

3-2009

Oral Healthcare in Kenya: Implications for Dental Hygiene Care

Grace Kogi
Old Dominion University

Follow this and additional works at: https://digitalcommons.odu.edu/dentalhygiene_masters_papers

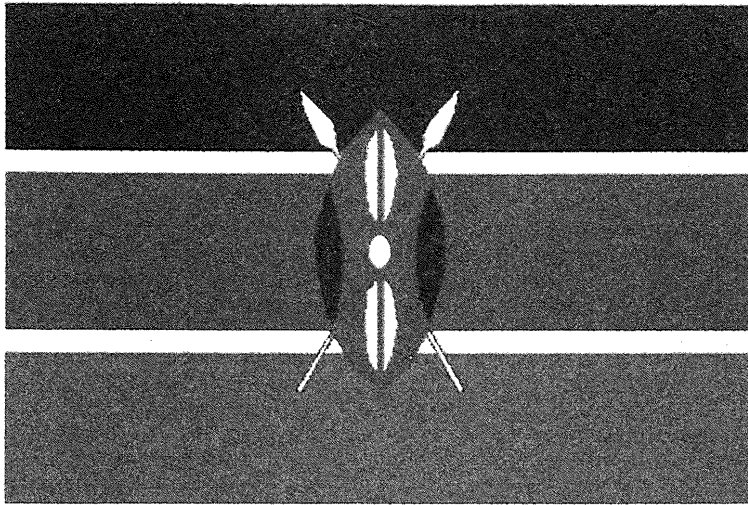
 Part of the [Dental Hygiene Commons](#), and the [Dental Public Health and Education Commons](#)

Recommended Citation

Kogi, Grace, "Oral Healthcare in Kenya: Implications for Dental Hygiene Care" (2009). *Dental Hygiene Master's Papers and Projects*. 3. https://digitalcommons.odu.edu/dentalhygiene_masters_papers/3

This Master's Project is brought to you for free and open access by the Dental Hygiene at ODU Digital Commons. It has been accepted for inclusion in Dental Hygiene Master's Papers and Projects by an authorized administrator of ODU Digital Commons. For more information, please contact digitalcommons@odu.edu.

**Oral Healthcare in Kenya:
Implications for Dental Hygiene Care**



By

Grace Kogi RDH, BSDH, MS
Gene W. Hirschfeld School of Dental Hygiene
Old Dominion University

A Review of the Literature Submitted
to the Faculty of Old Dominion University
in Partial Fulfillment of the
Requirement for the Degree of

MASTER OF SCIENCE IN DENTAL HYGIENE

Old Dominion University
March 2009

**Oral Healthcare in Kenya:
Implications for Dental Hygiene Care**

By

Grace Kogi RDH, BSDH, MS
Gene W. Hirschfeld School of Dental Hygiene
Old Dominion University

A Review of the Literature Submitted
to the Faculty of Old Dominion University
in Partial Fulfillment of the
Requirement for the Degree of

MASTER OF SCIENCE IN DENTAL HYGIENE

Old Dominion University
March 2009

Approved by:

Rodney C. Johns, DDS
(Director)

Michele L. Darby, BSDH, MS
(Member)

ABSTRACT

Oral Healthcare in Kenya: Implications for Dental Hygiene Care

Grace Kogi

Old Dominion University, 2009

Director: Dr. Rodney C. Johns

This paper is a review of literature describing the educational, healthcare delivery and healthcare finance systems in Kenya. The document discusses the unmet oral health needs of the Kenyan population and how implementing the role of the dental hygienist would positively impact oral health promotion throughout the country. Kenyan communities experience all of the major environmental determinants of oral disease, e.g., widespread poverty, underdevelopment, outdated dental equipment, insufficient supply and distribution of qualified dental care professionals and lack of preventive oral health services. About six in ten Kenyans are unable to afford healthcare, clothing, or food; therefore, oral healthcare has a very low priority. More focus is placed on crisis care rather than preventive services. Based on this review, it was concluded that Kenya is in great need of preventive oral health services and that dental hygienists could contribute to the oral healthcare system and oral status of the population.

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who supported me with the completion of this review of literature. First and foremost I thank God for the constant guidance and favor.

