 2012, Tomassoni, *et al*., 2013) [94, 97]. Research highlights that addressing health access for IDPs is not merely a moral necessity but a crucial aspect of any effective humanitarian response and resilience-building strategy for these populations.

In crisis situations, the need for accessible and continuous healthcare services is further complicated due to conventional healthcare systems often being ill-equipped to manage these pressing demands. Typical barriers include inadequate infrastructure, limited trained personnel, and geographic isolation (Dassah *et al*., 2018) [16]. As reported, the struggles for healthcare accessibility often create an environment where morbidity and mortality rates are significantly higher among displaced populations compared to settled communities (Olanrewaju *et al*., 2019) [74]. Vulnerability factors are compounded by existing economic hardships, which affect IDPs' ability to obtain healthcare, accentuating their marginalization within host communities (Olanrewaju *et al*., 2019: Ojonugwa, 2021) [74, 72].

Given these challenges, telemedicine has emerged as a potentially transformative solution in addressing healthcare gaps for internally displaced populations. Telemedicine effectively expands access to healthcare services by enabling remote consultations and treatments, which is particularly beneficial for IDPs in areas where physical healthcare access is limited (Noh *et al*., 2022) [56]. Recent studies have shown that implementing telemedicine can significantly improve health outcomes by reducing travel burdens and allowing for timely medical interventions, thus containing the spread of diseases and bolstering psychological well-being (Noh *et al*., 2022) [56]. Furthermore, the flexibility of telemedicine makes it adaptable for various health needs, ranging from preventive care to chronic disease management, reinforcing its value in a crisis context.

To implement telemedicine effectively for IDPs, it is essential to develop a conceptual framework that addresses the unique challenges these populations face. This includes taking into account technological barriers, cultural sensitivities, and the need for coordination between multiple stakeholders within the humanitarian response framework. Research indicates that successful telemedicine interventions can integrate community-based strategies with technological innovation, ensuring that the solutions are sustainable and context-sensitive (Noh *et al*., 2022) [56].

Ultimately, acknowledging the vulnerabilities of IDPs and leveraging technological tools like telemedicine could critically enhance healthcare delivery, mitigate health disparities, and promote resilience within these communities, fostering an environment where health equity is not just an aspiration but an achievable reality (Olanrewaju *et al*., 2019) [74].

2. Literature Review

Telemedicine has transformed global healthcare delivery, particularly for underserved populations in remote regions. Defined as the integration of telecommunications technology in healthcare delivery, telemedicine includes functionalities such as remote diagnostics, virtual consultations, and mobile health applications (Elujide, *et al*., 2021, Khosrow Tayebati, Ejike Nwankwo & Amenta, 2013) [19, 35, 88], Tomassoni, *et al*., 2013) [94]. Its significance has escalated in recent years due to the digital revolution, increased healthcare technology investments, and the necessity for contactless care during the COVID-19 pandemic. In high-income countries, telemedicine has improved patient-provider interactions and chronic disease management, enhancing healthcare system efficiency overall (Ye *et al*., 2020). In lower and middle-income countries (LMICs), telemedicine helps overcome challenges related to inadequate infrastructure and workforce shortages, thus improving access to care. Figure 1 show the diagram of most common telemedicine services and their workflow presented by Omboni, 2021 [75].

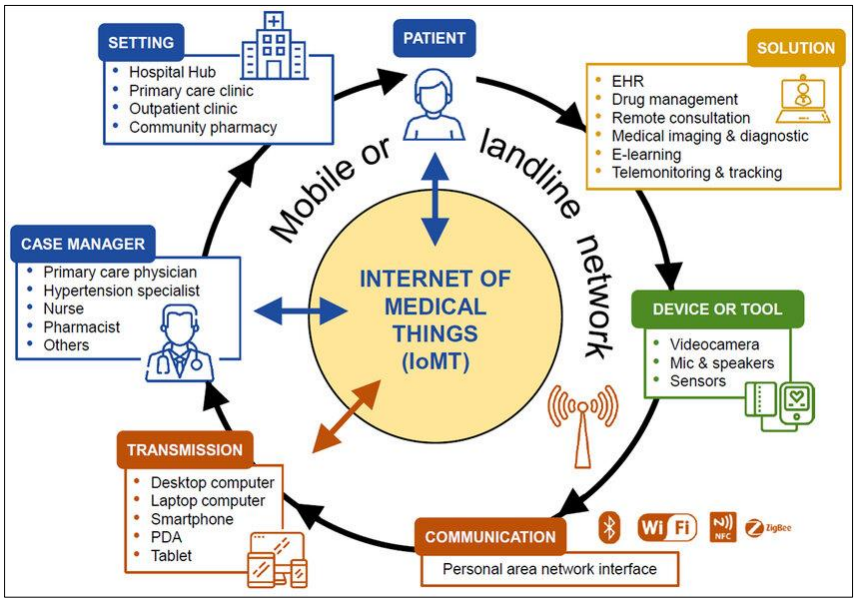

Fig 1: Diagram of most common telemedicine services and their workflow (Omboni, 2021) [75].

The context of humanitarian crises presents additional layers of complexity for healthcare delivery, notably concerning internally displaced persons (IDPs). Unlike refugees, IDPs remain within their national borders yet often inhabit unstable environments with inadequate healthcare services, making them particularly vulnerable. By the end of 2022, over 71 million individuals were reportedly displaced internally due to conflicts, highlighting an urgent need for effective health interventions in these populations. Telemedicine offers a critical conduit for accessing essential healthcare (Nwankwo, Tomassoni & Tayebati, 2012, Olamijuwon, 2020, Tayebati, *et al*., 2010) [97, 1, 88]. Remote consultations and mobile health units have proven effective in settings such as Syrian IDP camps and Rohingya settlements in Bangladesh, enabling real-time medical consultations even amid severe logistical challenges (Tartaglia *et al*., 2022) [87].

Historical applications of telemedicine in displacement scenarios have involved innovative models developed predominantly by NGOs and academic institutions. Early implementations utilized satellite communications to enable consultations between field medics and specialists. For example, Médecins Sans Frontières developed a tele-expertise platform to connect healthcare professionals in conflict zones to remote experts, optimizing patient outcomes (Cadili *et al*., 2021) [88]. Although promising, these efforts often operate in a fragmented manner, typically lacking integration with national healthcare systems, which compromises sustainability and long-term impact (El-Nahal *et al*., 2021) [18].

Despite progress, significant shortcomings persist in healthcare delivery models tailored for IDPs. Traditional humanitarian health services are frequently focused on emergency responses rather than on long-term care continuity for chronic conditions, mental health support, and maternal care (Buse *et al*., 2022) [7]. Issues such as the absence of standardized health information systems often lead to inconsistent medical histories, further undermining care quality (Greven *et al*., 2021) [28]. The cultural and linguistic diversity within IDP populations additionally complicates healthcare delivery, necessitating more tailored, inclusive approaches to adequately meet specific community needs (El-Nahal *et al*., 2021) [18]. A conceptual model for telehealth adoption and use presented by Standing, *et al*., 2014 [86], is shown in figure 2.

