International Journal of Dental Sciences & Research

Challenges in Providing Removable Prosthodontic Care in Rural African Settings: A Retrospective Analysis

Dr. Eric Kwasi Elliason, Post PhD Research Scholar, Kennedy University, St Lucia

Abstract

Access to quality dental prosthodontic services remains a significant challenge in rural African communities, where populations face multiple barriers to oral healthcare delivery. This retrospective analysis examines the multifaceted obstacles encountered in providing removable prosthodontic care across rural African settings, drawing from clinical data, healthcare reports, and population-based studies conducted between 2015 and 2024. The study identifies critical challenges including inadequate infrastructure, shortage of trained prosthodontists, limited material supply chains, socioeconomic barriers, and cultural factors that collectively impede the delivery of prosthodontic services. Through systematic examination of case records and healthcare facility data from nine African countries, this analysis reveals that only 12-18% of rural populations requiring prosthodontic intervention receive adequate treatment. The findings underscore the urgent need for policy interventions, innovative service delivery models, and capacity-building initiatives to address the growing burden of edentulism in underserved African communities. This research contributes to the broader discourse on oral health equity and provides evidence-based recommendations for improving prosthodontic care accessibility in resource-limited settings.

Keywords: Removable prosthodontics, rural healthcare, dental services, Africa, edentulism, healthcare accessibility, oral health equity

1. Introduction

The provision of removable prosthodontic care represents a fundamental component of comprehensive oral healthcare, yet millions of individuals in rural African settings continue to experience significant barriers to accessing these essential services. Prosthodontic treatment, particularly the provision of complete and partial dentures, plays a crucial role in restoring masticatory function, improving nutritional intake, enhancing speech articulation, and contributing to overall quality of life among edentulous and partially edentulous populations. Despite the recognized importance of prosthodontic rehabilitation, the delivery of such services in rural African contexts remains profoundly challenging, characterized by systemic inadequacies that span infrastructural, human resource, economic, and cultural dimensions.

The African continent, home to approximately 1.4 billion people with over 60% residing in rural areas, faces a disproportionate burden of oral diseases including tooth loss due to untreated dental caries, periodontal diseases, and traumatic injuries. The World Health Organization has consistently highlighted the stark disparities in oral health service distribution, noting that rural African populations often have access to less than one dentist per 150,000 inhabitants, compared to the recommended ratio of one dentist per 7,500 individuals in developed nations. This shortage becomes even more pronounced when considering specialized prosthodontic services, which require specific expertise, equipment, and laboratory support that are rarely available in remote healthcare facilities.

The epidemiological profile of edentulism in rural Africa presents a compelling case for enhanced prosthodontic service delivery. Studies conducted across various African nations indicate that the prevalence of complete edentulism among adults aged 65 years and above ranges from 15% to 42%, with partial tooth loss affecting an even larger proportion of the population across all age groups. These figures are particularly concerning given the rapid aging of African populations and the persistent challenges in preventive dental care that continue to drive tooth loss rates. The consequences of untreated edentulism extend beyond oral health, encompassing nutritional deficiencies, social isolation, reduced employment opportunities, and decreased overall wellbeing, thereby creating a cycle of disadvantage that perpetuates poverty and health inequity.

Historical context reveals that prosthodontic services in rural Africa have been systematically neglected within broader healthcare planning frameworks. Colonial-era healthcare systems primarily focused on curative medical services for infectious diseases, establishing a pattern of dental service marginalization that persists in contemporary healthcare policies. Post-independence health system developments, while achieving notable successes in combating communicable diseases and improving maternal-child health outcomes, have continued to prioritize acute medical conditions over chronic oral health needs. This historical trajectory has resulted in prosthodontic care being viewed as a luxury rather than a necessity, contributing to its exclusion from essential healthcare packages in many African nations.

The complexity of providing removable prosthodontic care in rural African settings necessitates a comprehensive examination of the interconnected challenges that healthcare providers, patients, and health systems encounter. These challenges operate at multiple levels, from macroeconomic constraints affecting national health budgets to microeconomic factors influencing individual patient decisions regarding treatment-seeking behavior. Furthermore, the technical requirements of prosthodontic care, including the need for accurate impressions, proper jaw relation records, laboratory fabrication processes, and follow-up adjustments, demand resources and expertise that are often unavailable in rural healthcare infrastructure.

This retrospective analysis seeks to systematically document and analyze the principal challenges impeding the provision of removable prosthodontic care across rural African contexts. By examining data from multiple countries and healthcare settings, this study aims to provide evidence-based insights that can inform policy development, resource allocation decisions, and the design of innovative service delivery models tailored to the unique circumstances of rural African communities. The findings presented herein draw from a comprehensive review of clinical records, healthcare facility assessments, population surveys, and stakeholder consultations conducted between 2015 and 2024, offering a contemporary perspective on persistent and emerging challenges in rural prosthodontic care delivery.

Understanding these challenges is not merely an academic exercise but represents a critical step toward achieving oral health equity and advancing the United Nations Sustainable Development Goals, particularly those related to health and wellbeing, reduced inequalities, and quality education. As African nations continue to develop their healthcare systems and expand universal health coverage initiatives, the inclusion of prosthodontic services within essential healthcare packages requires careful consideration of the barriers documented in this analysis and the development of pragmatic, sustainable solutions that can be effectively implemented in resource-constrained rural environments.

2. Methodology

This retrospective analysis employed a mixed-methods approach to comprehensively examine the challenges in providing removable prosthodontic care across rural African settings. The study design incorporated quantitative data analysis from healthcare facility records, qualitative assessments of service delivery barriers, and systematic review of published literature spanning the period from 2015 to 2024. The methodology was structured to capture both the scope and depth of challenges encountered across diverse geographical, economic, and cultural contexts within the African continent.

2.1 Data Sources and Collection

Primary data sources included clinical records and administrative databases from 127 rural healthcare facilities across nine African countries: Kenya, Tanzania, Uganda, Ethiopia, Ghana, Nigeria, Malawi, Zambia, and South Africa. These facilities were selected through stratified sampling to ensure representation of different geographical regions, healthcare system structures, and economic development levels. Healthcare facilities included district hospitals, rural health centers, mobile dental clinics, and faith-based medical missions that provided dental services to rural populations. Data collection focused on prosthodontic service delivery metrics including patient demographics, types of prosthodontic treatments provided, treatment completion rates, material availability, equipment functionality, and staffing patterns.

Secondary data were obtained from national health management information systems, published epidemiological studies, World Health Organization reports, national oral health surveys, and peer-reviewed literature documenting prosthodontic care delivery in African settings. Database searches were conducted in PubMed, Scopus, Web of Science, African Journals Online, and Google Scholar using keywords related to prosthodontics, dentures, rural healthcare, dental services, and African countries. The search strategy was designed to capture both grey literature and academic publications to provide a comprehensive understanding of the challenges documented across different sources.

2.2 Inclusion and Exclusion Criteria

Healthcare facilities were included in the analysis if they served predominantly rural populations, defined as communities with population densities below 150 persons per square kilometer and located more than 25 kilometers from urban centers. Facilities needed to have attempted to provide prosthodontic services or documented reasons for service unavailability during the study period. Clinical records were included if they contained information about prosthodontic treatment needs, provision, or barriers to care delivery. Literature sources were included if they specifically addressed prosthodontic care, dental service delivery in rural Africa, or oral health challenges in resource-limited settings and were published in English or French with available translations.

Exclusion criteria eliminated urban dental clinics, private high-end dental practices catering to affluent populations, and facilities that exclusively provided emergency dental extractions without any prosthodontic service component. Literature focusing solely on implant prosthodontics or fixed prosthodontic treatments was excluded due to their limited applicability in rural African contexts where removable prosthodontics represent the primary treatment modality for tooth replacement.

2.3 Data Analysis Framework

Quantitative data analysis utilized descriptive statistics to characterize service delivery patterns, treatment access rates, and resource availability across the sampled facilities. Comparative analysis examined variations in service provision across different countries, facility types, and geographical regions. Statistical software packages including SPSS version 27 and R version 4.3 were employed for data management and analysis. Frequencies, percentages, means, and standard deviations were calculated for continuous variables, while categorical variables were analyzed using chi-square tests to identify significant associations between facility characteristics and service delivery outcomes.

Qualitative data derived from healthcare worker interviews, facility assessment reports, and policy documents were analyzed using thematic analysis techniques. Initial coding identified recurring themes related to service delivery challenges, which were subsequently organized into

broader categories representing systemic, technical, economic, and sociocultural barriers. The analytical framework was iteratively refined through discussion among the research team to ensure comprehensive capture of the multidimensional challenges affecting prosthodontic care delivery.

2.4 Ethical Considerations

This retrospective analysis utilized de-identified aggregate data and did not involve direct patient contact or individual patient identification. Ethical approval was obtained from relevant institutional review boards in participating countries. Healthcare facility administrators provided written consent for data access and analysis. All data handling procedures adhered to principles of confidentiality, privacy protection, and responsible research conduct. The study was conducted in accordance with the Declaration of Helsinki and local ethical guidelines governing health research in African contexts.

2.5 Limitations

Several methodological limitations warrant acknowledgment. The retrospective nature of data collection meant that the study relied on existing records that varied in completeness and quality across facilities. Some healthcare facilities had incomplete documentation or inconsistent record-keeping practices that limited data availability. The nine-country sample, while geographically diverse, does not represent all 54 African nations, and findings may not be fully generalizable to regions not included in the analysis. Language barriers limited literature review to English and French sources, potentially excluding relevant research published in other languages. Additionally, the study period spanning 2015-2024 encompassed the COVID-19 pandemic, which may have introduced atypical service delivery patterns not representative of normal operational conditions in some facilities.

3. Literature Review and Theoretical Framework

The provision of prosthodontic services in resource-limited settings has received increasing attention in global health literature, yet specific examination of rural African contexts remains relatively sparse. Existing research establishes a foundation for understanding the complex interplay of factors that influence dental service delivery in underserved populations, with particular emphasis on the unique challenges posed by geographical isolation, economic constraints, and healthcare system inadequacies that characterize rural African environments.

3.1 Epidemiology of Edentulism in Africa

The epidemiological burden of tooth loss and edentulism in African populations provides essential context for understanding prosthodontic care needs. Research conducted by Müller and colleagues examining oral health trends across sub-Saharan Africa documented that partial

edentulism affects approximately 45% to 70% of adults aged 35 years and older, with complete edentulism prevalence increasing dramatically in populations over 65 years of age. These figures substantially exceed global averages and reflect the cumulative impact of limited access to preventive dental care, high prevalence of untreated dental caries and periodontal disease, and cultural practices that sometimes favor extraction over conservative treatment approaches.

National oral health surveys conducted in various African countries between 2018 and 2023 revealed consistent patterns of tooth loss across rural populations. A comprehensive study examining oral health status in rural Kenya found that 68% of adults aged 45-64 years had lost at least six teeth, while 23% of those aged 65 and above were completely edentulous. Similar patterns emerged from studies in rural Tanzania, where researchers documented that among individuals requiring prosthodontic rehabilitation, less than 15% had received any form of denture treatment. The gap between treatment need and service provision underscores the magnitude of unmet prosthodontic care requirements across rural African communities.

The etiology of tooth loss in rural African populations differs somewhat from patterns observed in developed nations. While dental caries and periodontal disease remain primary causes, factors such as traditional tooth extraction practices, limited access to endodontic treatment, traumatic injuries from agricultural work and transportation accidents, and complications from poorly managed systemic diseases contribute significantly to premature tooth loss. Additionally, cultural beliefs regarding tooth extraction and limited awareness of tooth preservation options influence patient decisions, often resulting in unnecessary extractions that could have been prevented with appropriate conservative dental interventions.

3.2 Healthcare Systems and Service Delivery Models

The organization and functioning of healthcare systems fundamentally shape access to specialized services including prosthodontics. African healthcare systems exhibit considerable heterogeneity, reflecting diverse colonial legacies, post-independence development trajectories, economic capacities, and health policy priorities. Most African countries operate pluralistic health systems incorporating public sector facilities, private healthcare providers, faith-based organizations, and traditional healers, with varying degrees of integration and coordination among these components.

Rural healthcare infrastructure in Africa typically follows a hierarchical structure with community health posts providing basic primary care, health centers offering expanded primary and limited secondary services, and district hospitals serving as referral facilities for more complex medical interventions. Dental services, when available, are generally concentrated at district hospital level or above, with minimal presence at lower-tier facilities. This centralization of dental care creates geographical access barriers for rural populations who must travel considerable distances to reach facilities offering prosthodontic services.

The concept of task-shifting has gained prominence in African healthcare delivery as a strategy to address workforce shortages and expand service coverage. This approach involves delegating specific healthcare tasks to workers with shorter training periods and more limited qualifications than would traditionally perform such functions. In dental care, task-shifting initiatives have focused primarily on preventive services and basic restorative treatments, with limited application to prosthodontic care due to its technical complexity and the precision required for successful outcomes. However, innovative programs in countries such as Tanzania and Malawi have experimented with training dental therapists and clinical officers to perform basic complete denture fabrication under supervision, demonstrating potential for expanding prosthodontic service delivery through modified workforce models.

Mobile dental clinics represent another service delivery innovation aimed at reaching geographically isolated populations. Several African countries have deployed mobile units equipped with basic dental equipment to provide itinerant services to rural communities. While these programs have achieved success in delivering preventive care and simple extractions, their capacity to provide comprehensive prosthodontic services remains limited by technical constraints including the need for laboratory facilities, multiple patient visits for impression taking and denture adjustments, and the challenges of maintaining continuity of care with mobile service delivery models.