I am grateful to Dr. Rodney Johns for his insightful ideas and Prof. Michele Darby for keeping me focused throughout the whole writing process. Thank you both for your encouragements; your wonderful enthusiasm really pushed me to produce something I am proud of.

My deepest gratitude goes out to my whole family; they each helped me put together different pieces of information about Kenya and their moral support and prayers helped me stay positive.

TABLE OF CONTENT

List of Tables.....	vi
List of Figures.....	vii
I. Introduction.....	1
II. Overview of Kenya.....	2
Geography and Demographics.....	2
Economy.....	4
Education.....	7
III. Healthcare Delivery and Finance.....	11
IV. Healthcare Policy.....	17
V. Dental Care Workforce.....	20
Dentists.....	20
Registration and Fees.....	23
VI. Allied Dental Care Personnel.....	24
Dental Technologists.....	25
Dental Hygienists.....	26
Community Oral Health Officers.....	26
Dental Laboratory Technicians.....	28
Dental Nurses.....	28
VII. Dental Care Perspectives.....	28
Government.....	28
Individual.....	28
VIII. Oral Health Status.....	29

Dental Caries and Fluoride.....	29
Periodontal disease.....	34
Oral Cancer.....	35
Noma.....	36
Ceremonial Extractions.....	37
IX. Recommendations.....	38
X. Conclusion.....	40
XI. References.....	42

LIST OF TABLES

Table 1. School of Dental Sciences Graduation Rates, University of Nairobi.....	10
Table 2. Government Health Facilities in Kenya, 2004.....	13
Table 3. Health Workforce in Kenya.....	14
Table 4. Number of Dentists in Kenya.....	20
Table 5. Number of Specialists in Kenya.....	21
Table 6. Kenya Dental Association Fees Schedule.....	24
Table 7. Allied Dental Care Personnel in Kenya.....	25
Table 8. DMFT Scores in Kenya.....	30
Table 9. Prevalence of Oral Lesions in Kenya.....	35
Table 10. Ethnic Groups Known to Practice Ceremonial Manipulation or Extraction of Teeth.....	37

LIST OF FIGURES

Figure 1. Map of Kenya in Relation to Africa.....	2
Figure 2. Map of Kenya Showing Ethnic Groups.....	3
Figure 3. Tea Harvesting in Kenya.....	5
Figure 4. Wildlife in Kenya.....	6
Figure 5. A Beach in Mombasa, Kenya.....	6
Figure 6. University of Nairobi, College of Health Sciences, Kenya.....	9
Figure 7. Government Clinic in Thangathi, Kenya	12
Figure 8. A Physician Adjusting the Drip of an Injured Patient at Kenyatta National Hospital in Nairobi, Kenya.....	12
Figure 9. Jua Kali Blacksmith, Kamakunji Market, Nairobi, Kenya.....	16
Figure 10. A Dental Clinic in Nairobi, Kenya.....	22
Figure 11. Patient Receiving Dental Care at a Kenyan Dental Clinic.....	22
Figure 12. School Boy Presenting With Dental Caries at Eric Dental Clinic, Mutomo, Kenya.....	31
Figure 13. Maasai Patient Presenting With Severe Dental Fluorosis.....	33
Figure 14. Types of Defluoridation Filters Used in Kenya.....	34
Figure 15. Example of a Patient Presenting With Noma.....	36

ORAL HEALTHCARE IN KENYA: IMPLICATIONS FOR DENTAL HYGIENE CARE

INTRODUCTION

African communities experience all of the major environmental determinants of oral disease, e.g., widespread poverty, underdevelopment, outdated dental equipment, insufficient supply and distribution of qualified dental care professionals and lack of preventive oral health services.¹ About six in ten Kenyans are unable to afford healthcare, clothing, or food²; therefore, oral healthcare has a very low priority. More focus is placed on crisis care rather than preventive services; most people seek dental care when the oral pain affects day to day function. Due to the low socioeconomic status of the Kenyan communities, the most common dental service provided is dental extractions.