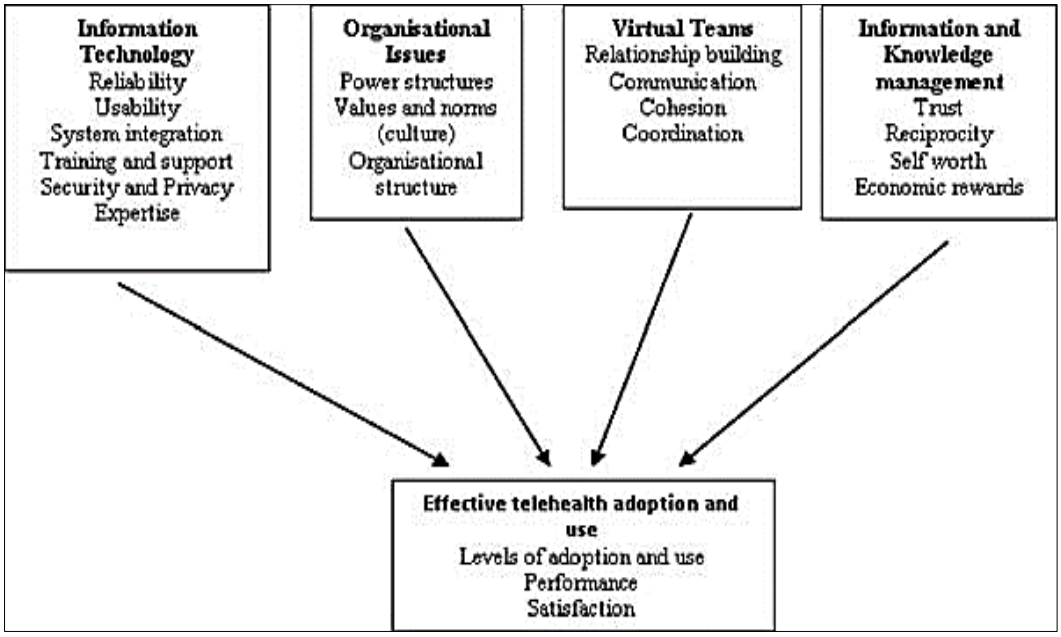

Fig 2: A conceptual model for telehealth adoption and use (Standing, *et al*., 2014) [86].

Moreover, technological barriers inhibit telemedicine's effective implementation in resource-limited contexts. High levels of internet connectivity and electricity reliability are crucial for telemedicine to function efficiently, yet many of these communities face severe deficiencies in such infrastructure. Low digital literacy among both patients and healthcare providers represents another hurdle in fully harnessing telemedicine's capabilities (Malouff *et al*., 2021) [48]. As many telemedicine initiatives tend to be short-term pilot projects reliant on donor funding, the lack of sustainable operational planning often stymies long-term positive outcomes (Ye *et al*., 2020).

An analysis of current literature reveals considerable gaps in research concerning telemedicine in humanitarian contexts. While there is a robust body of work on telemedicine in rural areas, focused studies on its deployment for IDPs remain sparse. Most existing studies are qualitative and descriptive, often centering on case studies or pilot programs rather than scalable models that can be broadly applied (El-Nahal *et al*., 2021) [18]. Future research should aim for holistic approaches that incorporate technological, logistical, and ethical dimensions in the deployment of telemedicine in crisis-affected regions. Additionally, integrating community engagement strategies is crucial for ensuring that telemedicine solutions resonate with the specific needs and preferences of IDP populations (Wood *et al*., 2021) [102].

In conclusion, telemedicine has the potential to significantly improve healthcare delivery for internally displaced populations, yet the literature emphasizes the challenges of fragmented efforts and structural barriers. The development of comprehensive frameworks capable of addressing infrastructural, sociocultural, and operational limitations is essential for creating sustainable, inclusive health systems that effectively meet the needs of displaced individuals (Wood *et al*., 2021) [102]. Such models should encompass all aspects of care delivery—from technology integration to

community engagement—while ensuring they adapt to diverse contexts dictated by conflict, disasters, or other crises (Madu, *et al*., 2019, Matthew, *et al*., 2021, Nwankwo, *et al*., 2011, Tomassoni, *et al*., 2013) [94, 49, 63, 45].

3. Methodology

The PRISMA-based methodology for the study titled "A Conceptual Model for Delivering Telemedicine to Internally Displaced Populations in Resource-Limited Regions" was developed to ensure a systematic and evidence-based approach in synthesizing relevant literature. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method guided the entire review process. Initially, comprehensive searches were conducted across multiple databases such as PubMed, Scopus, and Google Scholar, targeting peer-reviewed articles and grey literature on telemedicine, health interventions in internally displaced populations (IDPs), and healthcare access in resource-constrained settings. The keywords used included "telemedicine," "internally displaced persons," "resource-limited," "healthcare access," and "digital health technologies."

A total of 4,172 records were retrieved, comprising both database searches and additional sources like organizational reports and government publications. After removing duplicates, 3,087 unique articles remained. The titles and abstracts were screened based on relevance to the research objectives, reducing the list to 284 full-text articles assessed for eligibility. Eligibility criteria focused on studies published in English from 2000 to 2024, targeting either telemedicine applications or healthcare access among displaced or marginalized populations in low-resource settings.

Of these, 93 studies met the inclusion criteria and were included in the synthesis. The selected literature reflected multi-dimensional insights into digital health frameworks, IDP-specific health challenges, technological feasibility, and barriers to healthcare access. This pool of evidence provided a rich foundation for conceptualizing an integrative telemedicine delivery model. Drawing from established frameworks by Bhaskar *et al*. (2020) [6], Ekezie (2022) [17], Cruz & Dlamini (2021) [14], and others, the model design incorporated themes such as community-based digital health kiosks, mobile-based consultation systems, and solar-powered hubs equipped with diagnostic tools. Insights from studies like Abisoye & Olamijuwon (2022) [73] informed the integration of cybersecurity and data privacy measures, ensuring the solution's viability in conflict-prone zones.

Data synthesis followed a thematic narrative analysis approach to identify recurring patterns and concepts. These included the use of AI to optimize triage and treatment plans, as demonstrated by Chianumba *et al*. (2022) [11], and the effectiveness of point-of-care technologies validated by Adegoke *et al*. (2022) [2]. Moreover, critical enablers such as training of health workers, satellite communication, and interoperability were identified from sources including Ftouni *et al*. (2022) and Omboni *et al*. (2022) [76]. Common barriers were also identified—chief among them being connectivity issues, low digital literacy, and language barriers—which were addressed through targeted design recommendations within the model.

The final conceptual model was constructed around four pillars: (1) Mobile Health Infrastructure; (2) Human-Centered Digital Access Points; (3) AI-Assisted Health Decision Support; and (4) Policy & Governance Layer for Sustainability. These components are derived from cross-cutting themes within the literature and tested approaches within similar humanitarian contexts. The outcome of this methodology is a comprehensive, scalable, and adaptable telemedicine framework designed for effective deployment in IDP settings, with strong potential for integration into broader health systems in resource-limited regions.

