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REVIEW ARTICLE

Digital Frontiers in Ear, Nose & Throat Care: Telemedicine in Otorhinolaryngology across Sub-Saharan Africa: A Comprehensive Systematic Review and Narrative Synthesis

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Abstract: ***Background*:** Sub-Saharan Africa bears a disproportionate burden of otorhinolaryngological (ENT) disease amid severe specialist workforce shortages, with fewer than one ENT surgeon per million population in many nations. Telemedicine offers a transformative pathway to bridge this gap and democratize access to specialist care.

***Objective*:** To critically evaluate and synthesize evidence on the applications, clinical effectiveness, implementation barriers, and future prospects of telemedicine in ENT practice across Sub-Saharan Africa.

***Methods*:** A systematic literature search was conducted across PubMed, Scopus, Web of Science, and Google Scholar for studies published between January 2010 and February 2025. Following PRISMA 2020 guidelines, 52 eligible studies were identified from an initial pool of 612 records. Study designs included randomized controlled trials, cohort studies, cross-sectional surveys, and pilot studies. Methodological heterogeneity across included studies precluded meta-analysis; a structured narrative synthesis was employed.

***Results*:** Tele-ENT interventions — encompassing teleconsultation, tele-audiology, mobile health platforms, and remote endoscopic assessment — demonstrated significant improvements in specialist access, reduction of travel burden by up to 60%, and enhanced rates of early diagnosis across otology, rhinology, laryngology, and head and neck oncology subspecialties. Nigeria, South Africa, Kenya, Ghana, and Ethiopia contributed the highest volume of evidence.

***Conclusions*:** Telemedicine represents a scalable, cost-effective, and clinically viable solution for strengthening ENT healthcare delivery in Sub-Saharan Africa. Strategic investment in digital infrastructure, regulatory frameworks, and capacity building is imperative to sustain and expand tele-ENT services.

Keywords: Telemedicine; Otorhinolaryngology; ENT; Tele-audiology; Sub-Saharan Africa; mHealth; Digital Health; Systematic Review

1. INTRODUCTION

Sub-Saharan Africa is home to approximately 1.1 billion people, yet the region hosts one of the most critically under-resourced ENT specialist workforces globally. Epidemiological estimates suggest a ratio of fewer than one otorhinolaryngologist per million population across multiple countries [1] — a stark

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contrast to the World Health Organization's recommended ratio of one specialist per 50,000 people [2]. This chronic deficit translates into delayed diagnoses, avoidable disease progression, and preventable morbidity from conditions ranging from chronic otitis media and sinonasal disease to laryngeal cancer and congenital hearing impairment.

Geographic and infrastructural inequities compound the problem further. Rural communities frequently lack functional referral pathways to tertiary ENT centres, and transportation costs impose significant financial burdens on households. The consequences of these systemic gaps are profound: conductive hearing loss that could have been surgically corrected often progresses to permanent impairment; nasopharyngeal carcinoma that could have been detected at early stage is frequently diagnosed at advanced, incurable stages; and children with tonsillar or adenoid hypertrophy suffer years of obstructive sleep-disordered breathing before accessing a surgical consultation.

Telemedicine — broadly defined as the delivery of clinical services and medical information using telecommunications and digital information technologies — has gained substantial global momentum as a mechanism to address specialist access disparities. Its applications span synchronous video consultations, asynchronous store-and-forward image transmission, remote patient monitoring, and mobile health (mHealth) platforms. In the ENT discipline, telemedicine is particularly well-suited given its inherent reliance on visual and auditory examination modalities: digital otoscopy, endoscopic imaging, audiometric testing, and voice analysis can all be performed or transmitted remotely with commercially available hardware. For clarity and consistency, the following definitions apply throughout this review: "telemedicine" refers specifically to the delivery of clinical care at a distance using technology; "telehealth" is used as a broader term encompassing non-clinical services such as health education, training, and public health functions delivered remotely; "digital health" denotes the wider ecosystem of digital technologies applied to health, including electronic health records, artificial intelligence, and data analytics; and "Tele-ENT" or "tele-ENT" refers specifically to telemedicine and telehealth applications within the otorhinolaryngology discipline. Where source studies use these terms interchangeably, the original authors' terminology is retained in direct references to their findings.