The main oral diseases include dental caries, periodontal diseases, oral cancer, and fluorosis. In Africa, dental caries are less common and less severe as compared to European, Asian and Latin American countries but 90% of the caries in African countries remain untreated.³ The mean DMFT score for 12 year olds in Kenya is 0.9-1.8 as compared to the 12 year old global DMFT score of 1.6.⁴ The prevalence of Periodontal disease is low (1–10%), and ulcerative lesions are rare (0.12%). Previous studies also have shown that oral cancer is very low, accounting for 2% of all malignancies with oral candidiasis being the most prevalent oral lesion amongst HIV/AIDS patients.⁵ Although the oral disease prevalence in low income countries is generally low, a high percentage of the oral conditions such as dental caries remain untreated and lead to more severe conditions affecting the standard of life. The purpose of this paper is to present an overview of Kenya's healthcare structure by reviewing oral and general health problems,

public policy issues and finally discussing ways to promote oral health throughout the country.

OVERVIEW OF KENYA

Geography and Demographics. Kenya is located on the Eastern coast of Africa. Slightly more than twice the size of Nevada, Kenya lies along the equator and is bordered by Sudan, Somalia, Ethiopia, Uganda and Lake Victoria. Tanzania and Mount Kilimanjaro are to the south while the Indian Ocean lies to the east (See Figure 1).

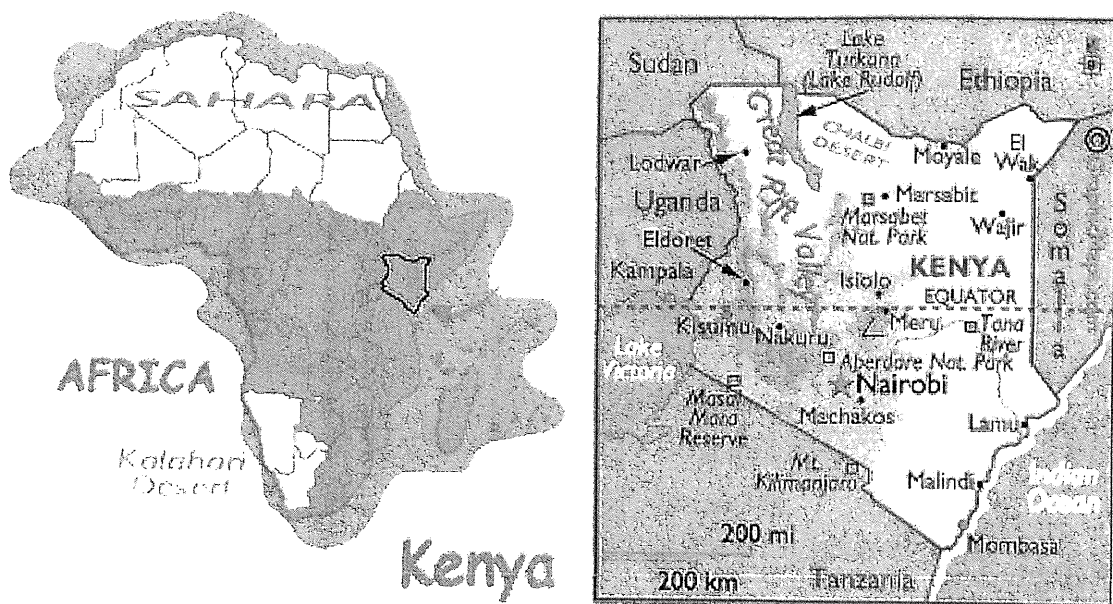


Figure 1. Map of Kenya in Relation to Africa

Source: www.dafo-africa.eu/.../lands/kenya/kenya_map.jpg

Thirty-six million people² concentrate in the central and western parts of the country; the northern and northeastern parts of the country are sparsely populated due to the semi desert climatic conditions.⁶ Given Kenya's 43 ethnic groups, about two-thirds speak Bantu languages, mostly from three ethnic groups – Kikuyu, Luhya, and Kamba. Other peoples include the Kalenjin, Luo, Maasai, Turkana, and, on the coast, the Mijikenda (See Figure 2).