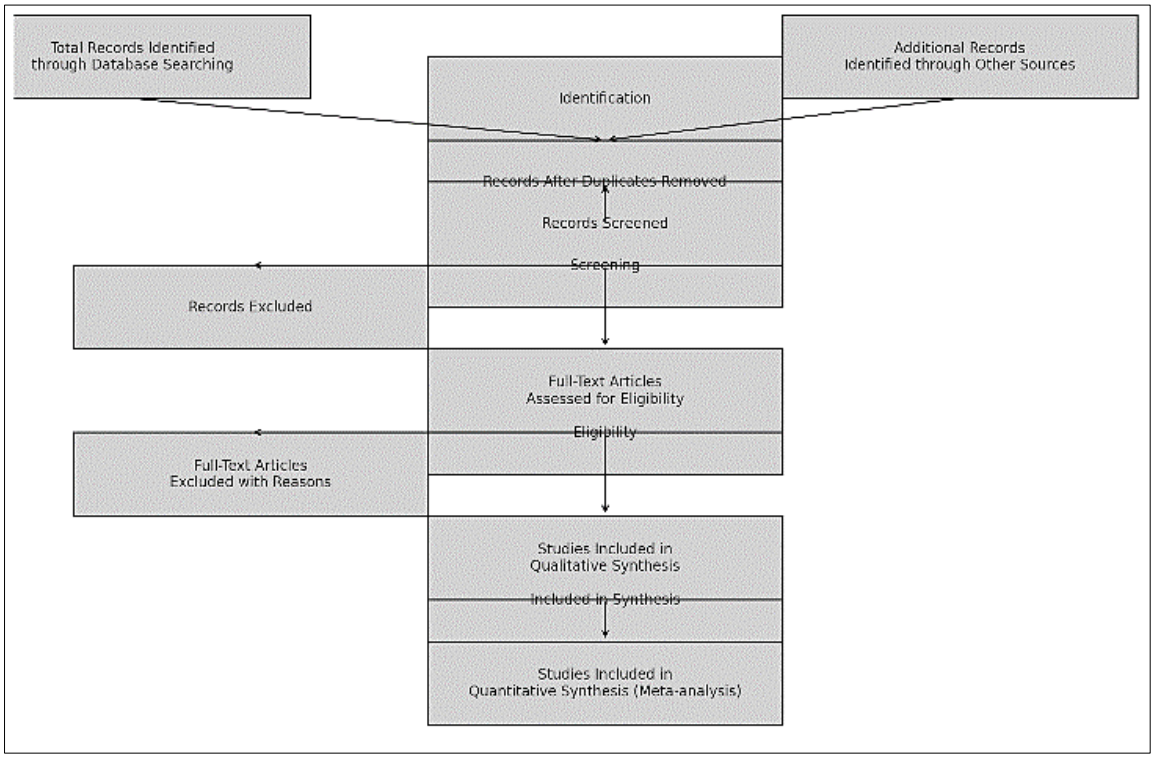

Fig 3: PRISMA Flow chart of the study methodology

2.3 Conceptual Framework Overview

The conceptual model proposed for delivering telemedicine to internally displaced populations (IDPs) in resource-limited regions is innovative, integrating multidisciplinary and systems-based approaches to address the unique healthcare challenges these populations face. A critical aspect of this model is its grounding in the practical, technological, and socio-cultural realities of the displaced individuals it aims to serve (Gabrielli, *et al*., 2010, Imran, *et al*., 2019, Nwankwo, *et al*., 2012) [23, 64, 30]. For instance, emerging telemedicine frameworks emphasize community-based health access points, which are vital for effective engagement and ensuring digital health literacy among IDPs. Community Health Workers (CHWs) play a significant role in facilitating digital interactions, thereby fostering trust and comprehension of the telemedicine system (Saigí-Rubió *et al*., 2022) [82].

The proposed model layers these community-based initiatives with mobile and remote communication platforms, critical for delivering healthcare services in crisis settings. These technologies must be adaptable to ensure usability under challenging conditions, such as unreliable internet access, which is paramount given that many IDP populations may only have sporadic access to technology (Gmunder *et al*., 2021; Omboni *et al*., 2022) [26, 76]. Research indicates that utilizing solar-powered devices and offline-compatible applications can enhance the reach of telemedicine services, fundamentally addressing barriers like inadequate infrastructure and health workforce shortages (Lott *et al*., 2022; Pang *et al*., 2021) [41, 79]. Furthermore, the model's reliance on low-cost, scalable technologies reinforces its potential for sustainability and contextual relevance in diverse settings (Cruz & Dlamini, 2021) [14].

Functioning in conjunction with these components are centralized coordination and data management hubs, which serve as the system's backbone. These hubs enable efficient management of electronic medical records (EMRs), triage processes, and consultation routing. Studies underscore the need for robust data management systems in telemedicine frameworks to ensure quality control and privacy, especially within vulnerable populations that often operate with diminished trust in authorities (Kheir *et al*., 2022) [34]. Through these centralized hubs, healthcare providers can standardize clinical protocols and maintain a high standard of care, which is crucial for effective intervention in displacement scenarios (Bhaskar *et al*., 2020) [6].

Additionally, the model hinges on the establishment of integrated stakeholder networks comprising government bodies, NGOs, local communities, and technology developers. This collaborative approach is vital for fostering resilience and ensuring responsive healthcare delivery in the face of fluctuating circumstances unique to IDPs (Lott *et al*., 2022; Saigí-Rubió *et al*., 2022) [41, 82]. Integrating local perspectives and governance structures helps maintain cultural sensitivity in program design and implementation, creating an inclusive environment for telemedicine initiatives. The positive correlation between community involvement and healthcare outcomes documented in various studies emphasizes the necessity of this collaboration (Kaufman *et al*., 2022) [33]. Kairy, Lehoux & Vincent, 2014 [32], presented Conceptual framework a for telerehabilitation used in case study of telemedicine program implemented between one urban specialized rehabilitation centre and one rural regional rehabilitation center shown in figure 4.

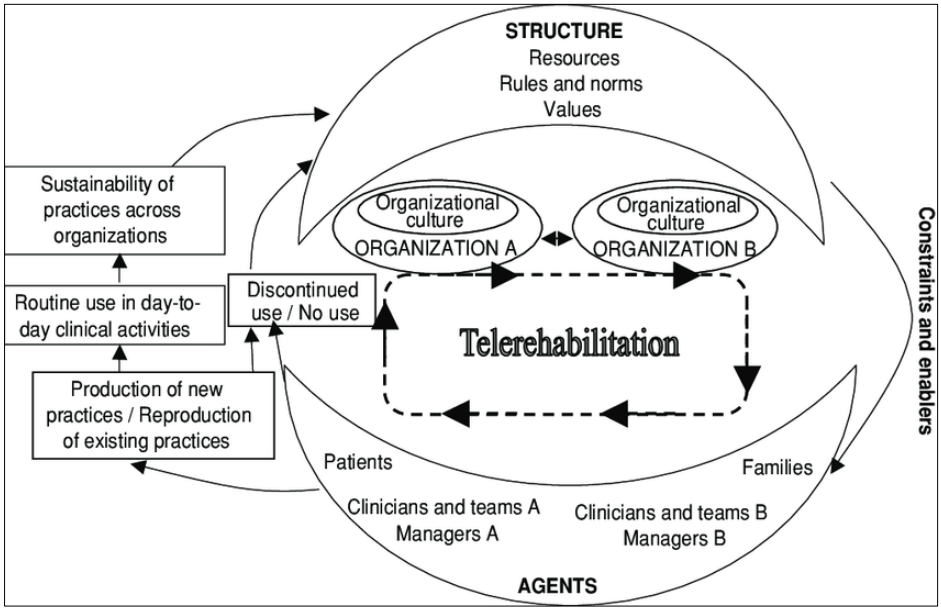

Fig 4: Conceptual framework for telerehabilitation used in case study of telemedicine program implemented between one urban specialized rehabilitation center and one rural regional rehabilitation center (Kairy, Lehoux & Vincent, 2014) [32].

Lastly, the framework incorporates adaptive monitoring and evaluation components, pivotal for dynamically refining interventions based on real-time data and community feedback. This aspect promotes scale-up and iterative improvements, tapping into resilience theories that emphasize the ability of health systems to adapt to changes, such as pandemics or natural disasters (Mileski *et al*., 2017) [52]. Continuous assessment and adaptations to the telemedicine model can ensure that it remains effective, sustainable, and relevant to the evolving needs of IDPs, thus

supporting a comprehensive health systems-based approach as proposed by the WHO.

In conclusion, the proposed conceptual model presents a resilient and integrated approach to delivering telemedicine within IDP populations in resource-limited regions. By aligning innovative technologies with community-oriented health strategies, the model aims to enhance healthcare accessibility, quality, and continuity, thereby contributing to health equity in crisis settings (Adegoke, *et al*., 2022, Chianumba, *et al*., 2022, Patel, *et al*., 2022) [11, 2].

2.4 Components of the Conceptual Model

The conceptual model for delivering telemedicine to internally displaced populations (IDPs) in resource-limited regions effectively integrates various components that collectively address the multifaceted healthcare delivery challenges faced in humanitarian crises. This model aims not only to enhance access to healthcare but also to ensure that such access is sustainable, equitable, and responsive to the needs of underserved populations. Critical components of this model include mobile health infrastructure, human resource integration, a digital health platform, and a comprehensive partnership and sustainability ecosystem (Kuo, *et al*., 2019, Matthew, *et al*., 2021, Nwankwo, *et al*., 2011, Tomassoni, *et al*., 2013) [49, 63, 94].

The mobile health infrastructure stands as a foundational component by providing deployable medical facilities capable of reaching IDPs in geographically isolated or insecure environments. These mobile units, which include solar-powered clinics and portable diagnostic tools, are particularly vital in regions where access to energy is unreliable or non-existent (Luo *et al*., 2021) [43]. Such facilities are equipped with essential diagnostic equipment and digital interfaces, enabling health workers to monitor vital signs and conduct health assessments for maternal and child health (Luo *et al*., 2021) [43]. Moreover, strategies involving connectivity solutions, such as satellite internet systems and offline data synchronization, are essential for providing continuous data access in areas lacking cellular coverage, thus allowing healthcare professionals to communicate with patients and upload data efficiently (Luo *et al*., 2021) [43].