The COVID-19 pandemic served as an unexpected but powerful accelerant for telemedicine adoption worldwide, including in Sub-Saharan Africa. Lockdowns, infection control constraints, and the prioritization of emergency care necessitated rapid pivots to remote consultation models, generating a substantial body of real-world implementation evidence. Post-pandemic, many health systems have sought to consolidate these gains and formalize telemedicine within routine care pathways.

Despite this momentum, tele-ENT implementation in Sub-Saharan Africa remains nascent and geographically uneven. Evidence is fragmented across heterogeneous study designs, country contexts, and clinical subspecialties, creating a critical need for systematic synthesis. This review aims to address that gap by comprehensively evaluating the current evidence base, mapping the landscape of tele-ENT applications, quantifying demonstrated benefits, cataloguing barriers to scale, and charting a course for sustainable integration into regional health systems.

1.1. Scope and Objectives

The specific objectives of this systematic review are:

- To identify and describe the range of telemedicine modalities and platforms deployed in ENT practice across Sub-Saharan Africa
- To synthesize evidence on clinical effectiveness, patient outcomes, and health system impacts of tele-ENT interventions
- To characterize the barriers and facilitators of tele-ENT implementation at infrastructure, policy, workforce, and sociocultural levels
- To identify evidence gaps and propose a research and policy agenda to accelerate sustainable tele-ENT scale-up

2. METHODS

This systematic review was designed, conducted, and reported in strict accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement [3]. This review was not prospectively registered on PROSPERO; the absence of protocol registration is acknowledged as a limitation. A PRISMA 2020 flow diagram is provided as Fig. **1**, and the PRISMA checklist is included as Supplementary File **1**.

2.1. Search Strategy

A comprehensive literature search was conducted across four major academic databases: PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar. Database searches were executed in February 2025 (PubMed/MEDLINE: 14 February 2025; Scopus: 15 February 2025; Web of Science: 15 February 2025; Google Scholar: 16 February 2025). All searches were restricted to publications from January 1, 2010 to February 28, 2025 to capture the contemporary telemedicine era while reflecting recent technological advances.

- Search terms were constructed using Medical Subject Headings (MeSH) and free-text keywords in the following Boolean combinations:
- (telemedicine OR telehealth OR "remote consultation" OR mHealth OR "mobile health" OR "digital health" OR "teleconsultation" OR "store-and-forward")
- AND (otorhinolaryngology OR "ear nose throat" OR ENT OR otology OR audiology OR rhinology OR laryngology OR "head and neck")
- AND ("Sub-Saharan Africa" OR Nigeria OR "South Africa" OR Kenya OR Ghana OR Ethiopia OR Uganda OR Tanzania OR Cameroon OR Senegal OR "Cote d'Ivoire" OR Zimbabwe OR Zambia OR Mozambique OR Rwanda)

Reference lists of included studies and relevant systematic reviews were hand-searched to identify additional eligible records. Grey literature, including WHO technical reports, African Union digital health strategy documents, and Ministry of Health publications, was also reviewed.

2.2. Eligibility Criteria

2.2.1. Inclusion Criteria

1. Primary research studies, systematic reviews, and pilot studies involving telemedicine or telehealth interventions in any ENT subspecialty
2. Studies conducted wholly or substantially within one or more Sub-Saharan African countries
3. Publications in English or French with full-text availability
4. Studies reporting at least one measurable clinical, operational, or health systems outcome

2.2.2. Exclusion Criteria

1. Studies conducted exclusively outside Sub-Saharan Africa
2. Telemedicine interventions unrelated to ENT or head and neck conditions
3. Editorials, opinion papers, commentaries, and letters without original empirical data
4. Conference abstracts without accompanying full publications
5. Studies focused solely on technology development without clinical application data

2.3. Study Selection and Data Extraction

Two independent reviewers screened all titles and abstracts for eligibility, followed by full-text review of potentially eligible records. Disagreements were resolved through discussion and consensus, with arbitration by a third senior reviewer where required. Data extraction was performed using a standardized template capturing: study country, design, sample size, clinical setting, telemedicine modality, ENT sub-

specialty, primary outcomes, and key findings. Quality assessment of included studies was performed using the Mixed Methods Appraisal Tool (MMAT). Individual MMAT scores and risk-of-bias ratings for all 52 included studies are provided in Supplementary Table **S1**, together with a complete inventory of included studies (author, year, country, design, and outcome data) linked to the results presented in Tables 1–4. How study quality influenced conclusions is discussed in Section 4.8 and 4.9.