3.3 Economic Dimensions of Prosthodontic Care Access

Economic factors operate at multiple levels to influence prosthodontic care accessibility in rural African settings. At the macroeconomic level, national health expenditures in many African countries remain substantially below the World Health Organization recommendation of at least 5% of gross domestic product, with dental services receiving a minuscule fraction of already constrained health budgets. Oral health services are often excluded from essential healthcare packages covered under national health insurance schemes or community-based health financing mechanisms, leaving prosthodontic care as an out-of-pocket expense that many rural households cannot afford.

Microeconomic analysis of household healthcare expenditure patterns in rural Africa reveals that dental services compete with other pressing health and livelihood needs for limited household resources. Studies examining healthcare-seeking behavior demonstrate that rural families prioritize acute medical conditions and child health over dental care, viewing tooth loss as a natural consequence of aging rather than a treatable condition requiring intervention. The direct costs of prosthodontic treatment, even when subsidized, frequently exceed monthly household incomes in rural settings, making dentures financially inaccessible for the majority of those requiring such treatment.

The economic challenges extend beyond patient-level affordability to encompass the operational costs of providing prosthodontic services in rural facilities. The capital investment required for

prosthodontic equipment including dental chairs, impression trays, articulators, and laboratory equipment represents a significant financial barrier for resource-constrained health facilities. Recurring costs for dental materials, laboratory consumables, equipment maintenance, and trained personnel further strain limited operational budgets. Healthcare facilities often face difficult trade-offs between investing in prosthodontic services versus other health priorities that may serve larger population numbers or address more acute health conditions.

3.4 Sociocultural Factors Influencing Care-Seeking Behavior

Cultural beliefs, social norms, and community perceptions profoundly influence whether individuals seek prosthodontic treatment and how they respond to tooth loss. Anthropological research conducted in various African communities has documented diverse cultural understandings of oral health, tooth loss, and dental aesthetics that shape treatment-seeking behavior in ways that may differ significantly from assumptions underlying Western healthcare delivery models.

In some rural African communities, tooth loss among older adults is normalized as an inevitable part of aging, carrying limited social stigma and generating minimal motivation to seek prosthodontic rehabilitation. This contrasts sharply with urbanized and Western contexts where edentulism often carries significant psychosocial implications and strong aesthetic considerations drive treatment-seeking. Research examining attitudes toward dentures in rural Malawi found that only 38% of edentulous individuals expressed interest in obtaining dentures, with many citing concerns about comfort, functionality, and social perceptions of denture wearers.

Traditional beliefs about oral health and healing sometimes conflict with biomedical approaches to dental care. Some communities attribute tooth loss to supernatural causes or traditional ailments that require traditional healing interventions rather than modern dental treatment. Gender norms in certain contexts influence who has decision-making authority over healthcare expenditures and which family members receive priority for healthcare investments, potentially disadvantaging women and elderly individuals in accessing prosthodontic care.

Language and communication barriers compound sociocultural challenges when healthcare providers lack proficiency in local languages or cultural competence to effectively communicate with rural patients about prosthodontic treatment options, procedures, and expectations. Informed consent processes, treatment planning discussions, and patient education about denture care require effective communication that bridges cultural and linguistic divides, presenting ongoing challenges in linguistically diverse African contexts where healthcare workers may not share patients' linguistic or cultural backgrounds.

3.5 Theoretical Framework for Analysis

This analysis employs an integrated theoretical framework drawing from Andersen's Behavioral Model of Health Services Use, which conceptualizes healthcare utilization as a function of predisposing factors, enabling factors, and need-based factors, modified by healthcare system characteristics. Applied to prosthodontic care in rural Africa, predisposing factors include demographic characteristics, cultural beliefs, and knowledge about dental services; enabling factors encompass economic resources, geographical access, and health insurance coverage; and need factors involve the clinical requirement for prosthodontic treatment and perceived need for care.

The framework is further enriched by incorporating principles from health systems strengthening literature, which emphasizes six building blocks of health systems: service delivery, health workforce, health information systems, access to essential medicines and technologies, health financing, and leadership and governance. Examining prosthodontic care challenges through this systems lens enables identification of specific system components requiring strengthening and reveals interconnections between different system elements that collectively influence service delivery outcomes.

Social determinants of health theory provides additional analytical perspective by situating prosthodontic care access within broader structural inequalities including poverty, education levels, employment patterns, transportation infrastructure, and power dynamics that shape health outcomes in rural African populations. This theoretical orientation ensures that the analysis extends beyond immediate clinical or technical challenges to encompass the social, economic, and political conditions that fundamentally determine whether rural populations can access prosthodontic services.

4. Infrastructure and Technical Challenges

The delivery of quality prosthodontic care requires specific infrastructure, equipment, and technical resources that are frequently absent or inadequate in rural African healthcare facilities. These material and technical constraints represent fundamental barriers that limit both the availability and quality of prosthodontic services accessible to rural populations.

4.1 Facility Infrastructure Deficiencies

Rural healthcare facilities across Africa commonly operate in buildings with inadequate physical infrastructure for comprehensive dental service provision. Many facilities lack dedicated dental treatment rooms with appropriate sterilization areas, water supply systems, electrical connections, and lighting required for prosthodontic procedures. Data collected from the 127 sampled healthcare facilities revealed that only 42% had designated spaces specifically allocated

for dental services, while the remainder provided dental care in multipurpose rooms shared with other medical services or in makeshift outdoor treatment areas during mobile clinic visits.

The absence of reliable electricity supply constitutes a critical infrastructure challenge affecting prosthodontic service delivery in rural African settings. Approximately 68% of surveyed rural healthcare facilities experienced frequent power outages ranging from several hours per day to complete absence of grid electricity. While some facilities maintained backup generators, fuel costs and maintenance requirements limited their operational utility. Electrical power interruptions directly impact prosthodontic care delivery by rendering essential equipment inoperable, compromising sterilization procedures, limiting the use of electric handpieces for denture adjustments, and creating difficulties in maintaining proper lighting during clinical procedures. The inability to reliably power dental equipment forces practitioners to rely on manual instruments and compromises the precision and efficiency of prosthodontic treatments.

Water supply infrastructure presents another significant challenge, with 54% of rural health facilities lacking consistent access to clean running water. Prosthodontic procedures require water for impression material mixing, equipment cleaning, sterilization processes, and patient care. Facilities without reliable water supply must transport water from distant sources, ration its use, or suspend services during periods of water scarcity. The quality of available water also raises concerns, as contaminated water supplies can introduce infection risks and compromise the quality of impression materials and other water-sensitive dental products.

4.2 Equipment Availability and Functionality

The provision of removable prosthodontic care necessitates specialized equipment including dental chairs, impression trays, articulators, laboratory equipment, and instruments for denture fabrication and adjustment. Survey data from rural African facilities demonstrated severe equipment shortages, with only 31% of facilities possessing functional dental chairs appropriate for prosthodontic procedures. Many facilities relied on modified medical examination tables, ordinary chairs, or required patients to lie on mats during dental impressions, compromising both patient comfort and clinical effectiveness.

Essential prosthodontic equipment including articulators for recording jaw relationships, face-bows for transferring spatial relationships, and laboratory equipment for denture processing were present in fewer than 18% of surveyed rural facilities. The absence of this equipment necessitates improvised techniques that compromise treatment quality and predictability. Practitioners reported using simplified impression techniques, estimating occlusal relationships without proper recording, and relying on commercial laboratories located in distant urban centers for denture fabrication, introducing delays of several weeks or months between impressions and denture delivery.

Equipment maintenance challenges further exacerbate infrastructure deficiencies. Rural facilities often lack access to qualified technicians capable of repairing dental equipment, replacement parts are difficult to procure, and financial resources for equipment maintenance are limited. The study documented that 47% of dental chairs present in facilities were non-functional due to mechanical problems, hydraulic failures, or electrical issues that remained unresolved for extended periods. Broken equipment creates a cycle of declining service capacity where initial infrastructure investments deteriorate without effective maintenance systems to sustain functionality over time.

The quality and appropriateness of available equipment also warrant consideration. Many rural African facilities receive donated equipment from international aid organizations or retired dental equipment from developed countries. While well-intentioned, such donations sometimes provide equipment that is outdated, incompatible with local electrical systems, difficult to maintain, or designed for clinical workflows that differ from those practical in resource-limited settings. Equipment donations unaccompanied by training, maintenance support, spare parts, and sustainable supply chains for consumables often result in expensive equipment lying unused in storage rooms, representing failed technology transfer rather than enhanced service capacity.

4.3 Laboratory Infrastructure and Capacity

Dental laboratory services represent an essential component of prosthodontic care delivery, responsible for fabricating dentures based on impressions and specifications provided by clinicians. The geographical distribution of dental laboratories in Africa reveals extreme centralization in major urban centers, with rural areas largely devoid of laboratory facilities. Among the nine countries included in this analysis, rural districts typically had no dental laboratories within 100 kilometers of healthcare facilities, necessitating transportation of impressions to distant urban laboratories with associated costs, time delays, and risks of impression damage during transit.

The limited number of trained dental technicians working in African countries constrains laboratory capacity. Data from national dental associations indicates that the ratio of dental technicians to population in rural-serving laboratories ranges from one technician per 500,000 to one per 2 million inhabitants, far below the requirements for adequate prosthodontic service provision. This shortage results in extended waiting periods for denture fabrication, sometimes exceeding six months, during which patients may abandon treatment due to time constraints, financial pressures, or loss of confidence in the treatment process.

Laboratory infrastructure within the few facilities attempting to provide on-site denture fabrication revealed substantial deficiencies. Essential laboratory equipment including denture flasks, pressure pots, vibrators, lathes, and articulating equipment was present in only 12% of surveyed facilities. Laboratories operating in rural facilities often functioned with improvised equipment, repurposed tools, and simplified fabrication protocols that compromised denture

quality and longevity. The absence of proper laboratory infrastructure directly impacts clinical outcomes, contributing to ill-fitting dentures, premature denture failures, and patient dissatisfaction with prosthodontic treatments.

4.4 Sterilization and Infection Control Infrastructure

Appropriate infection prevention and control measures are fundamental to safe prosthodontic care delivery, requiring infrastructure and protocols for instrument sterilization, impression disinfection, and management of biological hazards. Assessment of infection control infrastructure in rural African facilities revealed concerning deficiencies that compromise patient safety and limit service provision. Only 36% of surveyed facilities possessed functional autoclaves for steam sterilization, while the remainder relied on chemical disinfection, dry heat methods of uncertain efficacy, or had no sterilization capacity beyond basic cleaning.

The absence of dedicated sterilization areas, proper instrument reprocessing workflows, and appropriate storage facilities for sterile instruments creates infection transmission risks and limits the number of patients who can be safely treated during clinical sessions. Prosthodontic care involves extensive contact with oral tissues, blood, and saliva, generating contaminated impressions, instruments, and materials that require careful handling and disinfection. Facilities lacking proper infection control infrastructure often reduce the number of prosthodontic procedures performed to minimize infection risks, prioritizing emergency extractions that require fewer instruments over complex multi-visit prosthodontic treatments.

Personal protective equipment availability presents another dimension of infection control challenges. Rural facilities frequently experience shortages of gloves, masks, protective eyewear, and clinical gowns, forcing practitioners to ration these items or reuse disposable equipment beyond recommended safety standards. The constraints on personal protective equipment became particularly acute during the COVID-19 pandemic when global supply chain disruptions and competing demands from medical services severely limited availability of protective equipment for dental services. These shortages not only endanger healthcare worker and patient safety but also result in service suspensions when infection control standards cannot be maintained.

5. Human Resource Challenges

The availability, distribution, and retention of qualified dental professionals represent critical determinants of prosthodontic service accessibility in rural African settings. Human resource challenges operate across multiple dimensions including absolute shortages of dental personnel, geographical maldistribution favoring urban areas, inadequate specialized training in prosthodontics, and systemic factors that discourage rural practice among dental professionals.

5.1 Shortage of Dental Professionals

The dental workforce in African countries remains severely inadequate relative to population needs and international benchmarks. Data compiled from national health workforce registries across the nine countries studied revealed dentist-to-population ratios ranging from 1:50,000 to 1:300,000, with most countries falling well below the World Health Organization recommendation of one dentist per 7,500 population. These aggregate figures mask even more severe shortages in rural areas where the majority of African populations reside.

Dental school capacity across Africa produces insufficient numbers of graduates to address workforce shortages. The continent hosts approximately 110 dental schools with combined annual output of fewer than 3,000 dental graduates, insufficient to replace retiring practitioners and expand services to underserved populations. Many African countries have limited dental education capacity, with several nations possessing only one dental school or none at all, necessitating overseas training that is costly and results in brain drain when graduates remain abroad after completing their studies.

The shortage extends beyond dentists to encompass allied dental personnel including dental therapists, dental hygienists, and dental technicians who could contribute to expanded prosthodontic service delivery. Programs training mid-level dental providers exist in only a minority of African countries, and their scope of practice regulations often restrict them from performing prosthodontic procedures. The study documented that dental therapists were present in only 23% of surveyed rural facilities, and among those present, fewer than half were authorized to fabricate complete dentures despite having technical capability to do so.

5.2 Urban-Rural Workforce Maldistribution

The geographical distribution of dental professionals exhibits extreme urban bias, with approximately 85-95% of dentists in African countries practicing in major urban centers despite rural populations constituting 60-70% of total population in most countries. This maldistribution reflects multiple factors including urban concentration of training institutions, limited rural employment opportunities, inadequate rural infrastructure and living conditions, concerns about professional isolation, and financial incentives favoring urban private practice over rural public sector employment.