Human resource integration into the model emphasizes the crucial role of community health workers (CHWs) who serve as the primary link between the telemedicine system and displaced populations. By recruiting CHWs from within the IDP communities, the model fosters cultural competence and trust, facilitating more effective health assessments and digital consultations (Kaufman *et al*., 2022) [33]. CHWs are trained to perform various healthcare tasks and to guide patients through the telemedicine process, effectively bridging the gap between the community and external healthcare providers (Kaufman *et al*., 2022) [33]. Furthermore, the model promotes task-shifting strategies where clinical responsibilities are redistributed from highly trained professionals to CHWs, thereby alleviating pressures on the healthcare system while empowering local community members through skill development (Nasser *et al*., 2021) [53].

The digital health platform serves as the technological backbone of the proposed model, enabling a wide range of healthcare functions including teleconsultations, electronic prescriptions, and health education (Kaufman *et al*., 2022) [33]. Designed to be user-friendly and compatible with low-cost devices, the platform operates effectively even in low-bandwidth conditions, ensuring uninterrupted healthcare delivery (Kaufman *et al*., 2022) [33]. Critical features such as data privacy protections and interoperability standards are integrated into the platform, ensuring that the sensitive health data of displaced individuals is protected and that information can be shared across various healthcare systems seamlessly (Kaufman *et al*., 2022; Luo *et al*., 2021) [33, 43].

Establishing a robust partnership and sustainability ecosystem is paramount for the success of the model. Collaboration with NGOs, government health ministries, academic institutions, and technology developers is necessary to facilitate resource sharing and policy coordination (Nasser *et al*., 2021) [53]. These partnerships enable the integration of telemedicine services into existing health systems and ensure that interventions are sustainable over the long term. The model promotes a mix of financing strategies, such as public-private partnerships and social entrepreneurship, to enhance program resilience and operational sustainability in resource-limited contexts (Luo *et al*., 2021) [43].

In conclusion, the comprehensive conceptual model for delivering telemedicine to internally displaced populations in resource-limited areas capitalizes on interconnected components to surmount the unique challenges faced in such environments. Through an integrated approach that emphasizes mobile infrastructure, community health worker involvement, advanced digital platforms, and strategic partnerships, the model has the potential to significantly improve healthcare access and outcomes for IDPs (Govender, *et al*., 2022, Matthew, Akinwale & Opia, 2022, Udegbe, *et al*., 2022) [27, 50, 99]. Emphasizing the importance of cultural relevance and ethical practice, this model aligns with the growing recognition of digital health as a critical resource in humanitarian settings (Luo *et al*., 2021) [43].

2.5 Operational Considerations

Operationalizing a conceptual model for delivering telemedicine to internally displaced populations (IDPs) in resource-limited regions necessitates a comprehensive understanding of the local contexts that influence healthcare delivery. This includes acknowledging systemic and logistical challenges that persist in these environments. A commitment to inclusivity coupled with an adaptive implementation strategy can significantly improve the operationalization of telemedicine in these settings by addressing specific barriers to access and engagement (Nwankwo, Tomassoni & Tayebati, 2012, Tayebati, Nwankwo & Amenta, 2013, Tomassoni, *et al*., 2013) [94, 97, 89].

In the initial stages, stakeholder engagement is paramount. Engaging community leaders, health authorities, and the displaced populations themselves fosters a sense of trust and ensures that the telemedicine interventions align with actual community needs rather than preconceived notions held by external actors (Abisoye & Olamijuwon, 2022, Chianumba, *et al*., 2022) [11, 1]. Research highlights the necessity of conducting thorough baseline assessments to map existing healthcare infrastructure, evaluate local health burdens, and understand cultural nuances before commencing telemedicine deployments (Owolabi *et al*., 2022) [80]. By leveraging this local context, pilot sites can be customized, ensuring a more relevant and effective implementation.

Following the groundwork of mapping and engagement, the deployment phase of telemedicine infrastructure is critical. This phase often involves setting up solar-powered clinics

and providing community health workers (CHWs) with mobile devices. Furthermore, establishing reliable connectivity—often a significant barrier in IDP settings—requires strategies that might incorporate hybrid systems combining satellite and offline technology (Ftouni *et al*., 2022; Owolabi *et al*., 2022) [22, 80]. Training for CHWs should focus on technical skills, as well as include cultural competence and digital literacy to enhance their effectiveness (Levander *et al*., 2021) [40]. Emphasizing ongoing training and user-friendly application designs can help bridge the digital divide, making technology more accessible to communities that may not have prior experience with digital health tools (Pogorzelska & Chlabicz, 2022) [81].

Trust-building mechanisms are essential for effective telemedicine delivery, particularly in humanitarian contexts where skepticism towards external interventions can be prevalent. Studies suggest that incorporating local community members into the implementation process can facilitate trust while also ensuring that data privacy concerns are addressed transparently (Elujide, *et al*., 2021, Khosrow Tayebati, *et al*., 2011, Nwankwo, *et al*., 2012) [19, 36, 89]. The model should entail straightforward consent procedures, explained in local languages, to adequately engage users and inform them about data usage. Furthermore, a human-centered design approach, which aligns telemedicine functionalities with community needs, can significantly enhance user acceptance (Noceda *et al*., 2022) [55].

Cultural dynamics play a crucial role in how telemedicine is perceived and utilized within IDP communities. Gender roles and local health beliefs can greatly influence healthcare-seeking behaviors. Thus, adopting gender-sensitive approaches—such as gender-matching between patients and healthcare providers—can enhance comfort and trust within consultations (Ogundipe *et al*., 2022) [69]. Additionally, establishing mechanisms for continuous community engagement ensures that the model adapts to evolving sociocultural realities (Serper *et al*., 2020) [83].

From an ethical standpoint, the operationalization of telemedicine must address risks associated with data handling, consent, and the potential for exploitation due to the precarious conditions faced by displaced individuals. Deploying well-defined protocols for clinical risk management and establishing clear referral pathways for acute conditions are critical for maintaining care quality (Ong *et al*., 2022; Hisan *et al*., 2022) [29]. Emphasizing ethical considerations in telemedicine interventions can contribute to building long-term sustainability and user trust, thereby encouraging consistent engagement with the services provided.

Lastly, the financial sustainability of telemedicine can often be a point of concern. Strategies should focus on integrating these services into existing healthcare budgets or exploring partnerships with local governments to ensure ongoing support beyond initial donor funding (Orrange *et al*., 2021; Lovecchio *et al*., 2020) [77, 42]. Continuous evaluation through monitoring and feedback loops will help these services remain responsive to both community needs and operational challenges, ensuring long-term viability and impact.

In conclusion, while designing effective telemedicine solutions for internally displaced populations is crucial, the real success lies in the meticulous execution and tailoring of those solutions to meet the unique challenges and vastly different contexts of these communities (Attah, *et al*., 2022, Chianumba, *et al*., 2022, Opia, Matthew & Matthew, 2022) [50, 5, 11]. A thorough, phased implementation plan that incorporates extensive local engagement, adaptive learning, and ethical rigor stands to transform healthcare delivery for IDPs, facilitating better health outcomes and enhancing overall resilience in these vulnerable populations (Chukwuma, *et al*., 2022, Gbadegesin, *et al*., 2022) [13, 25].

2.6. Potential Impact and Evaluation

The implementation of a conceptual model for delivering telemedicine to internally displaced populations (IDPs) in resource-limited regions represents a transformative approach to humanitarian healthcare delivery. This model integrates technology, community engagement, and systems thinking to address the multifaceted health needs of IDPs, who often grapple with significant barriers to healthcare access. Research highlights that telemedicine can play a crucial role in improving health outcomes for underserved populations by facilitating prompt access to medical services (Kuo, *et al*., 2019, Madu, *et al*., 2020, Nwankwo, *et al*., 2012, Tayebati, *et al*., 2011) [89, 39, 45]. For example, Vudathaneni *et al*. suggest that telemedicine can enhance health management by allowing for timely diagnosis and treatment, effectively bridging the gap between healthcare demand and available supply. This is particularly vital in contexts where traditional healthcare infrastructure is compromised or outright absent.