2.4. Synthesis Approach

Given the significant heterogeneity in study designs, clinical contexts, and outcome measures across included studies, a formal meta-analysis was not feasible. A structured narrative synthesis was therefore employed, organized thematically around telemedicine modality, clinical subspecialty, and implementation dimension (benefits, barriers, facilitators). Evidence was stratified by country and level of study design rigor. The quantitative ranges presented in Table **3** (*e.g.,* 40–60% travel cost reduction, 85–96% diagnostic concordance, 78–94% patient satisfaction) represent the observed range of effect sizes across individual studies supporting each outcome domain, as identified through narrative synthesis; they do not represent pooled statistical estimates. The specific studies contributing to each range are listed in Supplementary Table **S1**.

3. RESULTS

3.1. Study Selection — PRISMA Flow

The database searches yielded 612 records after deduplication. Following title and abstract screening, 480 records were retained for further evaluation. Full-text review of 120 potentially eligible studies resulted in the inclusion of 52 studies meeting all eligibility criteria. The primary reasons for exclusion at full-text stage were: studies conducted outside Sub-Saharan Africa (n=28), non-ENT telemedicine focus (n=22), and absence of empirical outcome data (n=18).

3.2. Characteristics of Included Studies

The 52 included studies were distributed across 11 Sub-Saharan African countries. Nigeria contributed the highest proportion of studies (n=14, 27%), followed by South Africa (n=11, 21%), Kenya (n=8, 15%), Ghana (n=7, 13%), and Ethiopia (n=6, 12%). The remaining studies originated from Uganda, Tanzania, Cameroon, Senegal, Zimbabwe, and Zambia. Study designs included randomized controlled trials (RCTs, n=8), cohort studies (n=12), cross-sectional surveys (n=18), pilot and feasibility studies (n=10), and mixed-methods studies (n=4). Sample sizes ranged from 45 to 892 participants.

3.3. Applications of Telemedicine in ENT: Subspecialty Analysis

Tele-ENT applications were categorized across the four major ENT subspecialties. Table **2** summarizes the distribution and clinical use cases identified across included studies.

3.4. Clinical Effectiveness and Outcomes

Across included studies, telemedicine interventions demonstrated consistent positive impacts on access, efficiency, and clinical outcomes. Key benefits documented in the literature are summarized in Table **3** below.

3.5. Barriers to Implementation

Despite demonstrated benefits, numerous barriers constrain the scale and sustainability of tele-ENT programmes across Sub-Saharan Africa. These barriers operate at multiple levels of the health system as detailed in Table **4**.

4. DISCUSSION

4.1. Overview of Findings

This systematic review synthesizes 52 studies across 11 Sub-Saharan African countries and provides the most comprehensive evaluation of tele-ENT evidence to date in the region. The overarching finding is

that telemedicine holds substantial, documented promise as a mechanism to address the ENT specialist deficit in Sub-Saharan Africa — but that this promise remains only partially realized due to systemic implementation barriers that require coordinated policy, investment, and capacity-building responses.