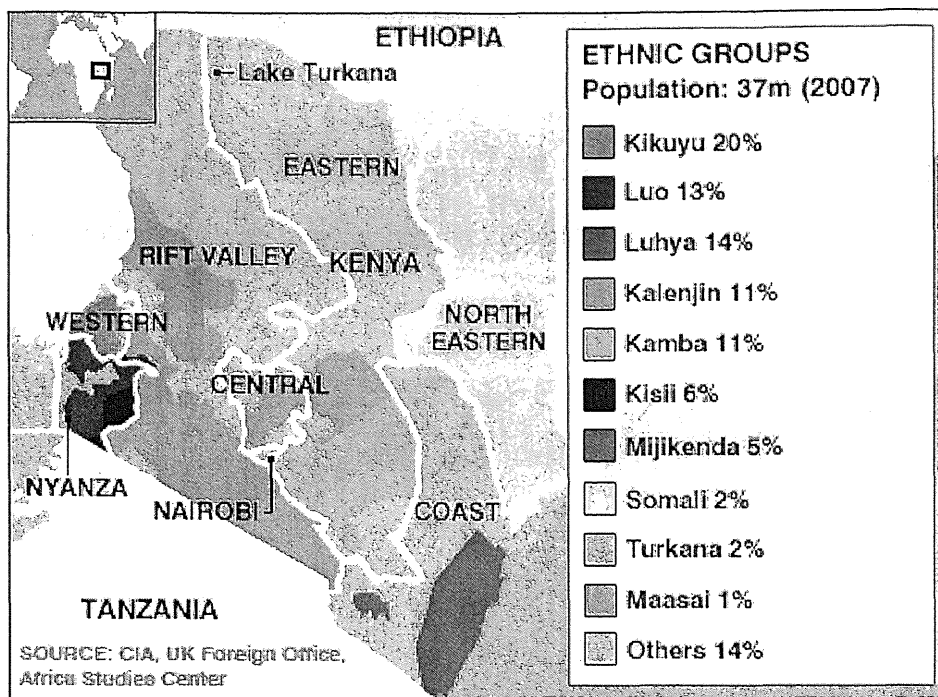


Figure 2. Map of Kenya Showing Ethnic Groups

Kenya is also home to remnants of the former British colonialists and immigrants from India and Pakistan. Small numbers of Indian, Pakistani, and European descendants live in the interior, as well as some Arabs along the coast.⁷

Although a wide variety of languages are spoken, the official Kenyan dialect is Swahili, a language that evolved along the coast from elements of Bantu languages, Arabic, Persian, Portuguese, Hindi, and English. Swahili and English are the official languages of trade, the Kenyan legislative body, the National Assembly, the courts and the school system.⁸

Economy. The economy of Kenya, at present, depends mainly on agriculture (tea, coffee, dairy produce, meat, sisal, and pyrethrum) and tourism.⁶ The agriculture sector accounts for 26% of the Gross Domestic Product (GDP) and about 80% of the Kenyan population lives in the rural areas where they are heavily dependent on agriculture for their livelihood.⁹ Tea, fresh flowers, fruits and vegetables, and coffee constitute the greatest proportion of Kenya's exports (See Fig 3).



Figure 3. Tea Harvesting in Kenya

Source: <http://www.flickr.com/photos/franz88/473189380/>

The chief trading partners are found in the East, Central and South African trading bloc known as the Common Market for Eastern and Southern Africa (COMESA) which includes countries such as Burundi, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Libya, Madagascar, Malawi, Mauritius, Rwanda, Seychelles, Sudan, Swaziland, Uganda, Zambia and Zimbabwe which have agreed to promote regional integration through development of trade and natural and human resources for the mutual benefit of all their peoples.¹⁰

Kenya is endowed with a unique combination of tropical beaches, abundant wildlife in natural habitats (See Fig 4 & 5), scenic beauty and a geographically diverse landscape; therefore, tourism is one of Kenya's major sources of foreign exchange, with visitors coming largely from the European Union.