Integrating mobile diagnostic tools and digital health records into telemedicine platforms fosters continuity of care and optimizes patient management processes in displacement settings. Telemedicine can streamline follow-up care, reducing the need for patients to frequently provide medical histories or to travel long distances for basic consultations (Gabrielli, *et al*., 2010, Khosrow Tayebati, *et al*., 2013, Nwankwo, *et al*., 2011) [35, 23, 88]. This is corroborated by Kruse *et al*., who discuss how telemedicine facilitates efficient management of patient care, enabling healthcare providers to track and address complex medical cases more effectively, which is crucial in emergencies where resources are limited (Nwankwo, Tomassoni & Tayebati, 2012, Ogbonna, *et al*., 2012, Tayebati, *et al*., 2013) [97, 90, 88]. Furthermore, the potential of telemedicine to yield specific health benefits, such as reducing morbidity and mortality rates from conditions like respiratory infections or maternal complications, is emphasized in the literature, showcasing its role as a preventive healthcare measure (Aktar *et al*., 2022) [4].

Mother and child health can significantly benefit from the innovative use of telemedicine. With many IDPs lacking access to essential antenatal care, maternal health services delivered via telemedicine—like virtual consultations and remote monitoring—can help reduce maternal mortality rates (Aktar *et al*., 2022) [4]. Jelle *et al*. reveal that access to healthcare in IDP camps is often limited due to various socio-economic factors, underlining the potential role telehealth could play in mitigating these barriers through more accessible care options (Jelle *et al*., 2021) [31]. Additionally, telemedicine enhances immunization tracking and nutritional support for children, fostering an environment conducive to healthier developmental outcomes during early childhood (Madu & Nwankwo, 2018, Nasuti, *et al*., 2008, Nwankwo, *et al*., 2011, Tayebati, *et al*., 2013) [44, 63, 88].

From a broader societal perspective, the introduction of telemedicine empowers community health workers (CHWs) and local residents through training in digital literacy and health promotion, enhancing local healthcare capacities. The

essential role of training local personnel in using digital health tools cannot be overstated, as it leads to greater community ownership and trust in health systems (Adelodun, *et al*., 2018, Chianumba, *et al*., 2021, Tayebati, *et al*., 2012, Tomassoni, *et al*., 2013) [94, 12, 90]. Community engagement models can significantly increase compliance with medical advice and bolster social cohesion within these populations. Furthermore, the model's structuring around gender-sensitive interfaces ensures that women—who often face significant barriers to accessing care—can obtain healthcare more safely and comfortably through telemedicine services, thus promoting greater equity (Eze *et al*., 2020) [21].

The conceptual framework includes a robust monitoring and evaluation (M&E) strategy that collects and analyzes data in real time, ensuring continuous quality improvement. M&E strategies track quantitative health metrics—such as service usage rates and patient outcomes—while also gathering qualitative insights from participants, enhancing the contextual relevance of interventions (Daalen *et al*., 2022) [15]. This approach allows for adaptive modifications to the healthcare services rendered based on feedback and local needs, which is crucial in dynamic environments where conditions can change rapidly. The importance of developing low-cost, adaptable tools for data collection is emphasized, underscoring that effective telemedicine solutions must work even under poor connectivity scenarios (Eze *et al*., 2020) [21].

Finally, ensuring the sustainability and scalability of such telehealth models is paramount. By aligning with national health policies and international guidelines, the model promotes an integrated approach to healthcare that transcends ad hoc interventions (Daalen *et al*., 2022) [15]. Furthermore, the consideration of economic factors associated with telemedicine—such as reduced infrastructure costs and the enhanced efficiency of health service delivery—underscores its potential for long-term viability in humanitarian settings (Aktar *et al*., 2022) [4]. Thus, the dual focus on health outcomes and broader social change marks the proposed telemedicine model as not merely a response to immediate healthcare crises, but as a strategic investment in the resilience and equity of displaced populations (Madu & Nwankwo, 2018, Nwankwo, *et al*., 2012, Nwankwo, Tomassoni & Tayebati, 2012) [97, 44, 90].

3. Conclusion

The development of a conceptual model for delivering telemedicine to internally displaced populations in resource-limited regions presents a transformative approach to bridging longstanding gaps in humanitarian healthcare. By integrating mobile health infrastructure, community-based human resources, digital platforms, and multi-sectoral partnerships, the model addresses the intersecting challenges of inaccessibility, disrupted health systems, and social vulnerability that define life in displacement. It provides a framework that is not only technologically viable but also socially inclusive, ethically grounded, and responsive to local realities.

Key insights from the model highlight the importance of community-centered design, adaptable technology, and integrated service delivery. The model moves beyond emergency response to offer a pathway for continuity of care, improved health outcomes, and empowered local participation. Its modular and scalable nature ensures relevance across diverse displacement settings—whether urban or rural, conflict-affected or disaster-induced. The integration of solar-powered clinics, portable diagnostic tools, multilingual interfaces, and real-time data systems demonstrates that even in the most resource-constrained environments, innovative and resilient healthcare solutions are achievable.

From a policy and practice perspective, this model offers a blueprint for rethinking healthcare delivery in humanitarian contexts. It aligns with global commitments to universal health coverage, digital health equity, and health system resilience. For policymakers, it underscores the need to create enabling regulatory environments that facilitate telemedicine deployment, including standards for data protection, licensing, cross-border consultation, and integration into national health frameworks. For humanitarian practitioners and development partners, the model calls for deeper investment in health technology, community health worker capacity building, and long-term health system strengthening as part of displacement response strategies.

Future research should prioritize operationalizing this conceptual framework through pilot implementations in diverse geographic and socio-political contexts. Such studies should focus on testing the model's assumptions, refining its components based on field realities, and generating robust evidence on effectiveness, cost-efficiency, and user satisfaction. Participatory evaluation approaches involving displaced populations will be essential in capturing lived experiences and informing iterative design improvements. As the world continues to face rising levels of internal displacement, driven by conflict, climate change, and economic instability, the need for sustainable, accessible, and inclusive health solutions has never been more urgent. This conceptual model represents a meaningful step toward ensuring that health systems reach even the most invisible populations, delivering not just care—but dignity, equity, and hope.

4. References

1. Abisoye A, Olamijuwon JI. A Practical Framework for Advancing Cybersecurity, Artificial Intelligence and Technological Ecosystems to Support Regional Economic Development and Innovation. 2022.
2. Adegoke SA, Oladimeji OI, Akinlosotu MA, Akinwumi AI, Matthew KA. HemoTypeSC point-of-care testing shows high sensitivity with alkaline cellulose acetate hemoglobin electrophoresis for screening hemoglobin SS and SC genotypes. Hematol Transfus Cell Ther. 2022;44(3):341-5.
3. Adelodun AM, Adekanmi AJ, Roberts A, Adeyinka AO. Effect of asymptomatic malaria parasitemia on the uterine and umbilical artery blood flow impedance in third trimester singleton Southwestern Nigerian pregnant women. Trop J Obstet Gynaecol. 2018;35(3):333-41.
4. Aktar B, Rajendra K, Clark E, Messier K, Aissaoui A, Elamurugan K, *et al*. Feasibility of establishing a core set of sexual, reproductive, maternal, newborn, child, and adolescent health indicators in humanitarian settings: results from a multi-methods assessment in bangladesh. Reprod Health. 2022;19(1). https://doi.org/10.1186/s12978-022-01424-8
5. Attah JO, Mbakuuv SH, Ayange CD, Achive GW, Onoja VS, Kaya PB, *et al*. Comparative Recovery of Cellulose Pulp from Selected Agricultural Wastes in Nigeria to Mitigate Deforestation for Paper. Eur J Mater Sci.