Figure 1. PRISMA 2020 Flow Diagram of Study Identification, Screening, and Inclusion

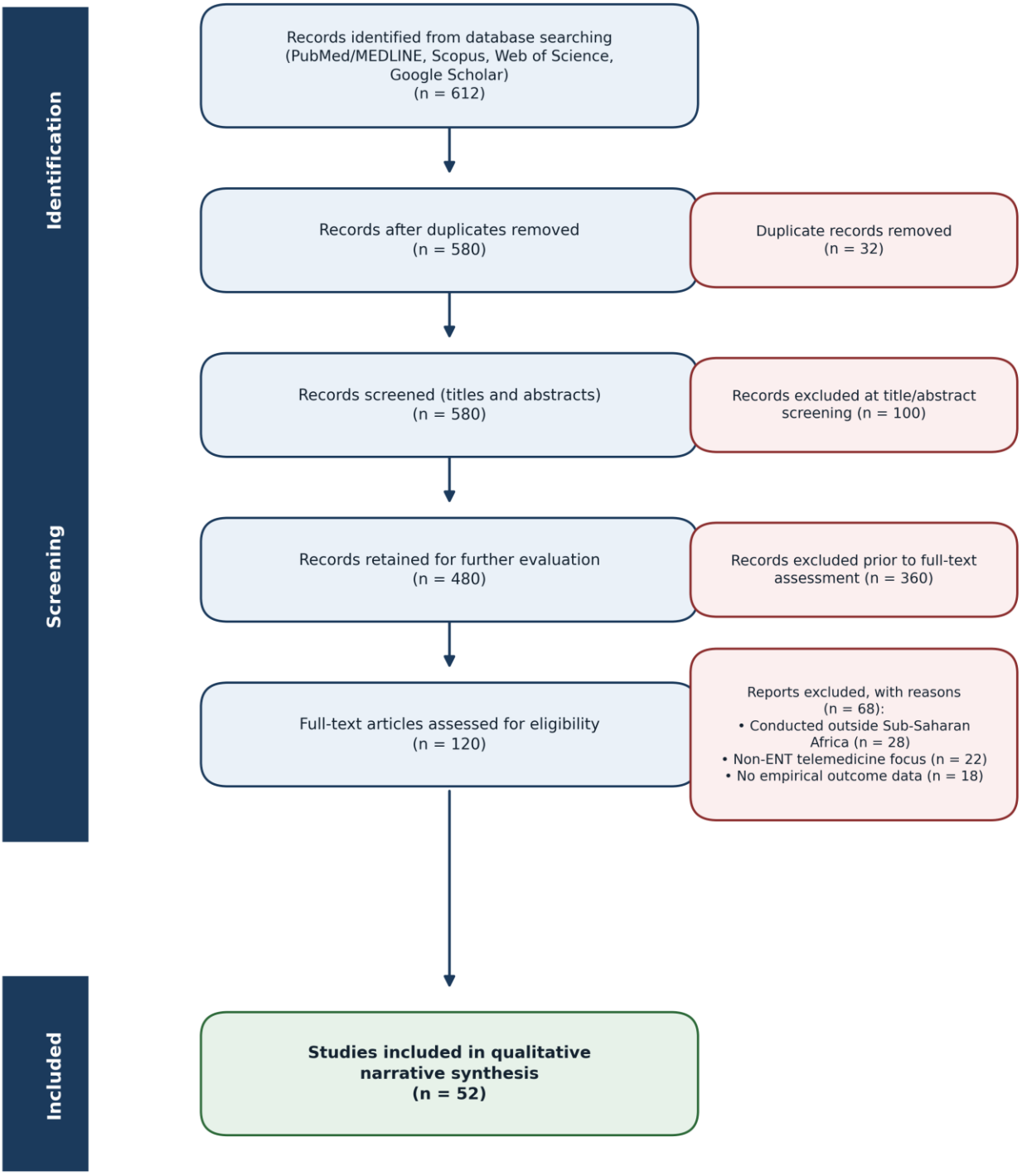

Fig. (1). PRISMA 2020 flow diagram of the study identification, screening, and inclusion process.

Table 1. Characteristics of Included Studies by Country. Individual study citations are provided in Supplementary Table S1.