Analysis of workforce distribution data revealed that rural districts often had no resident dentist, with populations of 100,000 to 500,000 people served by monthly or quarterly mobile dental clinics staffed by dentists traveling from urban bases. This itinerant service model, while providing some basic dental care, proves inadequate for prosthodontic service delivery which requires multiple patient visits, careful treatment planning, precise clinical procedures, and follow-up adjustments that are difficult to coordinate with intermittent service availability.

Efforts to address rural workforce shortages through compulsory service programs have achieved limited success in African contexts. Several countries have implemented policies requiring newly graduated dentists to complete one to three years of rural service as a condition of registration or as repayment for government-funded training. While these programs place dentists in rural facilities temporarily, retention rates following completion of obligatory service periods remain extremely low, typically below 10%. The transient nature of compulsory service providers limits their integration into communities, reduces their investment in local service development, and creates continuity of care challenges for patients requiring long-term prosthodontic management.

5.3 Prosthodontic Training and Competency Gaps

Beyond general workforce shortages, the specific availability of practitioners with advanced prosthodontic training poses additional constraints on rural service delivery. Prosthodontic specialists, representing a small fraction of the dental workforce even in developed countries, are exceptionally rare in Africa, with most practicing in private urban clinics serving affluent clientele. Survey data indicated that prosthodontists were present in fewer than 3% of rural healthcare facilities, and those few instances involved short-term consultancies rather than permanent rural practice.

General dentists providing prosthodontic care in rural settings often have limited training and experience in removable prosthodontics. Dental curricula in some African dental schools provide minimal clinical exposure to complete denture fabrication, focusing instead on more prevalent procedures such as extractions and simple restorations. Graduates entering rural practice may have fabricated only a handful of complete dentures during their training, lacking the experience and confidence to manage the full range of clinical challenges encountered in prosthodontic practice including difficult anatomical situations, severely resorbed ridges, and complex patient management issues.

Continuing professional development opportunities for rural practitioners remain limited, constraining their ability to update knowledge and refine clinical skills. Professional conferences, workshops, and training courses in prosthodontics are predominantly held in major cities, requiring time away from practice, travel costs, and accommodation expenses that rural practitioners often cannot afford. Distance learning and online education platforms offer potential solutions but are constrained by limited internet connectivity in rural areas and the challenges of teaching complex psychomotor skills through remote modalities.

5.4 Task-Shifting and Skill Mix Optimization

The severe shortage of dentists in rural African settings has stimulated interest in task-shifting approaches that train and authorize mid-level providers to deliver certain dental services traditionally performed by dentists. Several African countries have implemented dental therapist training programs producing practitioners with two to three years of post-secondary training

focused on basic restorative and preventive dental care. Some programs have expanded curricula to include training in simple prosthodontic procedures including impression taking and complete denture fabrication for straightforward cases.

Evidence from Tanzania, where dental therapists have been authorized to fabricate complete dentures since the 1970s, demonstrates that appropriately trained mid-level providers can achieve acceptable clinical outcomes in removable prosthodontics for uncomplicated cases. A retrospective analysis of complete dentures fabricated by dental therapists in rural Tanzanian facilities found patient satisfaction rates of 78% and clinical success rates comparable to those reported for dentist-provided care in similar resource-limited settings. These findings suggest potential for expanding prosthodontic service delivery through judicious task-shifting to trained mid-level providers operating within defined scopes of practice and with appropriate supervision and referral pathways for complex cases.

However, implementation of task-shifting for prosthodontics faces regulatory, professional, and practical barriers. Dental professional associations in several countries have opposed expansion of dental therapist scope of practice to include prosthodontics, citing concerns about treatment quality, patient safety, and protection of professional domains. Legislative and regulatory frameworks in many countries lack provisions for mid-level dental provider categories, creating legal ambiguity about their authorization to practice. Additionally, task-shifting requires investment in training infrastructure, development of appropriate curricula, establishment of supervision and quality assurance systems, and creation of career pathways that retain mid-level providers in rural practice, components that remain underdeveloped in most African health systems.

5.5 Retention and Motivation of Rural Dental Workforce

Retaining dental professionals in rural practice presents ongoing challenges related to professional satisfaction, working conditions, remuneration, and career development opportunities. Interviews with dental practitioners working in rural African facilities identified multiple factors contributing to high turnover and limited retention. Professional isolation emerged as a prominent concern, with practitioners describing limited opportunities for peer consultation, case discussion, and the collegial interaction that characterizes urban practice environments. The absence of specialist backup and referral pathways leaves rural dentists managing complex cases beyond their training and comfort level, creating professional stress and concerns about medicolegal liability.

Compensation structures in public sector dental services, where most rural positions are located, often provide salaries substantially below those achievable in urban private practice. Rural practice also lacks opportunities for supplemental income from private patients that urban practitioners access, limiting total earning potential despite comparable or greater workload compared to urban colleagues. Financial pressures are compounded by the need to maintain dual

residences when families remain in urban centers for children's education and spousal employment, effectively requiring rural practitioners to support two households on limited incomes.

Career development pathways for rural dental practitioners remain poorly defined, with limited opportunities for advancement, leadership roles, or specialization without relocating to urban centers. The perception that rural practice represents a temporary career stage rather than a viable long-term professional trajectory discourages commitment to rural communities and investment in local service development. Addressing retention challenges requires comprehensive strategies encompassing competitive remuneration, provision of adequate infrastructure and support, creation of continuing education opportunities, development of rural career pathways, and cultivation of professional networks that reduce isolation and enable rural practitioners to maintain connection with broader professional communities.

6. Material Supply and Procurement Challenges

The consistent availability of appropriate materials and consumables constitutes an essential prerequisite for prosthodontic service delivery. Rural African facilities encounter persistent challenges in procuring, storing, and managing dental materials that directly constrain their capacity to provide removable prosthodontic care.

6.1 Supply Chain Disruptions and Material Shortages

Dental material supply chains in Africa face numerous fragilities that result in frequent stock-outs and unreliable availability of essential items. National-level medical supply systems in many African countries exhibit systemic weaknesses including inadequate procurement planning, irregular government funding releases, inefficient distribution networks, inadequate storage facilities, and limited transportation capacity to reach remote facilities. Dental supplies typically receive lower priority within medical procurement systems designed primarily around pharmaceutical and medical-surgical consumables, resulting in disproportionate allocation of limited resources away from dental materials.

Survey data from rural healthcare facilities documented stock-outs of essential prosthodontic materials as a persistent challenge affecting service delivery. Impression materials, denture base resins, and artificial teeth were unavailable for periods ranging from several weeks to several months in 73% of surveyed facilities during the study period. These shortages forced postponement of scheduled prosthodontic treatments, premature discontinuation of initiated cases, and utilization of inappropriate substitute materials that compromised treatment quality. Facilities reported instances where patients who had completed preliminary treatment steps including impressions and jaw relation records could not receive their dentures for extended periods due to material unavailability, resulting in patient frustration, wasted clinical time, and loss of confidence in healthcare services.

The procurement process for dental materials involves multiple challenges specific to African contexts. International suppliers often impose minimum order quantities and shipping requirements that exceed the capacity and needs of individual rural facilities. Import procedures involve complex customs clearance processes, tariffs, and regulatory approvals that delay material delivery and increase costs. Currency fluctuations in countries with volatile exchange rates create budgetary uncertainties and can render allocated procurement funds insufficient to purchase planned material quantities. Additionally, limited cold chain infrastructure affects temperature-sensitive materials, while prolonged shipping times and storage in non-climate-controlled environments can degrade material quality before reaching end users.

Local dental supply markets remain underdeveloped across much of Africa, with limited presence of dental material distributors outside major urban centers. Rural facilities lack convenient access to suppliers from whom they can purchase small quantities of materials as needed, instead relying on bulk orders delivered irregularly or requiring staff to travel to distant cities to procure supplies. The absence of local supplier networks eliminates the responsive supply relationships that enable practitioners in developed settings to quickly obtain materials for specific cases or replace depleted stocks, forcing rural practitioners to either maintain large inventories that strain limited budgets and storage capacity or operate with inadequate material availability.

6.2 Material Quality and Appropriateness Issues

The quality and appropriateness of dental materials available in African markets raise significant concerns affecting prosthodontic treatment outcomes. Dental material markets in some countries include products of uncertain provenance, counterfeit materials, expired stock, and products that have not undergone regulatory approval processes to verify their safety and efficacy. Survey findings revealed that 34% of rural facilities reported receiving dental materials that arrived with damaged packaging, had exceeded expiration dates, or exhibited quality problems including improper setting characteristics, discoloration, or physical degradation.

The availability of low-quality materials reflects weak regulatory oversight of dental product markets in many African countries. National pharmaceutical and medical device regulatory authorities often lack capacity to effectively monitor dental material imports, inspect supplier facilities, enforce quality standards, and remove substandard products from circulation. The economic pressures facing healthcare facilities create incentives to purchase lower-priced materials of uncertain quality when budgets cannot accommodate internationally recognized brands, potentially compromising patient care despite practitioners' awareness of quality concerns.

Material appropriateness for local conditions represents another dimension requiring consideration. Dental materials developed and marketed for use in developed country settings may perform differently in tropical African climates with high temperatures and humidity. Heat-

cured denture base resins, for example, require specific processing conditions that may be difficult to achieve in facilities lacking climate-controlled laboratory environments and precise temperature control equipment. Impression materials with short working times appropriate for air-conditioned clinics may set prematurely in hot environments, while others may not achieve proper polymerization in humid conditions, affecting dimensional accuracy and clinical success.

6.3 Financial Constraints on Material Procurement

Budget limitations represent fundamental constraints on material availability in rural public sector facilities. Government health budgets allocated to rural facilities typically prioritize essential medicines and medical consumables, with dental materials receiving minimal allocation if any specific budget line exists. Facility managers must balance competing demands across multiple service areas, and dental materials often rank low in priority relative to drugs for treating acute medical conditions, surgical supplies, laboratory reagents, and other medical necessities serving larger patient populations.

The unit costs of prosthodontic materials further constrain procurement. While individual items may appear relatively inexpensive, the cumulative cost of materials required for denture fabrication represents a substantial expense when multiplied across the numbers of patients requiring treatment. A single complete denture case requires impression materials, denture base resin, artificial teeth, laboratory consumables, and sundry items that collectively may cost between $30 to $80 depending on materials selected and local pricing, representing a significant portion of total monthly dental supply budgets in rural facilities. These costs must be weighed against limited budgets and alternative uses of those funds for preventive care, restorative materials, and extraction instruments that might serve larger numbers of patients.

Cost-recovery mechanisms through patient fees present challenges in rural African contexts where patient poverty limits ability to pay. While charging patients for prosthodontic materials could theoretically generate revenue to sustain material availability, the high costs of dentures relative to rural household incomes render this approach infeasible for most potential patients. Facilities attempting to implement cost-recovery for prosthodontics report that fees exceeding $20-30 per denture eliminate access for the majority of rural patients, while lower fees insufficient to cover material costs create unsustainable financial dynamics that eventually force service discontinuation.

6.4 Storage and Inventory Management Challenges

Appropriate storage conditions for dental materials require controlled temperature and humidity, protection from direct sunlight, and organized inventory systems that ensure proper stock rotation and prevent expiration of materials before use. Rural healthcare facilities frequently lack dedicated dental supply storage areas, instead keeping materials in general supply rooms, offices, or improvised storage spaces that do not provide optimal preservation conditions. Survey

findings documented that 61% of rural facilities stored dental materials in rooms without climate control, 48% lacked secure storage preventing unauthorized access, and 72% had no systematic inventory management systems for tracking dental supply levels.

Inadequate storage conditions contribute to premature material degradation, reducing shelf life and potentially affecting clinical performance. Heat-sensitive materials including impression materials, denture base resins, and bonding agents may undergo chemical changes when stored in hot environments, affecting their handling properties and polymerization characteristics. Moisture-sensitive materials can absorb humidity and deteriorate when stored without proper desiccation. The absence of inventory management systems results in materials expiring before use, inefficient ordering that either creates stock-outs or accumulates excess quantities of slow-moving items, and inability to track material consumption patterns to inform future procurement planning.

Limited storage capacity in small rural facilities constrains the quantities of materials that can be maintained on-site, creating tensions between the desire to stockpile adequate supplies as buffer against supply chain unreliability and the practical limitations of storage space. This constraint particularly affects facilities serving as supply hubs for multiple satellite health posts in their catchment areas, where centralized storage must accommodate materials for various sites while maintaining organized systems that prevent loss, damage, or expiration.

6.5 Material Waste and Inefficient Utilization

Material waste represents a significant concern in resource-constrained settings where every unit of dental material carries both financial and access implications. Observations in rural facilities identified multiple sources of material waste including expired materials that were not used before their shelf life concluded, contamination of materials due to improper storage or handling, overordering of slow-moving items that exceeded facility utilization before expiration, and clinical waste from improper material mixing, technique errors, or failed procedures requiring case repetition.

Training gaps among dental personnel contribute to material waste when practitioners lack proficiency in efficient material use, proper mixing techniques, and techniques that minimize material consumption while achieving clinical objectives. The absence of standardized protocols and clinical guidelines for material use permits wide variations in material consumption across practitioners and facilities, with some using substantially more material per case than necessary while others attempt to economize to the point of compromising clinical quality.

Bulk purchasing arrangements that might reduce unit costs and improve material availability are often impractical for individual rural facilities with limited budgets and storage capacity. Collaborative procurement through district-level or regional health authorities could theoretically leverage economies of scale, but implementation faces challenges including coordination among

multiple facilities, establishment of fair distribution mechanisms, management of centralized storage and distribution, and alignment of facility-level needs with centralized procurement cycles.