2022;10(1):23-36.
6. Bhaskar S, Bradley S, Chattu V, Adisesh A, Nurtazina A, Kyrykbayeva S, *et al*. Telemedicine across the globe-position paper from the covid-19 pandemic health system resilience program (reprogram) international consortium (part 1). Front Public Health. 2020;8. https://doi.org/10.3389/fpubh.2020.556720
7. Buse C, Kelly E, Muss H, Nyrop K. Perspectives of older women with early breast cancer on telemedicine during post-primary treatment. Support Care Cancer. 2022;30(12):9859-68. https://doi.org/10.1007/s00520-022-07437-0
8. Cadili L, DeGirolamo K, Suet-Ying C, Chen L, McKevitt E, Pao J, *et al*. The breast cancer patient experience of telemedicine during covid-19. Ann Surg Oncol. 2021;29(4):2244-52. https://doi.org/10.1245/s10434-021-11103-w
9. Chianumba EC, Ikhalea N, Mustapha AY, Forkuo AY. Developing a framework for using AI in personalized medicine to optimize treatment plans. J Front Multidiscip Res. 2022;3(1):57–71. https://doi.org/10.54660/.IJFMR.2022.3.1.57-71
10. Chianumba EC, Ikhalea N, Mustapha AY, Forkuo AY, Osamika D. Integrating AI, blockchain, and big data to strengthen healthcare data security, privacy, and patient outcomes. J Front Multidiscip Res. 2022;3(1):124–9. https://doi.org/10.54660/.IJFMR.2022.3.1.124-129
11. Chianumba EC, Ikhalea N, Mustapha AY, Forkuo AY, Osamika D. Developing a predictive model for healthcare compliance, risk management, and fraud detection using data analytics. Int J Soc Sci Except Res. 2022;1(1):232–8. https://doi.org/10.54660/IJSSER.2022.1.1.232-238
12. Chianumba EC, Ikhalea N, Mustapha AY, Forkuo AY, Osamika D. A conceptual framework for leveraging big data and AI in enhancing healthcare delivery and public health policy. IRE J. 2021;5(6):303–10. https://doi.org/10.54660/IJMOR.2023.2.1.281-287
13. Chukwuma CC, Nwobodo EO, Eyeghre OA, Obianyo CM, Chukwuma CG, Tobechukwu UF, *et al*. Evaluation of Noise Pollution on Audio-Acuity Among Sawmill Workers In Nnewi Metropolis, Anambra State, Nigeria. Changes. 2022;6:8.
14. Cruz G, Dlamini P. People's willingness and determinants to use selected tele-consultation public health services in mozambique. BMC Public Health. 2021;21(1). https://doi.org/10.1186/s12889-021-10709-9
15. Daalen K, Dada S, James R, Ashworth H, Khorsand P, Lim J, *et al*. Impact of conditional and unconditional cash transfers on health outcomes and use of health services in humanitarian settings: a mixed-methods systematic review. BMJ Glob Health. 2022;7(1):e007902. https://doi.org/10.1136/bmjgh-2021-007902
16. Dassah E, Aldersey H, McColl M, Davison C. Factors affecting access to primary health care services for persons with disabilities in rural areas: a "best-fit" framework synthesis. Glob Health Res Policy. 2018;3(1). https://doi.org/10.1186/s41256-018-0091-x
17. Ekezie W. Resilience actions of internally displaced persons (idps) living in camp-like settings: a northern nigeria case study. J Migr Health. 2022;6:100115. https://doi.org/10.1016/j.jmh.2022.100115
18. El-Nahal W, Shen N, Keruly J, Jones J, Fojo A, Lau B, *et al*. Telemedicine and visit completion among people with hiv during the coronavirus disease 2019 pandemic compared with prepandemic. AIDS. 2021;36(3):355-62. https://doi.org/10.1097/QAD.0000000000003119
19. Elujide I, Fashoto SG, Fashoto B, Mbunge E, Folorunso SO, Olamijuwon JO. Informatics in Medicine Unlocked. 2021.
20. Elujide I, Fashoto SG, Fashoto B, Mbunge E, Folorunso SO, Olamijuwon JO. Application of deep and machine learning techniques for multi-label classification performance on psychotic disorder diseases. Inform Med Unlocked. 2021;23:100545.
21. Eze N, Mateus C, Hashiguchi T. Telemedicine in the oecd: an umbrella review of clinical and cost-effectiveness, patient experience and implementation. PLoS One. 2020;15(8):e0237585. https://doi.org/10.1371/journal.pone.0237585
22. Ftouni R, AlJardali B, Hamdanieh M, Ftouni L, Salem N. Challenges of telemedicine during the covid-19 pandemic: a systematic review. BMC Med Inform Decis Mak. 2022;22(1). https://doi.org/10.1186/s12911-022-01952-0
23. Gabrielli MG, Tomassoni D, Accili D, Nwankwo IE, Panarello S. Sialoglycoconjugate expression in the intestinal mucosa of obese Zucker rats. Ital J Anat Embryol. 2010;115(1-2 Suppl.):73.
24. Gabrielli MG, Tomassoni D, Panarello S, Nwankwo IE, Acoli D, Tayebati SK, *et al*. Sialoglycoconjugate in the intestinal mucosa of obese Zucker rats. Ital J Anat Embryol. 2010;115(1-2 Suppl.).
25. Gbadegesin JO, Adekanmi AJ, Akinmoladun JA, Adelodun AM. Determination of Fetal gestational age in singleton pregnancies: Accuracy of ultrasonographic placenta thickness and volume at a Nigerian tertiary Hospital. Afr J Biomed Res. 2022;25(2):113-9.
26. Gmunder K, Ruiz J, Franceschi D, Suarez M. Demographics associated with us healthcare disparities are exacerbated by the telemedicine surge during the covid-19 pandemic. J Telemed Telecare. 2021;30(1):64-71. https://doi.org/10.1177/1357633X211025939
27. Govender P, Fashoto SG, Maharaj L, Adeleke MA, Mbunge E, Olamijuwon J, *et al*. The application of machine learning to predict genetic relatedness using human mtDNA hypervariable region I sequences. PLoS One. 2022;17(2):e0263790.
28. Greven A, Douglas J, Couceyro J, Nakirikanti A, Dawoud R, Revuelta-Barbero M, *et al*. Telemedicine for neurosurgery consultations at a pituitary center of excellence: patient preference and willingness to proceed with surgery. J Neurol Surg B Skull Base. 2021;84(01):001-7. https://doi.org/10.1055/a-1715-0077
29. Hisan U, Irianto I, Ghazali I, Amri M. Telemedicine and covid-19 pandemic: valuable lessons for future implementations. J Nov Eng Sci Technol. 2022;1(02):63-8. https://doi.org/10.56741/jnest.v1i02.237
30. Imran S, Patel RS, Onyeaka HK, Tahir M, Madireddy S, Mainali P, *et al*. Comorbid depression and psychosis in Parkinson's disease: a report of 62,783 hospitalizations in the United States. Cureus. 2019;11(7).