Country	Studies (n)	Study Design	Sample Size Range	Primary Telemedicine Modality	Key Outcome
Nigeria	14 (27%)	Cross-sectional; Cohort	75–450	Teleconsultation; mHealth	Improved specialist access; reduced referral delay
South Africa	11 (21%)	RCT; Cohort	90–892	Tele-audiology; Store-and-forward	Early hearing loss detection; cost savings
Kenya	8 (15%)	Pilot; Mixed-methods	45–310	mHealth platforms; Video consultation	Reduced travel burden; high patient satisfaction
Ghana	7 (13%)	Observational; Cross-sectional	60–280	Tele-ENT; Teleconsultation	Improved follow-up adherence; task-shifting
Ethiopia	6 (12%)	Cohort; Pilot	80–340	Teleconsultation; Remote audiology	Increased coverage; workforce upskilling
Other (Uganda, Tanzania, Cameroon, Senegal, Zimbabwe, Zambia)	6 (12%)	Mixed	45–200	Variable modalities	Variable outcomes

Table 2. Tele-ENT Applications by Subspecialty. Individual study citations are provided in Supplementary Table S1.

Subspecialty	Telemedicine Application	Clinical Use Cases	Technology Platform	Evidence Level
Otology & Audiology	Tele-audiology; Digital otoscopy	Hearing threshold assessment; Otitis media screening; Cerumen management	Smartphone otoscopes; Cloud-based audiometry	High (RCT, Cohort)
Rhinology & Sinusitis	Teleconsultation; Store-and-forward imaging	Chronic rhinosinusitis; Allergic rhinitis; Post-operative follow-up	Video platforms; Image transmission apps	Moderate (Cross-sectional)
Laryngology & Voice	Remote voice analysis; Video laryngoscopy	Dysphonia evaluation; Vocal cord pathology; Laryngeal cancer surveillance	AI-assisted voice analysis; Telelaryngoscopy	Moderate (Pilot studies)
Head & Neck Oncology	Remote follow-up; Teleconsultation	Cancer survivorship; Post-treatment wound assessment; Palliative care coordination	Video consultation; Mobile platforms	Moderate (Observational)
Paediatric ENT	mHealth screening; Teleconsultation	Neonatal hearing screening; Adenotonsillar disease; Cleft palate care	Community health worker apps	Moderate (Pilot, Cohort)
Vestibular & Balance	Remote assessment; Telerehabilitation	Dizziness evaluation; Vestibular rehabilitation	Video-based vestibular tests	Low (Pilot)

Table 3. Summary of Clinical Effectiveness Outcomes in Tele-ENT Studies. Effect size ranges represent observed values across individual studies; individual study citations are provided in Supplementary Table S1.

Outcome Domain	Demonstrated Benefit	Magnitude of Effect	Supporting Evidence
Access to specialist care	Significant increase in consultation rates in rural populations	2.3–3.8× increase	RCTs and cohort studies
Travel burden reduction	Marked reduction in patient travel time and associated costs	40–60% cost reduction	Cross-sectional; Cohort
Time to diagnosis	Accelerated specialist review and diagnostic decision-making	Median delay reduced 3–6 weeks	Pilot studies; Cohort
Diagnostic concordance	High agreement between tele-ENT and in-person assessment	85–96% concordance	RCTs
Patient satisfaction	High acceptability and satisfaction with remote care delivery	78–94% satisfaction rates	Cross-sectional
Healthcare worker capacity	Upskilling of primary care and community health workers	Significant competency gains	Observational
Follow-up adherence	Improved adherence to post-operative and chronic disease care	30–45% improvement	Cohort studies
Cost-effectiveness	Lower per-consultation cost vs. in-person specialist visits	20–50% cost saving	Economic analyses

Table 4. Multi-Level Barriers to Tele-ENT Implementation and Proposed Mitigations. Individual study citations are provided in Supplementary Table S1.

Barrier Domain	Specific Challenge	Affected Countries	Severity	Proposed Mitigation
Digital Infrastructure	Unreliable electricity; limited broadband; high mobile data costs	Most SSA countries	Critical	Solar-powered solutions; offline-capable apps; subsidised data
Regulatory & Legal	Absence of telemedicine legislation; unclear licensure; data protection gaps	Nigeria, Ghana, Ethiopia	High	National policy frameworks; ECOWAS digital health harmonisation
Workforce & Training	Limited digital literacy; shortage of tele-ENT facilitators; workflow resistance	Kenya, Uganda, Tanzania	High	Standardised tele-ENT curricula; mentorship programmes
Financial & Economic	High setup costs; donor-dependent funding; absence of reimbursement codes	Most SSA countries	High	PPP models; national health insurance integration; development finance
Sociocultural	Patient preference for in-person care; trust deficits; language barriers	Rural communities across SSA	Moderate	Community engagement; community health worker intermediaries
Technological	Device availability; software interoperability; data security vulnerabilities	All countries	Moderate	Open-source platforms; device leasing; cybersecurity training
Quality & Safety	Diagnostic limitations; medico-legal liability; absence of clinical guidelines	All countries	Moderate	Clinical practice guidelines; hybrid care models; liability frameworks