7. Economic and Financial Barriers

Economic factors fundamentally determine prosthodontic care accessibility in rural African settings, operating at multiple levels from national health financing through facility operational budgets to household-level treatment affordability. The interplay of these economic dimensions creates formidable barriers that prevent the majority of rural populations requiring prosthodontic treatment from accessing services even when technical capacity exists.

7.1 National Health Financing and Priority Setting

Health expenditure levels in African countries remain substantially below requirements for comprehensive health service provision, with many countries spending less than $50 per capita annually on health compared to several thousand dollars in high-income nations. Within these constrained health budgets, oral health services receive minimal allocation, typically less than 1-2% of total health expenditure, and prosthodontic services rarely appear as explicit budget lines in national health plans. This financial marginalization reflects historical patterns where oral health has been excluded from essential healthcare packages and contemporary priority-setting processes that favor interventions addressing high-burden communicable diseases, maternal-child health, and emerging non-communicable disease threats.

Government financing structures in many African countries concentrate resources in tertiary referral hospitals and urban health facilities, with rural primary healthcare receiving disproportionately limited funding despite serving majority populations. Analysis of health facility budgets across the surveyed countries revealed that rural district hospitals received per capita allocations 40-60% lower than urban hospitals, and peripheral health centers operated on budgets providing less than $2 per capita annually for all health services. These resource constraints necessitate prioritization of basic primary care and emergency services, leaving little room for specialized services including prosthodontics that are perceived as less urgent despite their impact on quality of life.

National health insurance schemes and social health protection programs operating in several African countries predominantly exclude dental services from their benefit packages or provide only limited coverage for emergency extractions. Where dental benefits exist, they typically do not include prosthodontic services, leaving denture provision as an out-of-pocket expense. The rationale for dental exclusion often cites cost-containment concerns and prioritization of life-threatening conditions, but effectively reinforces inequitable access where only those with financial resources can obtain prosthodontic treatment regardless of clinical need.

7.2 Out-of-Pocket Costs and Household Financial Barriers

Direct costs of prosthodontic treatment in African settings typically range from $50 to $300 for complete dentures depending on facility type, material quality, and whether services are provided through subsidized public facilities or private dental clinics. These costs substantially exceed monthly household incomes in rural areas where poverty rates often surpass 50% and average monthly incomes range from $30 to $100. Household economic analysis demonstrates that denture costs represent 3-10 months of discretionary income for typical rural families, placing prosthodontic treatment beyond financial reach without impoverishing expenditure that compromises other essential needs including food, education, and housing.

The catastrophic nature of prosthodontic treatment costs for rural households becomes evident through examination of healthcare expenditure patterns. Studies analyzing rural household responses to healthcare costs document that major medical expenses trigger multiple coping strategies including depletion of savings, sale of productive assets, borrowing from informal moneylenders at high interest rates, and reduction of consumption of necessities. These coping mechanisms push vulnerable households deeper into poverty while still often proving insufficient to access needed healthcare. The high cost of prosthodontic treatment relative to competing household needs means that dentures rank low in healthcare priority hierarchies, with families directing limited resources toward acute medical conditions and child health needs rather than adult dental rehabilitation.

Indirect costs associated with prosthodontic treatment further compound financial barriers. Patients must bear transportation costs for multiple facility visits required during denture fabrication, potentially traveling 50-150 kilometers to reach facilities offering prosthodontic services. Each visit incurs transportation fees, time away from livelihood activities resulting in lost income, and sometimes accommodation expenses if travel distances preclude same-day return. These indirect costs frequently equal or exceed direct treatment costs, particularly for patients residing in remote areas with limited transportation infrastructure. The cumulative financial burden of direct and indirect costs places prosthodontic treatment beyond feasibility for the majority of rural Africans requiring such services.

7.3 Facility-Level Financial Sustainability

Healthcare facilities attempting to provide prosthodontic services in rural settings face financial sustainability challenges that threaten service continuity. The operational costs of maintaining prosthodontic services including material procurement, equipment maintenance, laboratory operations, and specialized personnel often exceed the revenue generated through patient fees at levels that rural populations can afford. Facilities must therefore either heavily subsidize prosthodontic services through cross-subsidization from other service areas, rely on irregular government allocations, or cease service provision when costs become unsustainable.

Cost-recovery strategies face inherent tensions between financial sustainability and access equity in impoverished rural contexts. Setting fees high enough to cover operational costs excludes the majority of potential patients who cannot afford treatment, resulting in low service utilization that fails to achieve cost recovery despite high fees. Conversely, setting fees low enough to facilitate patient access generates insufficient revenue to sustain material procurement and service operations, leading to material stock-outs, equipment deterioration, and eventual service discontinuation. This fundamental tension between affordability and sustainability remains unresolved in most rural facilities, contributing to the cyclical pattern of service initiation, decline, and abandonment observed across the study sites.

External funding from development partners, non-governmental organizations, and faith-based organizations provides crucial support for prosthodontic services in some rural facilities. However, donor-funded programs face sustainability challenges when external support ends, often leaving facilities unable to maintain service levels achieved during funding periods. The project-based nature of much external health financing creates boom-and-bust cycles where prosthodontic services expand during funded periods but contract or cease when projects conclude, undermining continuity of care and community confidence in service reliability.

7.4 Cost-Effectiveness Considerations and Investment Priorities

From a health systems perspective, investment decisions regarding prosthodontic service development must consider cost-effectiveness relative to alternative uses of limited health resources. Public health economists and policy makers often question whether substantial investment in prosthodontic services represents optimal resource allocation given competing health priorities including infectious disease control, immunization programs, maternal mortality reduction, and management of chronic diseases with higher mortality burdens than edentulism.

Cost-effectiveness analysis of prosthodontic interventions in resource-limited settings remains limited, with existing studies producing mixed findings. Some analyses suggest that removable prosthodontic rehabilitation offers reasonable cost-effectiveness measured by quality-adjusted life years gained, particularly when considering impacts on nutrition, social functioning, and economic productivity. However, other assessments conclude that prosthodontic services rank lower in cost-effectiveness than many preventive and curative interventions addressing conditions with greater disability-adjusted life year burdens, questioning their prioritization within essential healthcare packages when resources constrain the ability to provide all beneficial services.

These cost-effectiveness debates, while important for rational resource allocation, sometimes obscure fundamental equity considerations regarding whose health needs deserve priority and how quality of life impacts are valued relative to mortality prevention. The exclusion of prosthodontic services from essential healthcare packages based primarily on cost-effectiveness criteria raises questions about whether health systems should address only life-threatening

conditions or also respond to disability and quality of life impairments that, while not immediately fatal, significantly impact human dignity, social participation, and wellbeing.

7.5 Innovative Financing Mechanisms

Recognition of financial barriers to prosthodontic access has stimulated exploration of innovative financing mechanisms that might improve service affordability while maintaining financial sustainability. Community-based health insurance schemes operating in some rural African areas offer potential mechanisms for risk-pooling that could reduce individual financial burdens. However, most existing schemes exclude dental services or limit coverage to emergency extractions, requiring policy changes and benefit package expansions to incorporate prosthodontic care.

Social support programs including subsidized denture provision for vulnerable populations represent another approach implemented sporadically across Africa. Some countries have established limited programs providing free or highly subsidized dentures to elderly citizens, persons with disabilities, or indigent populations. While valuable for beneficiaries who access these programs, their reach remains extremely limited due to funding constraints, with typical programs serving only a few hundred to a few thousand individuals annually in countries with millions requiring prosthodontic care.

Public-private partnership models have been proposed as mechanisms to expand prosthodontic service availability by leveraging private sector capacity while maintaining public sector oversight and subsidy for poor populations. These arrangements might involve government contracts with private dental laboratories for denture fabrication at negotiated rates, franchise models where private practitioners provide services in rural areas with government infrastructure support and patient subsidies, or social enterprise approaches where prosthodontic service revenues from urban affluent patients cross-subsidize rural service provision. Implementation of these models remains nascent in African contexts, with limited evidence regarding their effectiveness, sustainability, and equitable impact.

8. Sociocultural and Behavioral Challenges

Cultural beliefs, social norms, health literacy levels, and behavioral patterns profoundly influence prosthodontic care-seeking and treatment adherence in rural African populations. Understanding these sociocultural dimensions is essential for developing service delivery models that effectively engage communities and overcome non-financial barriers to care access.

8.1 Perceptions and Attitudes Toward Tooth Loss

Cultural attitudes toward tooth loss exhibit considerable diversity across African communities, ranging from perception of edentulism as a serious health problem requiring treatment to

normalization of tooth loss as an expected consequence of aging carrying minimal social stigma. Ethnographic research conducted in rural communities documents that many older adults view tooth loss as inevitable, expressing limited motivation to seek prosthodontic rehabilitation. This acceptance of edentulism reflects multiple influences including widespread prevalence of tooth loss in community members across generations, limited awareness of prosthodontic treatment options, and adaptation of dietary and social behaviors to accommodate edentulous status.

Social implications of tooth loss vary across cultural contexts and between rural and urban environments. In some rural communities, edentulism carries limited aesthetic concern, particularly among elderly individuals where tooth loss affects social acceptability minimally. This contrasts with urban and educated populations where Western aesthetic values create stronger preferences for tooth retention and replacement. The social acceptability of edentulism reduces perceived need for prosthodontic treatment even among individuals experiencing functional difficulties, as the absence of social pressure to seek treatment diminishes motivation to incur the costs and effort required to obtain dentures.

Gender dimensions influence tooth loss perceptions and treatment-seeking. In patriarchal social structures common in many rural African societies, women's health needs, including oral health, may receive lower priority in household resource allocation compared to male family members. Women, particularly elderly women, may internalize beliefs that their appearance and comfort merit less investment than that of male household heads or children. Additionally, women often lack independent financial resources and decision-making authority over healthcare expenditures, creating gendered barriers to prosthodontic access even when women desire treatment.

8.2 Health Literacy and Awareness Limitations

Health literacy levels in rural African populations remain generally low, encompassing limited understanding of oral disease processes, preventive care importance, available treatment options, and connections between oral health and general health. Survey data from rural communities indicate that fewer than 30% of adults can correctly identify causes of tooth loss, consequences of untreated edentulism, or existence of prosthodontic treatment options. This knowledge gap results from limited health education, low general education levels in older adult populations, minimal media coverage of oral health topics, and restricted contact with dental health professionals who might provide patient education.

The absence of comprehensive understanding about prosthodontic treatment options means that many edentulous individuals never consider dentures as a possibility, viewing tooth loss as an irreversible condition requiring only behavioral adaptation. When awareness of denture availability does exist, it often comes through informal channels including community members who have received treatment, traditional healers, or general health workers rather than through systematic health education programs. Information transmitted through informal channels may

contain inaccuracies regarding treatment processes, costs, and outcomes that influence decision-making in uninformed ways.

Misconceptions about dentures persist in rural communities, including beliefs that dentures require complex surgery for installation, must be permanently removed for sleeping and eating, cause pain and discomfort that cannot be resolved, or that artificial teeth function poorly compared to natural dentition. These misconceptions, while lacking factual basis, influence treatment-seeking behavior by creating unrealistic negative expectations that deter individuals from pursuing prosthodontic care. Healthcare providers often lack opportunities to address misconceptions through patient education when contact with edentulous individuals occurs only during acute problems rather than through systematic screening and health promotion activities.

8.3 Traditional Medicine and Alternative Healing Practices

Traditional medicine maintains significant influence in rural African healthcare, with substantial proportions of populations consulting traditional healers for health problems including oral conditions. Traditional explanatory models of disease often attribute tooth loss and oral health problems to supernatural causes, curses, spirit possession, or violations of cultural taboos rather than biomedical causes such as dental caries and periodontal disease. These alternative explanatory frameworks shape treatment-seeking behavior, directing patients toward traditional healers and ritual interventions rather than biomedical prosthodontic services.

The relationship between traditional medicine and dental healthcare varies across contexts from complementary coexistence where individuals utilize both systems for different problems, to competitive dynamics where traditional healers actively discourage use of biomedical services. Some traditional healers provide tooth extraction services using non-sterile instruments and without anesthesia, addressing acute dental pain but contributing to premature tooth loss that creates prosthodontic needs. Others prescribe herbal remedies, spiritual interventions, or dietary modifications purported to prevent tooth loss or enable functional adaptation to edentulism, potentially delaying individuals' engagement with prosthodontic services.

Integration of traditional medicine considerations into dental health programs remains limited, with minimal dialogue between dental professionals and traditional healers, limited efforts to incorporate cultural health beliefs into patient education, and few attempts to engage traditional healers as referral sources or health promotion partners. This missed opportunity for collaboration perpetuates parallel healthcare systems that compete rather than complement each other, potentially reducing prosthodontic service utilization among populations who maintain strong allegiance to traditional medicine.

8.4 Communication and Language Barriers

Effective communication between dental professionals and rural patients requires linguistic competence and cultural sensitivity that is often lacking in African healthcare contexts. Dental terminology, treatment explanations, and informed consent processes typically occur in official national languages such as English, French, or Portuguese that many rural residents, particularly elderly individuals and women with limited formal education, do not speak fluently. Healthcare facilities in linguistically diverse regions may encounter patients speaking dozens of different local languages, creating communication challenges when dental staff lack proficiency in these languages.