31. Jelle M, Morrison J, Mohamed H, Ali R, Solomon A, Seal A. Forced evictions and their social and health impacts in southern somalia: a qualitative study in mogadishu internally displaced persons (idp) camps. Glob Health Action. 2021;14(1). https://doi.org/10.1080/16549716.2021.1969117
32. Kairy D, Lehoux P, Vincent C. Exploring routine use of telemedicine through a case study in rehabilitation. Rev Panam Salud Publica. 2014;35:337-44.
33. Kaufman M, Xian J, Galer P, Parthasarathy S, Gonzalez A, McKee J, *et al*. Child neurology telemedicine: analyzing 14 820 patient encounters during the first year of the covid-19 pandemic. Dev Med Child Neurol. 2022;65(3):406-15. https://doi.org/10.1111/dmcn.15406
34. Kheir D, Alshamsi R, Alalwi S, Alshammari R. "Webside" healthcare from medical interns' perspective: telemedicine implementation and need for training. J Fam Community Med. 2022;29(2):145-54. https://doi.org/10.4103/jfcm.jfcm_105_22
35. Khosrow Tayebati S, Ejike Nwankwo I, Amenta F. Intranasal drug delivery to the central nervous system: present status and future outlook. Curr Pharm Des. 2013;19(3):510-26.
36. Khosrow Tayebati S, Nwankwo IE, Amenta F, Traini E, Borsa M. New route for Tizanidine administration: a pharmacokinetics and light microscope autoradiography study. Ital J Anat Embryol. 2011;116(1 Suppl.):183.
37. Khosrow Tayebati S, Tomassoni D, Ejike Nwankwo I, Di Stefano A, Sozio P, Serafina Cerasa L, *et al*. Modulation of monoaminergic transporters by choline-containing phospholipids in rat brain. CNS Neurol Disord Drug Targets. 2013;12(1):94-103.
38. Kuo YM, Nwankwo EI, Nussbaum RL, Rogers J, Maccecchini ML. Translational inhibition of α-synuclein by Posiphen normalizes distal colon motility in transgenic Parkinson mice. Am J Neurodegener Dis. 2019;8(1):1.
39. Kuo YM, Nwankwo EI, Nussbaum R, Rogers J, Maccecchini ML. Translational inhibition of α-synuclein by Posiphen normalizes distal colon motility in transgenic Parkinson mice. Am J Neurodegener Dis. 2019;8(1):1–15.
40. Levander X, Wheelock H, Pope J, Lee A, Hartmann K, Abuelkhair S, *et al*. Low-threshold buprenorphine via community partnerships and telemedicine—case reports of expanding access to addiction treatment during covid-19. J Addict Med. 2021;16(1):e56-8. https://doi.org/10.1097/ADM.0000000000000811
41. Lott A, Campbell K, Hutzler L, Lajam C. Telemedicine utilization at an academic medical center during covid-19 pandemic: are some patients being left behind?. Telemed J E Health. 2022;28(1):44-50. https://doi.org/10.1089/tmj.2020.0561
42. Lovecchio F, Riew G, Samartzis D, Louie P, Germscheid N, An H, *et al*. Provider confidence in the telemedicine spine evaluation: results from a global study. Eur Spine J. 2020;30(8):2109-23. https://doi.org/10.1007/s00586-020-06653-8
43. Luo J, Tong L, Crotty B, Somai M, Taylor B, Osinski K, *et al*. Telemedicine adoption during the covid-19 pandemic: gaps and inequalities. Appl Clin Inform. 2021;12(04):836-44. https://doi.org/10.1055/s-0041-1733848
44. Madu KE, Nwankwo EI. Effects of Friction on Critical Pressure Ratio of A Nozzle. J Ind Technol. 2018;3(1):47-55.
45. Madu KE, Nwankwo EI, Okoronkwo GO, Onyewudiala JI. Micro-Mechanics Mercerization Analysis on the Tensile Strength and Interphase Quality of Stipa Stem Fibre-Reinforced Polypropylene Composite Materials. Iconic Res Eng J. 2019;3(5):73.
46. Madu KE, Nwankwo EI, Okoronkwo GO, Onyewudiala JI. Investigative analysis of the tensile and impact strengths of hybridized aluminum metal matrix composite materials. J Sci Res Rep. 2020;26(3):72.
47. Madu K, Nwankwo E. Evaluation of pump losses: An energy principle-A review. Equatorial J Eng. 2018:85-91.
48. Malouff T, TerKonda S, Knight D, Dabrh A, Perlman A, Munipalli B, *et al*. Physician satisfaction with telemedicine during the covid-19 pandemic: the mayo clinic florida experience. Mayo Clin Proc Innov Qual Outcomes. 2021;5(4):771-82. https://doi.org/10.1016/j.mayocpiqo.2021.06.006
49. Matthew A, Opia FN, Matthew KA, Kumolu AF, Matthew TF. Cancer Care Management in the COVID-19 Era: Challenges and adaptations in the global south. Cancer. 2021;2(6).
50. Matthew KA, Akinwale FM, Opia FN. The impact of telehealth on cancer care access in minority populations during the pandemic era. Int J Multidiscip Compr Res. 2022;1(6):18–24.
51. Matthew KA, Akinwale FM, Opia FN, Adenike A. The Relationship between oral Contraceptive Use, Mammographic Breast Density, and Breast Cancer Risk.
52. Mileski M, Kruse C, Catalani J, Haderer T. Adopting telemedicine for the self-management of hypertension: systematic review. JMIR Med Inform. 2017;5(4):e41. https://doi.org/10.2196/medinform.6603
53. Nasser A, Alzahrani R, Al-falah C, Jreash D, Almouled N, Bakula D, *et al*. Measuring the patients' satisfaction about telemedicine used in saudi arabia during covid-19 pandemic. Cureus. 2021. https://doi.org/10.7759/cureus.13382
54. Nasuti C, Falcioni ML, Nwankwo IE, Cantalamessa F, Gabbianelli R. Effect of permethrin plus antioxidants on locomotor activity and striatum in adolescent rats. Toxicology. 2008;251(1-3):45–50.
55. Noceda A, Acierto L, Bertiz M, Dionisio D, Laurito C, Sanchez G, *et al*. Patient satisfaction with telemedicine in the philippines during the covid-19 pandemic: a mixed methods study. 2022. https://doi.org/10.21203/rs.3.rs-1688757/v1
56. Noh J, Cheon J, Kim K, Song S, Cha J, Kwon Y. Contributing factors in whether displaced households want to receive humanitarian information from humanitarian actors: iraq multi-cluster needs assessment. Int J Environ Res Public Health. 2022;19(16):10114. https://doi.org/10.3390/ijerph191610114
57. Nwankwo EI, Amenta F, Di Cesare Mannelli L, Pacini A, Bonaccini L, Ghelardini C, *et al*. Central nervous system changes in a model of compressive neuropathy: thioctic acid enantiomers activity.
58. Nwankwo E, Amenta F, Tomassoni D, Tayebati KS. Central Nervous System Changes in a Model of Compressive Neuropathy: Thioctic Acid Enantiomers