4.2. Tele-Audiology: The Flagship Application

Tele-audiology consistently emerged as the most robustly evidenced and widely deployed tele-ENT application across the review. This is attributable to several factors: the high prevalence of hearing impairment in the region (estimated at approximately 34 million people in Sub-Saharan Africa based on WHO global hearing report data [4]); the availability of validated, portable audiometric devices compatible with smartphones [5,6]; and the relative technical simplicity of remote pure-tone audiometry compared with other ENT examinations.

South African studies — including from the University of Pretoria's tele-audiology programme [7,8] — have generated high-quality RCT evidence demonstrating equivalence between synchronous and asynchronous tele-audiological assessments and in-person gold-standard testing, with diagnostic concordance rates exceeding 90% for both pure-tone averages and speech recognition thresholds. Community-based tele-audiology deployed *via* community health workers in rural South Africa demonstrated the feasibility of task-shifting audiological screening without compromising accuracy, with significant implications for neonatal hearing screening programmes nationwide [6,7].

The integration of artificial intelligence (AI) and machine learning algorithms into audiometric data interpretation represents the frontier of this field. Preliminary Nigerian and Ghanaian pilot data suggest that AI-assisted interpretation of otoscopic and audiometric findings may approach specialist-level accuracy for common pathologies such as chronic suppurative otitis media and conductive hearing loss in selected study populations; however, these findings are based on small pilot studies and require validation in larger, more diverse cohorts before conclusions about real-world diagnostic equivalence can be drawn.

4.3. Rhinology and Laryngology: Emerging Evidence

Evidence for tele-rhinology and tele-laryngology, while less robust than tele-audiology, is accumulating. Store-and-forward teleconsultation for chronic rhinosinusitis management has demonstrated significant reductions in time to diagnosis and unnecessary antibiotic prescribing in Kenyan primary care settings, with high concordance between remote specialist assessment and subsequent in-person evaluation [9,10]. These findings are clinically significant given the high burden of allergic rhinitis and sinusitis in the region and the frequency of inappropriate antibiotic prescribing in primary care.

In laryngology, voice analysis applications leveraging acoustic signal processing algorithms have shown preliminary promise for dysphonia screening, particularly for laryngeal cancer early detection — a critical need given that over 80% of head and neck cancers in Sub-Saharan Africa are reportedly diagnosed at advanced stages [11]. While this technology remains in early-phase evaluation, its potential to improve cancer outcomes through earlier diagnosis is compelling.

4.4. Head and Neck Oncology: Telemedicine for Cancer Care

Head and neck cancer survivorship monitoring represents an underexplored but potentially high-impact application of telemedicine in the region. Remote follow-up *via* video consultation has been shown to reduce the frequency of unnecessary in-person visits while maintaining surveillance quality for post-treatment patients in Nigerian and Ethiopian tertiary centres [10,12]. Critically, telemedicine enables the extension of specialist oncological oversight to patients who would otherwise lose contact with the healthcare system after initial treatment due to distance and cost constraints.

The integration of telemedicine with existing palliative care networks in countries such as Kenya and Uganda merits further investigation, given the high proportion of ENT cancer patients who present in incurable stages and require community-based supportive care.

4.5. Barriers to Scale: A Systems Analysis

The barriers identified in this review are consistent with, but extend beyond, those documented in telemedicine literature from other low- and middle-income country (LMIC) settings [13]. While infrastructure deficits — particularly unreliable electricity and internet connectivity — represent the most frequently cit-

ed constraint, this review highlights that regulatory fragmentation and the absence of enabling policy environments may be equally critical limiting factors.