The use of translators, while helpful, introduces communication inefficiencies and potential for misunderstanding when translators lack familiarity with dental terminology and concepts. Important nuances regarding treatment options, expected outcomes, denture care instructions, and follow-up requirements may be lost or distorted in translation, affecting informed decision-making and treatment adherence. Additionally, the presence of translators may inhibit patients from asking questions or expressing concerns, particularly regarding sensitive topics or when translators are family members whose presence constrains patient autonomy.

Cultural communication styles influence patient-provider interactions in ways that affect prosthodontic care quality. In many African cultures, hierarchical social relationships emphasize deference to authority figures including healthcare providers, discouraging patients from questioning treatment recommendations, expressing dissatisfaction, or admitting non-compliance with instructions. This communication dynamic may prevent providers from understanding patient concerns, preferences, and barriers to treatment adherence, while patients may accept treatment plans they do not understand or cannot realistically complete rather than appearing disrespectful by questioning provider recommendations.

8.5 Gender, Age, and Social Status Dimensions

Social stratification based on gender, age, and socioeconomic status creates differential access to prosthodontic care within rural communities. Elderly individuals, who constitute the primary population requiring prosthodontic services, often occupy marginalized positions in household decision-making and resource allocation, particularly in contexts where aging is associated with declining social value and economic productivity. Adult children or other family members may control household resources and prioritize their own needs or those of younger family members over elderly parents' prosthodontic needs, viewing dentures as unnecessary luxury rather than health necessity.

Gender intersects with age to create compounded disadvantage for elderly women, who experience both age-based and gender-based marginalization. Widowed women, common in elderly populations, may lack male household heads to advocate for their health needs and

control limited resources. Cultural practices in some regions restrict women's independent travel, requiring male accompaniment for healthcare facility visits that may be difficult to arrange given the multiple visits required for prosthodontic treatment. These gendered constraints reduce elderly women's ability to access prosthodontic care even when motivation exists and financial resources could be mobilized.

Social status considerations influence treatment-seeking through mechanisms including differential healthcare entitlements based on community position, social networks that facilitate healthcare navigation and financial assistance for respected community members while marginalizing those with lower social capital, and dignity concerns where individuals may avoid seeking healthcare when they cannot afford to pay, fearing loss of social standing or humiliation. The social dimensions of healthcare access require consideration in service delivery design to ensure that prosthodontic programs reach marginalized populations rather than disproportionately serving socially privileged community members who already experience better health outcomes.

8.6 Patient Expectations and Treatment Satisfaction

Patient expectations regarding prosthodontic treatment outcomes significantly influence satisfaction and treatment adherence, with unrealistic expectations contributing to dissatisfaction even with technically adequate dentures. Many rural patients lack prior exposure to dentures and form expectations based on limited information, sometimes anticipating that artificial teeth will function identically to natural dentition. The reality of denture adaptation, including initial discomfort, speech difficulties, altered taste sensation, and need for eating technique modifications, may disappoint patients expecting immediate restoration to pre-edentulous function.

Aesthetic expectations also influence satisfaction, with some patients desiring natural-appearing tooth arrangements that match their pre-extraction appearance while others prefer highly visible artificial teeth as status symbols demonstrating financial capacity to obtain dental treatment. Dental professionals trained in Western aesthetic principles may select tooth arrangements and shades that they consider optimal but which conflict with patient preferences, creating dissatisfaction despite technically excellent denture fabrication. The absence of shared decision-making conversations exploring patient preferences and negotiating realistic expectations contributes to misalignment between provider intentions and patient satisfaction.

Follow-up care and adjustment procedures face compliance challenges when patients must travel long distances for appointments, incur additional costs for multiple visits, and take time from agricultural work or other livelihood activities. Non-attendance at follow-up appointments prevents necessary denture adjustments, contributing to discomfort and functional problems that might lead patients to abandon denture use and conclude that prosthodontic treatment was unsuccessful. The cyclical pattern of failed treatment experiences, patient dissatisfaction, and

negative community reputation of dental services perpetuates barriers to care access as community members hear disappointing testimonials from previous patients.

9. Policy and Governance Issues

Health policy frameworks, governance structures, and regulatory environments fundamentally shape the context within which prosthodontic services can be developed and delivered in rural African settings. Policy and governance challenges operate across multiple dimensions from national health planning through professional regulation to quality assurance systems.

9.1 Oral Health Policy Development and Implementation

Oral health policy in many African countries remains underdeveloped, with limited integration of oral health into national health strategic plans, inadequate policy frameworks addressing dental workforce development and service delivery, and minimal allocation of policy attention to prosthodontic care specifically. Analysis of national health policy documents from the nine study countries revealed that only four had standalone oral health policies, while the others included oral health peripherally within broader health sector plans or omitted substantive oral health policy content entirely. Even where oral health policies exist, implementation remains weak due to limited political prioritization, insufficient budget allocation, and absence of accountability mechanisms ensuring policy translation into programmatic action.

The marginalization of oral health in policy agendas reflects multiple factors including limited advocacy capacity of dental professional associations, the non-emergency nature of most oral conditions that reduces political visibility compared to acute health crises, competing demands from other health priorities in resource-constrained environments, and the perception that oral health represents an individual responsibility rather than public health concern. Prosthodontic services face particular neglect within policy frameworks, viewed as rehabilitative care that falls outside essential healthcare packages focused on preventive and curative interventions addressing high-burden disease conditions.

Policy development processes often exclude stakeholders from rural communities and dental service providers working in resource-limited settings, relying instead on urban-based policy elites whose perspectives may not reflect rural realities and priorities. This exclusion results in policies that, even when well-intentioned, lack practical relevance to rural implementation contexts and fail to address the specific barriers rural populations face in accessing prosthodontic care. Participatory policy development approaches that engage rural communities, frontline dental workers, and local health managers could produce more context-appropriate policies but remain rarely employed in oral health policy formulation.

9.2 Health System Governance and Accountability

Governance structures within African health systems influence prosthodontic service delivery through mechanisms including resource allocation decisions, facility management practices, supervision and support systems, and performance monitoring frameworks. Weak governance at facility and district levels manifests in irregular supervision of dental services, limited managerial attention to dental program performance, absence of service delivery standards and protocols for prosthodontic care, and inadequate quality assurance mechanisms ensuring acceptable treatment outcomes.

Accountability mechanisms within public health systems rarely extend to dental services, with performance measurement frameworks focused on indicators such as immunization coverage, facility delivery rates, and disease notification that exclude oral health metrics. The absence of dental service indicators from routine health management information systems renders prosthodontic service provision invisible to managers and policy makers, precluding evidence-based decision-making about resource allocation and program improvement. Where data collection systems for dental services exist, they often capture only service volumes such as number of extractions performed, omitting quality dimensions, patient satisfaction, treatment outcomes, and access equity considerations essential for comprehensive performance assessment.

Corruption and informal payment practices affect healthcare delivery in some African contexts, potentially creating additional barriers to prosthodontic access. Informal fees demanded by healthcare workers beyond official charges, diversion of materials intended for public facilities to private practice, and preferential treatment for patients with financial or social connections compromise equitable access and increase costs for vulnerable populations. While the extent of such practices varies widely across countries and facilities, their presence in some contexts undermines health system integrity and further disadvantages rural populations seeking prosthodontic care.

9.3 Professional Regulation and Standards

Regulatory frameworks governing dental professional practice exhibit substantial variation across African countries in terms of comprehensiveness, enforcement capacity, and relevance to contemporary practice realities. Dental professional councils or regulatory boards exist in most countries to oversee registration, licensing, scope of practice definition, and professional conduct, but their effectiveness varies considerably. Some regulatory bodies maintain outdated legislation from colonial eras, limited enforcement mechanisms, inadequate resources for regulatory oversight, and minimal engagement with issues specific to rural practice and service delivery innovation.

Scope of practice regulations for mid-level dental providers including dental therapists, dental nurses, and clinical officers remain ambiguous or restrictive in many countries, limiting their potential contributions to prosthodontic service delivery through task-shifting approaches. Regulatory frameworks developed when dentists were the sole providers of all dental services often prohibit other cadres from performing procedures they are technically capable of executing, creating artificial workforce constraints. Regulatory modernization to enable appropriately trained mid-level providers to deliver prosthodontic services within defined competency frameworks could expand rural service access but faces professional opposition and regulatory inertia.

Quality standards for prosthodontic care, including specifications for denture design, material requirements, fabrication protocols, and clinical outcome expectations, remain poorly defined in many African regulatory frameworks. The absence of explicit quality standards permits wide variations in practice, potentially compromising patient safety and treatment effectiveness without mechanisms for identifying and addressing substandard care. Professional associations could contribute to standard development and quality assurance, but their capacity remains limited and their membership predominantly comprises urban private practitioners whose priorities may not align with rural public sector service improvement.

9.4 Integration with General Health Services

The degree of integration between dental services and general health services influences prosthodontic care accessibility and efficiency. Most African health systems maintain vertical organizational structures where dental services operate separately from general medical services with limited coordination, referral pathways, or shared resources. This separation creates inefficiencies including duplication of infrastructure, missed opportunities for shared equipment and facilities, limited cross-referral between medical and dental services for patients with interrelated health conditions, and perpetuation of the perception that oral health exists outside mainstream healthcare.

Integration models that incorporate dental services within comprehensive primary healthcare teams offer potential advantages including improved access through presence of dental services in general health facilities, enhanced holistic patient care addressing oral and systemic health connections, opportunities for shared training and support supervision, and more efficient resource utilization. However, implementation faces challenges including resistance from dental professionals concerned about loss of professional identity, the specialized equipment and expertise required for dental care that differs from general medical services, and health system reform challenges associated with restructuring established service delivery patterns.

Specific to prosthodontics, integration opportunities include collaboration between dental and medical services for nutritional assessment and support for edentulous patients, coordination of care for patients with systemic conditions affecting prosthodontic treatment such as diabetes or

osteoporosis, and referral pathways connecting medical services that identify patients with prosthodontic needs to appropriate dental services. Real

izing these integration benefits requires deliberate system design, training of general health workers to recognize prosthodontic needs and make appropriate referrals, and establishment of bidirectional communication channels between dental and medical services.

10. Case Studies and Illustrative Examples

To provide concrete illustration of the challenges documented in this analysis, this section presents case studies from specific healthcare facilities and prosthodontic service delivery experiences that exemplify the barriers rural populations encounter in accessing removable prosthodontic care.

10.1 Case Study: Rural District Hospital in Western Kenya

A district hospital serving a rural catchment population of approximately 250,000 in Western Kenya attempted to establish prosthodontic services in 2018 following advocacy from a newly recruited dental officer and community requests from elderly residents. The facility allocated one room for dental services equipped with a donated dental chair, basic hand instruments, and a commitment to procure prosthodontic materials through the county health department supply system.

During the first six months, the dental officer examined 43 patients presenting with prosthodontic needs, predominantly complete edentulism in patients aged 55-78 years. Impressions were successfully taken for 28 patients using alginate impression material. However, the facility lacked an on-site dental laboratory and arrangements were made to send impressions to a commercial laboratory in Nairobi, located 350 kilometers away. Transportation logistics proved challenging, with impressions accumulating for several weeks until sufficient numbers justified the transport costs. During transit, several impressions were damaged and required patient recall for repeat impressions, which seven patients did not attend.

Material stock-outs created additional barriers. The alginate impression material was depleted after the initial patient cohort, and subsequent procurement orders were delayed for three months due to bureaucratic procurement procedures and county budget constraints. Artificial teeth in appropriate sizes were unavailable in the regional medical supply chain, requiring direct importation from international suppliers with associated customs clearance complications. By the end of the first year, only 11 of the original 28 patients had received completed dentures, with average treatment duration of 7.5 months from initial impression to denture delivery.

Patient feedback revealed mixed satisfaction levels. While some patients expressed gratitude for restored function and improved ability to eat diverse foods, others complained about denture

discomfort, poor retention, and speech difficulties. Follow-up adjustment appointments were poorly attended due to transportation costs and time constraints during agricultural planting and harvest seasons. The dental officer lacked formal prosthodontic training beyond undergraduate curriculum, having fabricated only five complete dentures during dental school training, and felt uncertain about troubleshooting complex clinical problems including managing severely resorbed ridges and addressing patient complaints.

By mid-2020, prosthodontic services had essentially ceased due to COVID-19 pandemic restrictions on non-emergency dental procedures, material supply disruptions, and reallocation of the dental officer to emergency medical response activities. Attempts to resume services in 2021 faced renewed challenges including departure of the trained dental officer to private urban practice, inadequate material budget allocation from the county government, and non-functional dental equipment that had deteriorated during the service suspension period. As of the study conclusion in 2024, the facility provided only emergency extractions and basic restorative care, with no prosthodontic services available to the rural population.

10.2 Case Study: Mobile Dental Clinic Program in Rural Tanzania

A faith-based medical mission organization operated a mobile dental clinic serving remote villages in rural Tanzania, visiting each community quarterly to provide dental services including extractions, health education, and prosthodontic care. The program employed a dental therapist trained in complete denture fabrication, supported by international volunteer dentists during annual mission trips. The mobile unit contained a portable dental chair, basic instruments, and supplies for impression taking and temporary restorative care.

The prosthodontic service delivery model involved taking impressions during community visits, transporting impressions to a dental laboratory in a regional town 200 kilometers away, and returning to deliver completed dentures during subsequent quarterly visits. This model created a minimum three-month interval between impressions and denture delivery, assuming no complications or delays. In practice, laboratory backlogs, transportation challenges, and scheduling complications often extended treatment duration to 6-9 months.

Community demand for prosthodontic services exceeded capacity significantly. During a typical village visit, the dental therapist would examine 40-60 patients, with approximately 15-20 requiring prosthodontic treatment. Resource constraints limited impression-taking to 5-8 patients per visit, creating waiting lists that extended for years as patients competed for limited appointment slots. Priority allocation became a source of community tension, with accusations of favoritism when certain individuals received treatment before others who had waited longer.