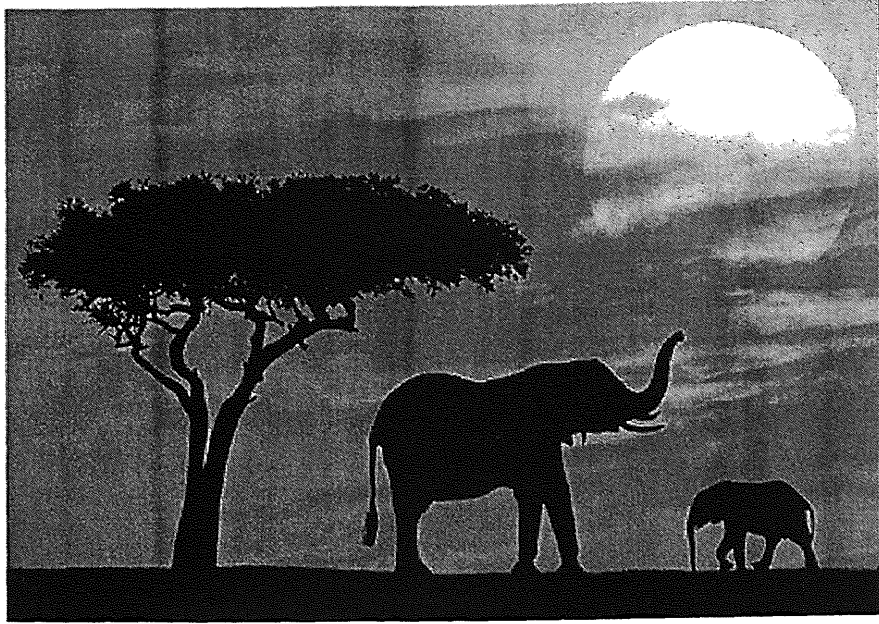


Figure 4. Wildlife in Kenya

Source: <http://www.flickr.com/photos/30428197@N04/2866401977/>



Figure 5. A Beach in Mombasa, Kenya

Source: <http://www.flickr.com/photos/8522055@N08/510978346/>

Currently, tourism accounts for 10% of the GDP, making it the third largest contributor to Kenya's economy after agriculture and manufacturing, and Kenya's third largest foreign exchange earner after tea and horticulture. Kenya's habitat is diverse equaled by a variety of flora and world famous wildlife heritage. Kenya's cultural history stretches back over 4.5 million years, with some of the oldest known evidence of early man. Kenya offers an unparalleled travel experience.¹¹

Education. In 2006/2007, the Ministry of Education was allocated Kenya Shillings (KES) 96.6 billion (US\$1.34 billion), which is about a third of the national recurrent expenditure. Most of the money, KES 71 billion (US\$986 million), is invested in salaries, administration and planning.¹²

In 1985, Kenya adopted the 8-4-4 educational system involving eight years of primary education (beginning at age six), four years of secondary school and four years of college or university.¹³ Primary grades (known as standards) focus on arts and crafts, language, mathematics, history, geography, science and religions. Some areas of instruction are provided in indigenous languages.¹⁴ Secondary grades (known as forms) focus on science and vocational subjects at the upper secondary level.

Entrance into secondary school is contingent upon passing a national examination and obtaining the *Kenyan Certificate of Primary Education (KCPE)* while admission into university requires passing the *Kenyan Certificate of Secondary Education (KCSE)* Exam. In addition to government schools, a number of private schools serve Asian and European communities. These internationally recognized schools which cater to the middle and upper classes offer *International General Certificate of Secondary Education*

(IGCSE), General Certificate of Secondary Education (GCE) at O-levels (Ordinary level) and A-levels (Advanced level), and International Baccalaureate (IB).

In 2002, the government introduced free primary school education; increased demand for services, overcrowding and a lack of resources followed. The mission of the Ministry of Education is

“To provide, promote and co-ordinate lifelong education, training and research for Kenya's sustainable development. To focus on priority areas within overall education goals, notably towards attaining 'universal primary education' by 2005, within the context of the wider objective of 'Education for All (EFA)' by 2015”

Therefore, despite the existing problems with free and compulsory primary education and Kenya's continuing economic problems, free secondary schooling was introduced in 2008 because many students have not been able to attend beyond the primary school level.¹³

A survey of all eight provinces showed that Kenya has a national adult literacy rate of 61.5% and a numeracy rate of 64.5%, indicating that more people possess computation than reading skills. On average 38.5% (7.8 million) of the Kenyan adult population is illiterate. The recorded literacy rate between ages 15 to 19 is 69.1%. Men performed better in reading and numeracy than women, at 64.2% and 67.9% compared with 58.9% and 61.4% respectively.¹⁵

Kenya has seven public and 17 private and chartered universities.¹⁶ Of the 24 universities, the University of Nairobi and Moi University have dental schools. The

University of Nairobi (See Fig 6) offers general dentistry training and residency programs in Pediatric Dentistry and Oral and Maxillofacial Surgery.