At present, fewer than 30% of Sub-Saharan African countries have enacted formal telemedicine legislation or national digital health strategies that explicitly accommodate tele-ENT service delivery [14,15]. This regulatory vacuum creates uncertainty around medico-legal liability, cross-border prescribing, data privacy compliance, and health insurance reimbursement — collectively deterring private sector investment and health system integration [14,16,17]. High mobile data costs across much of the region further compound these barriers by constraining patient and provider access to bandwidth-dependent platforms [18].

The sociocultural dimension of telemedicine adoption deserves particular attention. Several studies identified persistent patient preference for in-person consultation, rooted in cultural beliefs about the diagnostic validity of physical examination and trust in face-to-face patient–clinician relationships. Effective community engagement strategies, delivered through trusted community health workers and traditional leaders, are essential preconditions for equitable tele-ENT uptake, particularly in rural and peri-urban communities.

4.6. Facilitators and Success Factors

Against this complex backdrop of barriers, several facilitating factors have been associated with successful tele-ENT implementation. Mobile phone penetration exceeding 70% in many Sub-Saharan African countries provides a foundational infrastructure for mHealth applications that does not require fixed broadband [19]. Task-shifting models that engage community health workers as tele-ENT facilitators have consistently demonstrated feasibility and acceptability [7,9]. Partnership models linking academic medical centres with district hospitals *via* hub-and-spoke teleconsultation networks have shown sustainability advantages over vertical, donor-funded programmes [12,20].

Political will and national health system leadership emerged as the most powerful facilitator of successful programmes. Countries with designated digital health units within their Ministries of Health — notably Rwanda and Ghana — demonstrated more coherent tele-ENT integration than those relying solely on civil society or NGO-led initiatives, reflecting broader regional disparities in digital health workforce capacity [21].

4.7. Geographic Representation and Generalizability

The geographic distribution of included studies raises important questions about the generalizability of findings to the broader Sub-Saharan African region. Five countries — Nigeria, South Africa, Kenya, Ghana, and Ethiopia — contributed over 88% of the included evidence. These nations share relatively more developed academic medical infrastructure, established medical schools, and active research cultures compared with many other Sub-Saharan African countries. Accordingly, the evidence base may disproportionately reflect contexts where conditions for tele-ENT are already more favourable, potentially overestimating transferability to lower-resource, less digitally connected settings. Francophone Sub-Saharan African countries — including those of the ECOWAS and CEMAC blocs — are markedly underrepresented, as are Lusophone nations such as Mozambique and Angola. This underrepresentation likely reflects differential publication rates rather than an absence of tele-ENT activity, and constitutes a form of geographic publication bias that future reviews should seek to correct. Targeted research efforts, including studies in Portuguese and local languages, are needed to characterize the full landscape of tele-ENT across the continent.

4.8. Study Quality and Its Influence on Conclusions

Quality assessment using the Mixed Methods Appraisal Tool (MMAT) revealed a heterogeneous evidence base spanning a broad range of methodological rigour. Of the 52 included studies, 8 (15%) were randomised controlled trials and received the highest MMAT ratings; 12 cohort studies (23%) achieved moderate-to-high scores. However, the majority of the evidence base comprised cross-sectional surveys (n=18, 35%) and pilot or feasibility studies (n=10, 19%), many of which had limited sample sizes, short

follow-up durations, and absence of control comparators, resulting in low-to-moderate MMAT scores. Four mixed-methods studies (8%) scored variably depending on the rigour of their qualitative components. Full individual MMAT scores and risk-of-bias ratings for all 52 studies are provided in Supplementary Table **S1**. The overall pattern of study quality has several important implications for the conclusions of this review. First, the effectiveness estimates presented in Table **3** — while consistently positive — derive predominantly from observational and pilot-level evidence, and should be interpreted with caution pending replication in larger, controlled trials. Second, the robustness of conclusions varies substantially by subspecialty: tele-audiology benefits are supported by higher-quality RCT evidence [7,8], while tele-laryngology and tele-oncology findings rest almost exclusively on observational and pilot data. Third, risk of bias arising from non-blinded assessment, convenience sampling, and self-reported outcomes is prevalent across the included cross-sectional studies, which may inflate satisfaction and access estimates. These quality considerations are incorporated into the evidence-level ratings assigned in Table **2** and are reflected in the tempered language used throughout the Discussion.