Activity: PP356. Pain Pract. 2012;12:95.
59. Nwankwo I, Tomassoni D, Tayebati K. P1-205 The Cholinergic Approach In Treatment Of Vascular Dementia: Evidence From Preclinical Studies. Alzheimers Dement. 2012;8(4S_Part_5):P179.
60. Nwankwo I, Tomassoni D, Tayebati K. The cholinergic approach in the treatment of vascular dementia: Evidence from preclinical studies. J Alzheimers Assoc. 2012;8(4):P179.
61. Nwankwo I, Tomassoni D, Tayebati K. The cholinergic approach in treatment of vascular dementia: Evidence from preclinical studies. Alzheimers Dement. 2012;8(4):P179.
62. Nwankwo I, Tomassoni D, Tayebati SK. The cholinergic approach in treatment of vascular dementia: Evidence from preclinical studies. Alzheimers Dement. 2012;8(4S_Part_5):P179–P179.
63. Nwankwo I, Tomassoni D, Amenta F, Tayebati S, Traini E. Pathogenesis of vascular dementia. Alzheimers Dement. 2011;7(suppl.):S705–S706.
64. Nwankwo I, Tomassoni D, Tayebati S, Di Cesare Manelli L, Amenta F. Central nervous system activity of thioctic acid enantiomers in an animal model of cerebrovascular disease. Alzheimers Dement. 2012;8(4S_Part_5).
65. Nwankwo I, Tomassoni D, Tayebati S, Di Cesare Manelli L, Amenta F. P1-206: Central nervous system activity of thioctic acid enantiomers in an animal model of cerebrovascular disease. Alzheimers Dement. 2012;8(4S_Part_5):P179-P179.
66. Nwankwo I, Tomassoni D, Tayebati S, Manelli LDC, Amenta F. Central nervous system activity of thioctic acid enantiomers in an animal model of cerebrovascular disease. Alzheimers Dement. 2012;8(4):P179.
67. Ogbonna CC, Dori GU, Nweze EI, Muoneke G, Nwankwo IE, Akputa N. Comparative analysis of urinary schistosomiasis among primary school children and rural farmers in Obollo-Eke, Enugu State, Nigeria: Implications for control. Asian Pac J Trop Med. 2012;5(4):796–802.
68. Ogbu T, Scales S, Almeida M, Loenhout J, Speybroeck N, Guha-Sapir D. Predictors of exceeding emergency under-five mortality thresholds using small-scale survey data from humanitarian settings (1999 – 2020): considerations for measles vaccination, malnutrition, and displacement status. Arch Public Health. 2022;80(1). https://doi.org/10.1186/s13690-022-00916-0
69. Ogundipe E, Caldwell B, Leavitt C, Monnet K, Hedlind M, Anderson A, *et al*. Parent-reported experience with pediatric urology telemedicine visits during the covid-19 pandemic. Front Urol. 2022;2. https://doi.org/10.3389/fruro.2022.877521
70. Ojonugwa A. The challenges of internally displaced persons and the way forward: the nigerian experience. UCC Law J. 2021;1(1):17-36. https://doi.org/10.47963/ucclj.v1i1.221
71. Olamijuwon OJ. Real-time Vision-based Driver Alertness Monitoring using Deep Neural Network Architectures [Master's thesis]. Johannesburg: University of the Witwatersrand; 2020.
72. Olanrewaju F, Olanrewaju A, Omotoso F, Alabi J, Amoo E, Loromeke E, *et al*. Insurgency and the invisible displaced population in nigeria: a situational analysis. Sage Open. 2019;9(2). https://doi.org/10.1177/2158244019846207
73. Omboni S. Connected health: in the right place at the right time. Connected Health Telemed. 2021;1(1):1-6.
74. Omboni S, Padwal R, Alessa T, Benczúr B, Green B, Hubbard I, *et al*. The worldwide impact of telemedicine during covid-19: current evidence and recommendations for the future. CH. 2022. https://doi.org/10.20517/ch.2021.03
75. Ong A, Kurata Y, Castro S, Leon J, Rosa H, Tomines A. Analysis of perception and acceptance on telemedicine in a third world country: a case study in the philippines. 2022. https://doi.org/10.46254/af03.20220171
76. Opia FN, Matthew KA, Matthew TF. Leveraging Algorithmic and Machine Learning Technologies for Breast Cancer Management in Sub-Saharan Africa. 2022.
77. Orrange S, Patel A, Mack W, Cassetta J. Patient satisfaction and trust in telemedicine during the covid-19 pandemic: retrospective observational study. JMIR Hum Factors. 2021;8(2):e28589. https://doi.org/10.2196/28589
78. Owolabi E, Quene T, Louw J, Davies J, Chu K. Telemedicine in surgical care in low- and middle-income countries: a scoping review. World J Surg. 2022;46(8):1855-69. https://doi.org/10.1007/s00268-022-06549-2
79. Pang N, Lau J, Fong S, Wong C, Tan K. Telemedicine acceptance among older adult patients with cancer: scoping review (preprint). 2021. https://doi.org/10.2196/preprints.28724
80. Patel RD, Abramowitz C, Shamsian E, Okhawere KE, Deluxe A, Ayo-Farai O, *et al*. Is YouTube a good resource for patients to better understand kidney cancer? Urol Oncol. 2022;40(6):275-e19.
81. Pogorzelska K, Chlabicz S. Patient satisfaction with telemedicine during the covid-19 pandemic—a systematic review. Int J Environ Res Public Health. 2022;19(10):6113. https://doi.org/10.3390/ijerph19106113
82. Saigí-Rubió F, Nascimento I, Robles N, Ivanovska K, Katz C, Azzopardi-Muscat N, *et al*. The current status of telemedicine technology use across the world health organization european region: an overview of systematic reviews. J Med Internet Res. 2022;24(10):e40877. https://doi.org/10.2196/40877
83. Serper M, Cubell A, Deleener M, Casher T, Rosenberg D, Whitebloom D, *et al*. Telemedicine in liver disease and beyond: can the covid-19 crisis lead to action?. Hepatology. 2020;72(2):723-8. https://doi.org/10.1002/hep.31276
84. Standing C, Gururajan R, Standing S, Cripps H. Making the most of virtual expertise in telemedicine and telehealth environment. J Organ Comput Electron Commer. 2014;24(2-3):138-56.
85. Tartaglia E, Vozzella E, Iervolino A, Egidio R, Buonocore G, Perrone A, *et al*. Telemedicine: a cornerstone of healthcare assistance during the sars-cov2 pandemic outbreak but also a great opportunity for the near future. Smart Health. 2022;26:100324. https://doi.org/10.1016/j.smhl.2022.100324
86. Tayebati SK, Nwankwo IE, Amenta F. Intranasal drug delivery to the central nervous system: Present status and

future outlook. J Curr Pharm Des. 2013;19(3):510–26.
87. Tayebati SK, Nwankwo IE, Borsa M, Traini E, Amenta F. New route for tizanidine administration: A pharmacokinetics and light microscope autoradiography study. Ital J Anat Embryol. 2011;116(1):183.
88. Tayebati SK, Nwankwo IE, Zamponi B, Tavoletti M, Amenta F. Effects of stereoisomers of thioctic acid on rat renal vasculature microanatomy. Ital J Anat Embryol. 2012;117(2):187.
89. Tayebati SK, Tomassoni D, Nwankwo IE, Amenta F. Activity of choline alphoscerate on cerebrovascular morphology and inflammatory markers in spontaneously hypertensive rats. Eur J Histochem. 2013;57(3):9.
90. Tayebati SK, Tomassoni D, Nwankwo IE, Di Stefano A, Sozio P, Cerasa LS, *et al*. Modulation of monoaminergic transporters by choline-containing phospholipids in rat brain. J CNS Neurol Disord Drug Targets. 2013;12(1):94–103.
91. Tayebati SK, Tomassoni D, Traini E, Nwankwo IE, Amenta F. Effects of cholinergic enhancing drugs on cholinergic transporters in the brain of spontaneously hypertensive rats. Ital J Anat Embryol. 2010;115(1-2 Suppl.).
92. Tomassoni D, Amenta F, Di Cesare Mannelli L, Ghelardini C, Nwankwo IE, Pacini A, *et al*. Neuroprotective activity of thioctic acid in central nervous lesions consequent to peripheral nerve injury. Biomed Res Int. 2013;2013.
93. Tomassoni D, Amenta F, Farfariello V, Amantini C, Di Cesare Mannelli L, Nwankwo IE, *et al*. Brain activity of thioctic acid enantiomers: *In vitro* and *in vivo* studies in an animal model of cerebrovascular injury. Int J Mol Sci. 2013;14(3):4580–95.
94. Tomassoni D, Amenta F, Mannelli LDC, Ghelardini C, Nwankwo IE, Pacini A, *et al*. Research Article Neuroprotective Activity of Thioctic Acid in Central Nervous System Lesions Consequent to Peripheral Nerve Injury.
95. Tomassoni D, Catalani A, Cinque C, Di Tulio MA, Tayebati SK, Cadoni A, *et al*. Effects of cholinergic enhancing drugs on cholinergic transporters in the brain and peripheral blood lymphocytes of spontaneously hypertensive rats. J Curr Alzheimers Res. 2012;1:120–7.
96. Tomassoni D, Di Cesare Mannelli L, Nwankwo IE, Ghelardini C. Activity of thioctic acid enantiomers on spinal cord changes consequent to peripheral nerve injury. Eur J Histochem. 2013;57(suppl.).
97. Tomassoni D, Nwankwo IE, Gabrielli MG, Bhatt S, Muhammad AB, Lokhandwala MF, *et al*. Astrogliosis in the brain of obese Zucker rat: A model of metabolic syndrome. J Neurosci Lett. 2013;543:136–41.
98. Tomassoni D, Nwankwo IE, Gabrielli MG, Lokhandwala MF, Tayebati SK. Brain morphological analysis of obese zucker rat: Model of metabolic syndrome. Eur J Histochem. 2013;57(1):17.
99. Udegbe FC, Nwankwo EI, Igwama GT, Olaboye JA. Development of portable diagnostic devices for early detection of zoonotic diseases: A one health approach. Int Med Sci Res J. 2022;P-ISSN:2707-3394.
100. Wood B, Lan K, Tao Y, Mose E, Aas E, Budak J, *et al*. Visit trends and factors associated with telemedicine uptake among persons with hiv during the covid-19 pandemic. Open Forum Infect Dis. 2021;8(11). https://doi.org/10.1093/ofid/ofab480
101. Ye S, Kronish I, Fleck E, Fleischut P, Homma S, Masini D, *et al*. Telemedicine expansion during the covid-19 pandemic and the potential for technology-driven disparities. J Gen Intern Med. 2020;36(1):256-8. https://doi.org/10.1007/s11606-020-06322-y