Patient financial contributions represented another challenge. The mission organization charged subsidized fees of approximately $25 per complete denture to partially offset material and laboratory costs, with indigent patients receiving free treatment through donor sponsorship.

However, even these reduced fees exceeded affordability for many rural households, and the screening process for indigence created administrative burden and sometimes excluded deserving patients who did not meet formal poverty criteria despite genuine financial hardship.

Treatment quality concerns emerged related to the extended timeframes between clinical appointments. Patients experienced changes in residual ridge morphology due to continued resorption during the months between impression and denture delivery, resulting in dentures with suboptimal fit requiring extensive adjustment. The quarterly visit schedule limited opportunities for timely adjustments, forcing patients to either tolerate discomfort until the next scheduled visit or travel independently to the regional town dental facility, an option that few patients could afford.

The program demonstrated some notable successes despite these challenges. Over a five-year period, approximately 180 patients received complete or partial dentures, representing meaningful improvement in their nutritional intake, social participation, and quality of life based on follow-up surveys. Patient testimonials documented appreciation for restored chewing function, improved appearance, and enhanced self-confidence. Several patients reported economic benefits including ability to return to agricultural work that required adequate dentition and increased social interaction facilitating business opportunities.

However, sustainability concerns persisted. The program depended heavily on donor funding that fluctuated annually, creating uncertainty about service continuity. Equipment maintenance posed ongoing challenges, with the portable dental chair requiring repeated repairs that were difficult to obtain in rural Tanzania. Staff turnover when the trained dental therapist relocated for family reasons created a six-month service gap until a replacement could be recruited and trained. These experiences illustrated the fragility of externally supported service delivery models that, while valuable, operate outside integrated health system structures and face sustainability vulnerabilities when external support fluctuates.

10.3 Case Study: Community-Based Prosthodontic Program in Rural Ethiopia

A community-based prosthodontic program in rural Ethiopia attempted an innovative service delivery model partnering with local health extension workers to identify edentulous individuals requiring treatment and provide community-level oral health education. The program, implemented through a government health center supported by an international NGO, trained health extension workers in basic oral screening and referral protocols while establishing prosthodontic services at the health center level.

The health extension workers, predominantly women with secondary education and one year of health training, conducted household visits in their assigned villages, identifying elderly residents with complete or partial edentulism and educating families about prosthodontic treatment availability. This community-based screening identified substantially higher numbers

of individuals requiring prosthodontic care than traditional passive case-finding through facility visits, revealing the extent of unmet need in the rural population.

However, capacity to respond to identified needs fell far short of requirements. The health center dental clinic, staffed by a single dental nurse with basic prosthodontic training, could fabricate approximately 3-4 complete dentures monthly given time constraints from other dental service demands and the multi-step denture fabrication process. With health extension workers identifying 40-60 edentulous individuals requiring treatment across the health center catchment area, the gap between need and service capacity created a waiting list exceeding two years duration.

Economic barriers compounded access challenges despite the program's emphasis on reaching poor rural populations. The health center charged a cost-recovery fee of $30 per denture set to sustain material procurement, a sum representing nearly two months' income for impoverished rural households. The NGO provided subsidy vouchers covering 50% of treatment costs for identified vulnerable individuals including elderly poor, persons with disabilities, and female-headed households, but voucher availability was limited to approximately 50 annually across the health center catchment. Many screened individuals who recognized their prosthodontic needs following health extension worker education could not afford treatment despite motivation and facility proximity.

Cultural factors influenced program participation patterns in unexpected ways. Some elderly individuals, particularly women, declined referral for prosthodontic evaluation despite health extension worker encouragement, expressing beliefs that tooth loss represented God's will or natural aging that should be accepted rather than opposed. Others worried that denture use might violate cultural norms or make them appear vain, especially in contexts where few community members had dentures and denture wearers might be viewed as attempting to appear younger or wealthier than appropriate for their social position.

The program implemented several innovative adaptations to address challenges encountered. Group health education sessions conducted by health extension workers in community gathering spaces provided information about oral health, causes of tooth loss, prosthodontic treatment options, and denture care, helping to address knowledge gaps and cultural misconceptions. Flexible payment arrangements allowed patients to pay for treatment in installments over several months rather than requiring full upfront payment, improving affordability for some households. Partnership with local savings and credit cooperatives explored micro-financing mechanisms to support prosthodontic treatment costs, with mixed success as loan interest rates and repayment requirements created their own barriers.

Despite implementation challenges, the program demonstrated that community-based approaches could improve prosthodontic service awareness and access in rural populations. Over three years, 142 patients received complete or partial dentures, substantially exceeding the numbers served

through traditional facility-based models in comparable settings. Patient satisfaction surveys indicated 76% satisfaction rates, with positive impacts on nutrition, social participation, and psychological wellbeing. The program also stimulated community dialogue about elder care and the importance of oral health, contributing to gradual shifts in cultural attitudes toward dental care and aging.

11. Discussion

The findings of this retrospective analysis reveal that challenges in providing removable prosthodontic care in rural African settings operate at multiple, interconnected levels, creating a complex web of barriers that collectively result in severely limited access to essential dental rehabilitation services for the majority of rural populations requiring such care. The infrastructure, human resource, material supply, economic, sociocultural, and policy challenges documented across the nine study countries demonstrate remarkable consistency despite variations in national economic development levels, health system structures, and cultural contexts, suggesting that common structural factors underlie prosthodontic service delivery challenges across diverse African settings.

11.1 Systemic Nature of Access Barriers

A central finding of this analysis is that prosthodontic care access challenges cannot be reduced to single factors but reflect systemic inadequacies spanning multiple health system building blocks. Infrastructure deficiencies limit where services can be provided, human resource shortages determine whether qualified practitioners are available, material supply challenges affect whether treatments can be completed, economic barriers influence whether services are affordable, sociocultural factors shape whether populations seek care, and policy gaps determine whether prosthodontics receives priority attention and resource allocation. These challenges reinforce each other in ways that magnify their individual impacts and create barriers that are greater than the sum of their constituent parts.

For example, a facility may have infrastructure capacity for dental services but lack trained prosthodontists, or may have qualified personnel but experience material stock-outs, or may have both capacity and materials but serve populations who cannot afford treatment costs. The multiplicative nature of these barriers means that addressing any single challenge in isolation produces limited improvement in access outcomes, as remaining barriers continue to prevent service delivery. This systemic character necessitates comprehensive, multi-level interventions addressing infrastructure, workforce, supply systems, financing, community engagement, and policy simultaneously to achieve meaningful access improvements.

The interconnections between different challenges also create potential leverage points where interventions addressing one challenge can produce ripple effects ameliorating others. For instance, training mid-level dental providers in prosthodontics addresses workforce shortages

while potentially reducing service costs through lower salary requirements compared to specialist prosthodontists, creating affordability improvements. Similarly, establishing local dental laboratories addresses material supply and service delivery challenges while creating employment opportunities and building local technical capacity. Identifying and exploiting these interconnections offers strategic opportunities for efficient intervention design that maximizes impact relative to resource investment.

11.2 Equity Dimensions and Vulnerable Populations

The analysis reveals stark inequities in prosthodontic care access across multiple dimensions including geographical location, socioeconomic status, gender, and age. Rural populations experience profoundly worse access than urban populations, poor individuals receive substantially less care than wealthy individuals despite often having greater clinical needs, women face gendered barriers that reduce their access relative to men, and elderly individuals who constitute the primary population requiring prosthodontic care occupy marginalized positions in household and societal resource allocation.

These inequities reflect broader patterns of health system inequity where services become increasingly available to those with greater socioeconomic resources and social power while remaining inaccessible to vulnerable populations who experience the greatest burden of disease and disability. The concentration of dental professionals, facilities, and services in urban areas serving predominantly middle-class and wealthy populations perpetuates a situation where prosthodontic care functions as a luxury good accessible primarily to those who need it least, while remaining unavailable to impoverished rural populations experiencing high rates of edentulism and its functional consequences.

Addressing these inequities requires deliberate policy interventions that prioritize rural service development, target subsidies toward poor and vulnerable populations, implement gender-responsive service delivery models that recognize and accommodate women's specific constraints, and ensure that elderly individuals' health needs receive appropriate attention within family and societal resource allocation. Equity considerations should inform decisions about resource allocation, facility location, workforce deployment, and service design to ensure that prosthodontic services reach those with greatest need rather than those with greatest ability to pay.

11.3 Sustainability and Long-term Service Development

The case studies and facility experiences documented in this analysis reveal persistent challenges in sustaining prosthodontic services in rural settings. Many facilities have initiated prosthodontic programs that subsequently declined or ceased due to staff turnover, material supply interruptions, equipment failures, funding shortfalls, or other sustainability challenges. This pattern of cyclical service availability undermines community confidence, wastes initial

investments, and fails to produce the sustained service access required to address population prosthodontic needs.

Sustainability requires attention to multiple dimensions including financial sustainability through reliable funding sources that cover operational costs, technical sustainability through equipment maintenance systems and reliable material supply chains, workforce sustainability through recruitment and retention of qualified personnel, and institutional sustainability through integration of prosthodontic services within routine health system operations rather than as externally funded projects with finite timeframes. Achieving sustainability necessitates transition from donor-dependent project approaches to institutionalized service delivery models with government ownership, adequate budget allocation, and integration within health system structures and accountability mechanisms.

The role of external funding from development partners and NGOs presents complex considerations. While external support has enabled prosthodontic service delivery in contexts where government resources prove insufficient, donor-funded programs often create sustainability vulnerabilities when funding ends. Experiences across the study sites demonstrate that programs designed with insufficient attention to sustainability face predictable declines when external support concludes. Future external investments in prosthodontic service development should prioritize capacity building, system strengthening, and transition planning that enable services to continue after donor funding ends, rather than creating dependency on ongoing external support.

11.4 Comparative Perspectives and Lessons from Other Contexts

The challenges documented in this analysis of rural African prosthodontic care share features with service delivery barriers in other resource-limited settings globally while also exhibiting specificities related to African contexts. Similar challenges have been documented in rural areas of South and Southeast Asia, Latin America, and other developing regions, suggesting that infrastructure inadequacies, workforce shortages, material supply challenges, and economic barriers represent common structural features of health systems in low and middle-income countries rather than uniquely African phenomena.

However, certain dimensions appear particularly pronounced in African contexts including the extent of rural-urban health disparities, the severity of workforce shortages, the fragmentation of health systems with limited integration of services, and the persistence of material supply chain challenges. Additionally, the specific cultural contexts, linguistic diversity, traditional medicine systems, and historical patterns of health system development create context-specific challenges requiring solutions tailored to African realities rather than uncritical adoption of models developed in other global regions.

Comparative analysis also reveals successful innovations from other resource-limited settings that offer potential adaptability to African contexts. Task-shifting models successfully implemented in Southeast Asian countries demonstrate that trained mid-level providers can deliver quality prosthodontic care when provided with appropriate training, supervision, and referral support. Community-based service delivery models from Latin America illustrate approaches for engaging communities in identifying needs and facilitating access. Public-private partnership arrangements from South Asian countries offer potential financing and service delivery mechanisms. Critical evaluation of these international experiences for relevance and adaptability to African contexts could inform innovation in service delivery approaches.

11.5 Role of Technology and Innovation

Technological innovations offer potential avenues for addressing some prosthodontic service delivery challenges, though implementation faces significant barriers in rural African settings. Digital prosthodontics including computer-aided design and computer-aided manufacturing (CAD/CAM) of dentures presents theoretical advantages including reduced clinical time, improved precision, and simplified laboratory workflows. However, the high capital costs of digital equipment, requirement for reliable electricity and internet connectivity, need for technical expertise, and dependence on proprietary materials and software limit current applicability in resource-constrained rural African facilities.

Simplified prosthodontic techniques adapted to resource-limited settings represent more immediately applicable innovations. Simplified impression techniques requiring fewer materials and equipment, streamlined denture fabrication protocols that reduce laboratory complexity, and standardized denture tooth setups that decrease chair time show promise for improving service efficiency and accessibility. Research validating simplified approaches and training practitioners in their application could enable expanded service delivery with existing resource constraints.

Teledentistry and mobile health technologies offer potential for extending specialist expertise to rural areas through remote consultation, treatment planning support, and continuing professional development for rural practitioners. However, implementation requires telecommunications infrastructure, digital literacy among practitioners and patients, and regulatory frameworks that accommodate remote service delivery models. While current applicability remains limited, continued expansion of mobile phone networks and internet connectivity across Africa suggests growing potential for technology-enabled service delivery innovations in coming years.

11.6 Research Gaps and Future Investigation Needs

This retrospective analysis identifies numerous research gaps requiring future investigation to inform evidence-based policy and practice development. The lack of reliable epidemiological data on edentulism prevalence, prosthodontic treatment needs, and existing service coverage across African countries hampers rational planning and resource allocation. Investment in oral

health surveillance systems and population-based oral health surveys would provide essential data for needs assessment and priority setting.

Cost-effectiveness analysis of prosthodontic interventions in African contexts remains limited, constraining ability to make evidence-based arguments for resource allocation and priority setting. Research examining costs, health impacts, and cost-effectiveness of different prosthodontic service delivery models would inform policy decisions about optimal approaches for resource-limited settings. Similarly, implementation research examining barriers and facilitators to successful prosthodontic service delivery, effective approaches for community engagement, and sustainable service delivery models would generate practical knowledge to guide program design.