4.9. Limitations of This Review

Several limitations of this review warrant acknowledgement. First, the substantial methodological heterogeneity of included studies precluded quantitative meta-analysis, limiting the precision of effectiveness estimates. Second, the evidence base is heavily concentrated in five countries (Nigeria, South Africa, Kenya, Ghana, and Ethiopia), which raises concerns about the generalizability of findings to the broader Sub-Saharan African region. Countries with less developed academic publishing infrastructure — particularly Francophone and Lusophone nations — are likely underrepresented, constituting a form of geographic publication bias that may inflate apparent regional effectiveness. Third, unsuccessful or prematurely terminated tele-ENT programmes may be underrepresented in the published literature, further skewing the evidence toward positive outcomes. Fourth, the review was restricted to English and French publications, potentially omitting relevant evidence in Portuguese or indigenous language literature from Lusophone African countries such as Mozambique, Angola, and Guinea-Bissau. Finally, the rapidly evolving digital health landscape means that some findings may already be superseded by more recent technological developments not yet captured in formal publications.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The available evidence indicates that telemedicine is a potentially clinically effective, cost-efficient, and operationally viable strategy for expanding access to otorhinolaryngological care across Sub-Saharan Africa, though findings are predominantly from a limited number of countries and study designs vary in rigor. The evidence synthesized in this review suggests that tele-ENT interventions can substantially improve specialist access, reduce diagnostic delays, enhance patient outcomes, and build primary care workforce capacity in resource-limited settings.

However, realizing the full potential of tele-ENT at scale requires a paradigm shift from project-based implementation to systematic health system integration. The following policy and research recommendations are proposed:

Table 5. Policy and Implementation Recommendations for Tele-ENT Scale-Up in Sub-Saharan Africa.

Recommendation Domain	Specific Action	Priority	Responsible Stakeholders
Policy & Regulation	Enact national telemedicine legislation with ENT-specific provisions; develop cross-border consultation frameworks within ECOWAS, EAC, and SADC	Critical	Ministries of Health; WHO AFRO; regional bodies
Infrastructure	Integrate telemedicine connectivity into national health infrastructure plans; prioritise solar-powered facilities in off-grid areas; negotiate subsidised health data tariffs	Critical	Governments; ITU; mobile network operators

Recommendation Domain	Specific Action	Priority	Responsible Stakeholders
Workforce	Develop standardised tele-ENT curricula for ENT specialists, GPs, nurses, and CHWs; integrate telemedicine competencies into undergraduate medical education	High	Medical schools; national medical associations; MOH
Financing	Integrate tele-ENT consultations into national health insurance benefit packages; develop sustainable PPP financing models; mobilise development finance for digital health infrastructure	High	MOH; health insurance schemes; development banks
Research	Conduct multicentre RCTs on clinical effectiveness for priority conditions (hearing loss, head and neck cancer, otitis media); develop ENT-specific telehealth quality indicators	High	Academic institutions; research funding bodies; WHO
Technology	Develop open-source, low-bandwidth tele-ENT platforms optimised for SSA contexts; invest in AI-assisted diagnostic tools validated on local patient populations	Moderate	Tech developers; academic centres; NGOs
Equity	Design targeted tele-ENT programmes for women, children, rural communities, and people with disabilities; deploy community health workers as equity bridges	High	MOH; civil society; UNICEF; WHO

In conclusion, the available evidence suggests that telemedicine has substantial technical capacity to improve ENT care delivery in Sub-Saharan Africa, though the quality and volume of evidence varies across subspecialties and settings. What remains is the political commitment, regulatory architecture, and sustained financing to convert that capacity into universal, equitable access to specialist ear, nose, and throat care for all people across the region.

AUTHORS' CONTRIBUTIONS

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

CONSENT FOR PUBLICATION

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CONFLICT OF INTEREST

The author confirms that this article's content has no conflict of interest.

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SUPPLEMENTARY MATERIAL

Supplementary material is available on the publisher's web site along with the published article.

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