Clinical research adapted to African contexts is needed to validate simplified prosthodontic techniques, evaluate outcomes of task-shifted care delivered by mid-level providers, assess longevity and performance of dentures fabricated with different materials and techniques, and identify approaches for managing common clinical challenges encountered in rural practice. Such research would build evidence base for context-appropriate clinical protocols and practice guidelines.

Qualitative research exploring patient perspectives, cultural beliefs, and community understandings of oral health and prosthodontic care would inform culturally appropriate service delivery models and health communication strategies. Research examining health system factors including governance, financing mechanisms, workforce development, and integration of dental services within primary healthcare would generate insights for system strengthening interventions.

12. Recommendations

Based on the comprehensive analysis of challenges in providing removable prosthodontic care in rural African settings, this section presents evidence-based recommendations addressing policy, health system strengthening, service delivery, workforce development, and research domains. These recommendations aim to provide actionable guidance for governments, health system managers, development partners, professional associations, and other stakeholders working to improve prosthodontic care access in underserved populations.

12.1 Policy-Level Recommendations

National governments should develop and implement comprehensive oral health policies that explicitly include prosthodontic services as essential health services requiring adequate resource allocation and systematic service delivery planning. Oral health policies should be integrated within national health strategic plans rather than existing as standalone documents with limited implementation accountability. Policy frameworks should establish clear targets for

prosthodontic service coverage, specify resource allocation commitments, define service delivery standards, and establish monitoring and evaluation systems to track progress toward access equity objectives.

National health insurance schemes and social health protection programs should expand benefit packages to include prosthodontic services with appropriate cost-sharing arrangements that protect poor and vulnerable populations from financial barriers. Benefit design should consider tiered coverage with higher subsidies for indigent populations, elderly individuals, and other priority groups while allowing moderate cost-sharing for non-poor beneficiaries to promote financial sustainability. Insurance coverage for prosthodontics would reduce household financial burdens, improve service affordability, and create sustainable financing streams for service delivery.

Governments should implement incentive schemes to attract and retain dental professionals in rural practice including rural allowances, provision of housing and transportation, accelerated career progression opportunities, continuing professional development support, and student loan forgiveness programs for practitioners committing to rural service. Policy frameworks should also facilitate task-shifting by updating scope of practice regulations to authorize appropriately trained mid-level providers to deliver prosthodontic care within defined competencies and supervision frameworks, expanding workforce capacity to meet rural service needs.

Regional integration and South-South cooperation mechanisms should be strengthened to facilitate knowledge sharing, joint training programs, harmonization of professional standards, and collaborative procurement of dental materials and equipment. Regional bodies such as the African Union and Regional Economic Communities should prioritize oral health within health policy agendas and facilitate cross-border collaboration addressing shared challenges.

12.2 Health System Strengthening Recommendations

Infrastructure development should prioritize establishment of dental treatment facilities in rural health centers and district hospitals, ensuring adequate physical space, reliable electricity and water supply, appropriate equipment, and laboratory facilities necessary for prosthodontic service delivery. Investment should emphasize sustainable infrastructure including renewable energy solutions, water harvesting and purification systems, and appropriate technology choices matched to local maintenance capacity and resource availability.

Material supply systems should be strengthened through improved procurement planning incorporating dental materials within essential health products lists, establishment of reliable distribution networks reaching rural facilities, implementation of inventory management systems preventing stock-outs and expiration of materials, and development of local or regional manufacturing capacity for basic dental products where economically viable. Bulk procurement

arrangements through international organizations or regional procurement mechanisms could leverage economies of scale to reduce costs and improve supply reliability.

Dental laboratory infrastructure requires substantial strengthening including establishment of regional dental laboratories serving multiple rural facilities, provision of essential equipment and consumables, training of adequate numbers of dental technicians, and implementation of quality assurance systems ensuring acceptable technical standards. Public-private partnerships could mobilize private sector laboratory capacity to serve rural populations through contractual arrangements combining government infrastructure support with private sector technical expertise and efficiency.

Health information systems should incorporate dental service indicators within routine data collection and reporting frameworks, enabling monitoring of service coverage, identification of underserved populations, tracking of key performance indicators, and evidence-based management decision-making. Digital health solutions including electronic dental records, teledentistry platforms, and mobile applications for patient education and appointment management should be explored where telecommunications infrastructure permits.

12.3 Service Delivery Model Innovations

Mobile and outreach service delivery models should be expanded and optimized to reach geographically isolated populations, incorporating appropriate scheduling ensuring adequate follow-up opportunities, efficient logistics minimizing transportation costs and time, integration with community health programs to maximize reach, and partnerships with local organizations facilitating community engagement and patient mobilization.

Hub-and-spoke service delivery models could concentrate specialized prosthodontic expertise and laboratory facilities at district or regional hubs while deploying trained mid-level providers to peripheral health centers for preliminary procedures including screening, patient education, impressions, and follow-up adjustments. This model balances efficiency gains from centralized specialized capacity with improved geographic access through peripheral service points, requiring robust referral systems and communication linkages between hub and spoke facilities.

Community-based screening and referral programs engaging community health workers, village health committees, and local leaders can improve identification of individuals requiring prosthodontic care, provide health education addressing knowledge gaps and cultural misconceptions, facilitate patient navigation supporting transport arrangements and appointment attendance, and enable monitoring of service quality and patient outcomes. Community engagement creates demand for services while ensuring accountability to populations served.

Public-private partnerships should be explored as mechanisms for expanding service delivery through models including government contracting of private practitioners to provide services in

rural facilities, franchise arrangements where private providers operate under standardized protocols with government support and oversight, and social enterprise models cross-subsidizing rural services from urban revenue streams. Partnership arrangements require careful design ensuring accountability, quality assurance, and equitable access rather than cream-skimming of profitable services while neglecting unprofitable rural populations.

12.4 Workforce Development Recommendations

Dental education institutions should reform curricula to strengthen prosthodontic training ensuring graduates possess competencies required for rural practice, incorporate rural health rotations exposing students to rural practice realities and building rural practice interest, emphasize simplified techniques appropriate for resource-limited settings, and integrate public health perspectives emphasizing equity and population-level service delivery alongside clinical skill development.

Mid-level dental provider training programs should be expanded with curricula explicitly incorporating prosthodontic competencies appropriate to their scope of practice. Task-sharing frameworks should define clear roles for different provider cadres with prosthodontists managing complex cases, general dentists providing standard prosthodontic care, and trained mid-level providers delivering basic prosthodontic services for uncomplicated cases under appropriate supervision. Interprofessional education preparing different cadres to function effectively within collaborative team-based models would support implementation of task-sharing approaches.

Continuing professional development systems should provide ongoing training opportunities for rural practitioners through approaches including distance learning programs, regional workshops, mentorship and supervision programs linking rural practitioners with specialist consultants, and professional networks facilitating peer learning and case discussion. Investment in continuing education infrastructure including internet connectivity enabling access to online resources and telecommunications supporting remote consultation would enhance rural practitioner capacity and reduce professional isolation.

Dental technician training programs require expansion to address severe shortages constraining prosthodontic service delivery. Training should emphasize practical skills, appropriate technology use, quality control, and professional ethics while incorporating entrepreneurship education supporting establishment of private laboratories in underserved areas as viable business ventures contributing to local economic development alongside expanded service access.

12.5 Community Engagement and Health Promotion Recommendations

Comprehensive oral health promotion programs should be implemented addressing knowledge gaps regarding prosthodontic treatment options, challenging cultural beliefs that normalize

edentulism as inevitable, promoting tooth preservation through preventive care, and building community awareness of connections between oral health and overall wellbeing. Health promotion should utilize multiple channels including community meetings, religious institutions, schools, radio programs, and community health worker home visits to reach diverse population segments.

Participatory approaches engaging communities in identification of oral health priorities, design of service delivery models, and monitoring of service quality promote local ownership and ensure cultural appropriateness of interventions. Community advisory committees including diverse representation across age, gender, and socioeconomic groups can provide valuable input to service planning and create accountability mechanisms ensuring services respond to community needs and preferences.

Social mobilization addressing stigma associated with denture use and promoting positive attitudes toward prosthodontic treatment could include peer education programs where satisfied denture users share experiences with community members, engagement of respected community leaders and elders as prosthodontic service champions, and integration of oral health messages within existing community development programs addressing aging, nutrition, and wellbeing.

Gender-responsive programming should recognize and address women's specific barriers to prosthodontic access including limited financial autonomy, restricted mobility, competing care responsibilities, and lower priority in household resource allocation. Interventions might include women-focused health education sessions, flexible appointment scheduling accommodating women's time constraints, provision of transportation support or mobile services reaching women unable to travel independently, and engagement of male family members in understanding women's prosthodontic needs and supporting access.

12.6 Research and Knowledge Generation Recommendations

Operational research should be prioritized investigating implementation questions central to service delivery improvement including optimal service delivery models for rural contexts, effective approaches for community engagement, strategies for improving treatment adherence and follow-up attendance, cost-effective material and equipment choices, and approaches for ensuring service quality and patient satisfaction. Research should employ participatory methodologies engaging frontline providers and communities in problem identification and solution development.

Economic evaluation research should examine costs, cost-effectiveness, and financial sustainability of different prosthodontic service delivery approaches providing evidence for resource allocation decisions and policy prioritization. Research should consider multiple outcome dimensions including clinical outcomes, functional improvement, quality of life

impacts, and economic productivity effects to comprehensively assess prosthodontic intervention value.

Epidemiological research establishing reliable data on edentulism prevalence, prosthodontic treatment needs, and existing service coverage would support needs assessment and service planning. Population-based oral health surveys incorporating standardized methodologies enabling international comparisons should be conducted regularly to monitor trends and evaluate impacts of policy interventions.

Clinical research validating simplified prosthodontic techniques adapted to resource-limited settings, evaluating outcomes of care provided by task-shifted mid-level providers, and examining long-term performance of dentures fabricated using different materials and protocols would generate evidence base for context-appropriate clinical practice guidelines. Research should emphasize pragmatic trial designs with high external validity reflecting actual rural practice conditions.

Implementation science research examining barriers and facilitators affecting intervention uptake, mechanisms of successful scale-up from pilot projects to system-wide implementation, and processes of sustained integration within health systems would generate practical knowledge supporting effective translation of research findings into routine practice and policy.

Table 1: Distribution of Healthcare Facilities and Dental Services Across Study Countries

Country	Rural Facilities Surveyed	Facilities with Dental Services (%)	Facilities Offering Prosthodontics (%)	Dentist-to-Population Ratio	Dental Technician-to-Population Ratio
Kenya	18	61.1%	22.2%	1:85,000	1:650,000
Tanzania	16	56.3%	18.8%	1:125,000	1:450,000
Uganda	12	50.0%	16.7%	1:110,000	1:550,000
Ethiopia	15	46.7%	13.3%	1:150,000	1:800,000
Ghana	14	64.3%	28.6%	1:72,000	1:420,000
Nigeria	21	57.1%	19.0%	1:95,000	1:580,000
Malawi	11	45.5%	9.1%	1:180,000	1:900,000

Country	Rural Facilities Surveyed	Facilities with Dental Services (%)	Facilities Offering Prosthodontics (%)	Dentist-to-Population Ratio	Dental Technician-to-Population Ratio
Zambia	10	50.0%	20.0%	1:105,000	1:520,000
South Africa	10	70.0%	30.0%	1:48,000	1:280,000
Overall	**127**	**55.9%**	**19.7%**	**1:97,000**	**1:520,000**

Note: Data compiled from healthcare facility surveys and national health workforce registries, 2023-2024.

Table 2: Infrastructure and Equipment Availability in Rural Healthcare Facilities

Infrastructure/Equipment Component	Percentage of Facilities with Component	Percentage Functional
Dedicated dental treatment room	42.0%	87.0%
Reliable electricity supply	32.0%	68.0%
Consistent water supply	46.0%	73.0%
Functional dental chair	31.0%	53.0%
Autoclave for sterilization	36.0%	71.0%
Basic prosthodontic instruments	28.0%	82.0%
Impression trays (complete set)	23.0%	89.0%
Articulator	18.0%	78.0%
On-site dental laboratory	12.0%	58.0%
Laboratory equipment (flasks, lathes, etc.)	9.0%	44.0%

Note: Data from facility infrastructure assessments conducted 2022-2024 across 127 rural healthcare facilities.

Table 3: Material Availability and Stock-Out Frequency

Material Category	Facilities Stocking Material (%)	Average Stock-Out Duration per Year (weeks)	Percentage Experiencing Stock-Outs
Alginate impression material	47.0%	8.3	73.0%
Denture base resin (acrylic)	34.0%	11.6	79.0%
Artificial teeth	29.0%	14.2	82.0%
Laboratory consumables	22.0%	16.8	86.0%
Dental cement	58.0%	5.1	62.0%
Sterilization supplies	41.0%	7.4	68.0%
Personal protective equipment	52.0%	9.7	71.0%

Note: Data from material procurement and inventory records, 2020-2024. Stock-outs calculated as average weeks per year when materials were unavailable.

Table 4: Economic Barriers to Prosthodontic Care Access

Economic Factor	Median Value	Range	Impact on Access
Direct cost of complete denture (USD)	$75	$45-$280	High barrier
Average rural monthly household income (USD)	$82	$30-$165	-
Cost as percentage of monthly income	91%	27%-933%	Catastrophic
Transportation cost per facility visit (USD)	$8	$3-$25	Moderate barrier

Economic Factor	Median Value	Range	Impact on Access
Number of visits required for treatment	4.5	3-7	Time/cost multiplier
Total indirect costs (USD)	$42	$18-$120	Substantial barrier
Percentage of patients abandoning treatment due to cost	38%	22%-61%	Major access barrier

Note: Economic data compiled from patient surveys and household economic assessments, 2021-2024.

Table 5: Treatment Outcomes and Patient Satisfaction

Outcome Measure	Percentage/Value	95% Confidence Interval
Treatment completion rate	61.3%	57.8%-64.8%
Patient satisfaction (satisfied/very satisfied)	72.6%	68.9%-76.3%
Denture retention problems reported	44.2%	40.1%-48.3%
Speech difficulties reported	31.7%	27.9%-35.5%
Chewing ability improvement (self-reported)	78.9%	75.4%-82.4%
Willingness to recommend treatment to others	81.3%	77.9%-84.7%
Follow-up appointment attendance rate	47.8%	43.7%-51.9%
Denture use at 12-month follow-up	84.6%	81.2%-88.0%

Note: Data from patient follow-up surveys and clinical outcome assessments, n=486 patients across study sites, 2019-2023.

13. Conclusion

This retrospective analysis has comprehensively examined the multifaceted challenges impeding the provision of removable prosthodontic care in rural African settings, revealing that limited access to essential dental rehabilitation services reflects deeply rooted systemic inadequacies

spanning infrastructure, human resources, material supply, financing, sociocultural factors, and policy frameworks. The findings demonstrate that millions of rural Africans experiencing edentulism and its debilitating consequences remain unable to access prosthodontic care that could restore function, improve nutrition, enhance social participation, and contribute meaningfully to quality of life and wellbeing.

The magnitude of unmet prosthodontic need in rural Africa represents not merely a clinical service gap but a fundamental equity issue reflecting broader patterns of health system inequity where services concentrate among urban, wealthy populations while remaining inaccessible to rural, poor, and marginalized populations who experience greatest disease burdens. Addressing prosthodontic care access challenges requires sustained commitment from multiple stakeholders including governments establishing policy frameworks and allocating adequate resources, health system managers implementing effective service delivery models, professional associations supporting workforce development and quality assurance, development partners providing strategic support for system strengthening, and communities actively engaging in health promotion and service accountability.

The path toward improved prosthodontic care access in rural Africa demands comprehensive approaches simultaneously addressing infrastructure development, workforce expansion, material supply chain strengthening, financing reform, community engagement, and policy implementation. Single-dimensional interventions addressing isolated challenges prove insufficient given the systemic, interconnected nature of barriers that collectively create current access inadequacies. However, the examples of innovative programs achieving meaningful improvements despite resource constraints demonstrate that progress is possible when interventions thoughtfully address local contexts, engage communities as partners, leverage available resources creatively, and maintain commitment to equity as a fundamental principle guiding service development.

Looking forward, the continued growth of African populations, ongoing demographic aging increasing numbers of elderly individuals requiring prosthodontic care, persistent challenges in preventive dental care maintaining high rates of tooth loss, and expanding expectations for comprehensive health services all suggest that prosthodontic service needs will intensify in coming decades. Addressing these needs proactively through strategic investments in oral health infrastructure, workforce, and financing presents not only a health imperative but an opportunity to advance broader health equity goals and demonstrate health systems' commitment to comprehensive care addressing all dimensions of human health and dignity.

The evidence presented in this analysis should inform policy dialogue, resource allocation decisions, and program development initiatives seeking to expand prosthodontic care access in underserved African populations. While challenges are substantial, they are not insurmountable. With appropriate political commitment, adequate resource allocation, innovative service delivery

approaches, and sustained engagement of all stakeholders, significant progress toward prosthodontic care equity remains achievable. The fundamental question facing African health systems is not whether prosthodontic services can be provided to rural populations, but whether these systems will prioritize such provision through concrete policy and programmatic action translating commitments to health equity and comprehensive care into lived reality for millions of currently underserved rural Africans.

References

- Adeniyi, A., Sofola, O., & Kalliecharan, R. (2012). An appraisal of the oral health care system in Nigeria. *International Dental Journal*, 62(6), 292-300. https://doi.org/10.1111/j.1875-595X.2012.00122.x
- Benzian, H., Greenspan, J. S., Barrow, J., Hutter, J. W., Loomer, P. M., Stauf acher, S., Perry, D., & Williams, D. M. (2015). A competency matrix for global oral health. *Journal of Dental Education*, 79(4), 353-361.
- Bhayat, A., & Chikte, U. (2019). Human resources for oral health care in South Africa: A 2018 update. *International Journal of Environmental Research and Public Health*, 16(10), 1668. https://doi.org/10.3390/ijerph16101668
- Bolarinwa, O. A. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal*, 22(4), 195-201. https://doi.org/10.4103/1117-1936.173959
- Chen, M., & Andersen, R. M. (2016). The need for dental services by prosthodontic treatment complexity in low-income and rural populations. *Journal of Public Health Dentistry*, 76(2), 102-110.
- Chikte, U. M. E., Pontes, C. C., Karangwa, I., Kimmie-Dhansay, F., Erasmus, R. T., Kengne, A. P., & Matsha, T. E. (2019). Periodontal disease status and associated risk factors in patients with type 2 diabetes mellitus from the Western Cape Province, South Africa. *South African Dental Journal*, 74(1), 11-17.
- Chisumpa, V. H., Odimba, B. F. K., & Chanda, K. (2018). Oral health in Zambia: Opportunities and challenges. *Medical Journal of Zambia*, 45(2), 94-99.
- Gathece, L. W., Makokha, A., & Kakai, P. (2015). Prevalence and perceived outcomes of dental caries and tooth loss in a rural district in Kenya. *Journal of Dental Research in East Africa*, 2(1), 15-21.
- Glick, M., Williams, D. M., Kleinman, D. V., Vujicic, M., Watt, R. G., & Weyant, R. J. (2016). A new definition for oral health developed by the FDI World Dental Federation

opens the door to a universal definition of oral health. *Journal of the American Dental Association*, 147(12), 915-917.

- Hobdell, M., Petersen, P. E., Clarkson, J., & Johnson, N. (2003). Global goals for oral health 2020. *International Dental Journal*, 53(5), 285-288.
- Kamińska, A., Szalewski, L., Batkowska, J., Wallner, J., Wallner, E., Szabelska, A., Borowicz, J., & Borowicz, J. (2016). The dependence of dental caries on oral hygiene habits in preschool children from urban and rural areas in Poland. *Annals of Agricultural and Environmental Medicine*, 23(4), 660-665.
- Kassebaum, N. J., Smith, A. G. C., Bernabé, E., Fleming, T. D., Reynolds, A. E., Vos, T., Murray, C. J. L., Marcenes, W., & GBD 2015 Oral Health Collaborators. (2017). Global, regional, and national prevalence, incidence, and disability-adjusted life years for oral conditions for 195 countries, 1990–2015: A systematic analysis for the global burden of diseases, injuries, and risk factors. *Journal of Dental Research*, 96(4), 380-387.
- Kida, I. A., Åstrøm, A. N., Strand, G. V., Masalu, J. R., & Tsakos, G. (2006). Clinical and socio-behavioral correlates of tooth loss: A study of older adults in Tanzania. *BMC Oral Health*, 6(1), 5. https://doi.org/10.1186/1472-6831-6-5
- Listl, S., Galloway, J., Mossey, P. A., & Marcenes, W. (2015). Global economic impact of dental diseases. *Journal of Dental Research*, 94(10), 1355-1361.
- Makino, Y., Omura, M., Matsumoto, M., Kanegae, H., & Takeda, W. (2020). Influence of complete denture treatment on nutritional status in elderly edentulous people: A systematic review. *Journal of Prosthodontic Research*, 64(4), 357-363.
- Mathur, M. R., Singh, A., Dhillon, H., MTiba, B., & Oberoi, S. S. (2018). Strengthening dentistry in health systems: Opportunities for a paradigm shift. *Journal of Dental Research*, 97(12), 1235-1241.
- Minja, I. K., Nsolo-Yon, K., & Maregesi, B. (2016). Prevalence and correlates of complete edentulism among outpatients at tertiary health facilities in urban Tanzania. *Tanzania Dental Journal*, 19(1), 13-18.
- Müller, F., Naharro, M., & Carlsson, G. E. (2007). What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? *Clinical Oral Implants Research*, 18(Suppl 3), 2-14.
- Musinguzi, N., & Kemoli, A. (2021). Distribution of dental personnel and facilities in Uganda: An equity analysis. *Human Resources for Health*, 19(1), 1-13.

- Ndiaye, C. F., Critchlow, D., Leye, M. M., Cisse, D., Faye, D., & Watt, R. G. (2016). Oral health in sub-Saharan Africa: A scoping review of literature. *African Journal of Oral Health*, 5(1), 17-27.
- Ogunbodede, E. O., Kida, I. A., Madjapa, H. S., Amedari, M., Ehizele, A., Mutave, R., Sodipo, B., & Temilola, S. (2015). Oral health inequalities between rural and urban populations of the African and Middle East region. *Advances in Dental Research*, 27(1), 18-25.
- Osterberg, T., Carlsson, G. E., Tsuga, K., Sundh, V., & Steen, B. (2006). Associations between self-assessed masticatory ability and some general health factors in a Swedish population. *Gerodontology*, 13(2), 110-117.
- Petersen, P. E. (2003). The World Oral Health Report 2003: Continuous improvement of oral health in the 21st century–the approach of the WHO Global Oral Health Programme. Community Dentistry and Oral Epidemiology, 31(Suppl 1), 3-24. https://doi.org/10.1046/j..2003.com122.x
- Petersen, P. E., Bourgeois, D., Ogawa, H., Estupinan-Day, S., & Ndiaye, C. (2005). The global burden of oral diseases and risks to oral health. *Bulletin of the World Health Organization*, 83(9), 661-669.
- Petersen, P. E., & Kwan, S. (2011). Equity, social determinants and public health programmes–the case of oral health. *Community Dentistry and Oral Epidemiology*, 39(6), 481-487. https://doi.org/10.1111/j.1600-0528.2011.00623.x
- Ranganathan, N., &津rnhjelm, L. (2019). Task-shifting in oral health: A global systematic review. *Journal of Public Health Dentistry*, 79(3), 250-262.
- Sharma, G., Pai, K. M., Suhas, K., Ramapuram, J. T., Doshi, D., & Anup, N. (2010). Developing an algorithm for prosthodontic treatment planning using complete denture success quotient. *Journal of Indian Prosthodontic Society*, 10(4), 216-221.
- Sheiham, A., Steele, J. G., Marcenes, W., Finch, S., & Walls, A. W. G. (2001). The relationship among dental status, nutrient intake, and nutritional status in older people. *Journal of Dental Research*, 80(2), 408-413.
- Sheiham, A., & Watt, R. G. (2000). The common risk factor approach: A rational basis for promoting oral health. *Community Dentistry and Oral Epidemiology*, 28(6), 399-406.
- Slade, G. D., & Spencer, A. J. (1994). Development and evaluation of the Oral Health Impact Profile. *Community Dental Health*, 11(1), 3-11.

- Srisilapanan, P., & Korwanich, N. (2016). Differences in the number of natural teeth, denture wearing, chewing ability, and oral health-related quality of life in older adults from urban and rural areas in Northeast Thailand. *Journal of Investigative and Clinical Dentistry*, 7(4), 444-450.
- Taiwo, J. O., & Kolude, B. (2017). Dental service delivery in Nigeria: The place of prosthodontics. *Annals of Medical and Health Sciences Research*, 7(5), 282-286.
- Thorpe, S. (2006). Oral health issues in African countries. *International Dental Journal*, 56(3), 123-126.
- Tsai, C., Hayes, C., & Taylor, G. W. (2002). Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. *Community Dentistry and Oral Epidemiology*, 30(3), 182-192.
- van Wyk, P. J., & van Wyk, C. (2010). Trends in dental caries prevalence, severity and unmet treatment need levels in South Africa between 1983 and 2002. *South African Dental Journal*, 65(7), 310-314.
- Varenne, B., Petersen, P. E., & Ouattara, S. (2004). Oral health status of children and adults in urban and rural areas of Burkina Faso, Africa. *International Dental Journal*, 54(2), 83-89.
- Watt, R. G., Daly, B., Allison, P., Macpherson, L. M., Venturelli, R., Listl, S., Weyant, R. J., Mathur, M. R., Guarnizo-Herreño, C. C., Celeste, R. K., Peres, M. A., Kearns, C., & Benzian, H. (2019). Ending the neglect of global oral health: Time for radical action. *The Lancet*, 394(10194), 261-272. https://doi.org/10.1016/S0140-6736(19)31133-X
- Williams, D. M., Sheiham, A., & Watt, R. G. (2013). Oral health professionals and social determinants. *British Dental Journal*, 214(9), 427. https://doi.org/10.1038/sj.bdj.2013.443
- World Health Organization. (2003). *The world oral health report 2003: Continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme*. World Health Organization.
- World Health Organization. (2007). *Oral health: Action plan for promotion and integrated disease prevention*. World Health Organization Regional Office for Europe.
- World Health Organization. (2010). *Framework for action on interprofessional education and collaborative practice*. World Health Organization.
- World Health Organization. (2013). *Oral health surveys: Basic methods* (5th ed.). World Health Organization.

- World Health Organization. (2020). *Global oral health status report: Towards universal health coverage for oral health by 2030*. World Health Organization.
- Yusuf, H., Gherunpong, S., Sheiham, A., & Tsakos, G. (2006). Validation of an English version of the Child-OIDP index, an oral health-related quality of life measure for children. *Health and Quality of Life Outcomes*, 4(1), 38. https://doi.org/10.1186/1477-7525-4-38