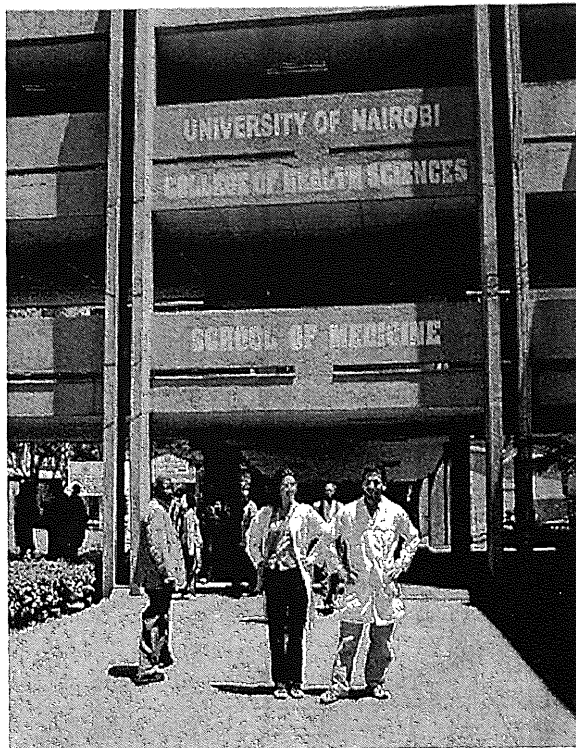


Figure 6. University of Nairobi, College of Health Sciences, Kenya

Source: <http://www.flickr.com/photos/carrieteicher/2253744857/>

The first group of 18 students were admitted in 1974 to the Bachelor of Dental Surgery Program. In 1977, with financial and material support from the Government of the Federal Republic of Germany, the University acquired and renovated the former Princess Elizabeth Maternity hospital to a university teaching dental hospital. The initial nine dental unit facility has grown to 52 dental units. In 2005, the Faculty of Dental

Sciences underwent restructuring and is now the School of Dental Sciences. Dental student graduation rates fluctuate yearly with an inexplicable high number of graduates in 2003/2004. The high graduation rate can probably be attributed to dentistry being marketable that year.⁶ (See Table 1)

Table 1. School of Dental Sciences Graduation Rates, University of Nairobi⁶

Degree	Year	# of students
Bachelor of Dental Surgery	2000/2001	14
Bachelor of Dental Surgery	2002/2003	27
Bachelor of Dental Surgery	2003/2004	189
Bachelor of Dental Surgery	2005/2006	28
Master of Dental Surgery in Oral and Maxillofacial Surgery	2005/2006	6
Bachelors of Dental Surgery	2007	33
Master of Dental Surgery in Oral & Maxillofacial Surgery	2007	3
Master of Dental Surgery in Pediatric Dentistry	2007	2

The second newly established dental school at Moi University enrolled its first class of 15 students in January 2008. In line with the University's mission and vision, the school aims to prepare dental surgeons capable of providing high quality, acceptable and appropriate oral healthcare.¹⁷

Although dentistry is recognized and practiced in Kenya, no dental hygiene programs exist in the country; therefore interested students go to train in places such as the U.K. and U.S.A.

HEALTHCARE DELIVERY AND FINANCE

For the 2006/07 budget year, KES 35 billion (USD \$445 m) was allocated to the health sector, which is equal to 8.99% of total expenditure. The allocation to this sector is forecast to rise to KES 43 billion in 2008/09, equivalent to 9.4%.¹⁸

The Kenyan Ministry of Health strives to provide quality healthcare for all citizens so that they may lead economically and socially productive lives¹⁶; however, healthcare faces problems in finance, infrastructure, equipment, personnel, supplies and sometimes, poor management.

Over 100 government-owned and operated hospitals provide basic referral care; 70 of these are district hospitals serving and supervising primary care networks. Clinical staff (primarily clinical personnel with 3 years of medical training) and nursing staff are also available¹⁹ but there is only one physician for every 33,000 rural residents compared to one physician for every 1,700 urban residents.²⁰

The public delivery system is organized in a traditional pyramidal structure. First level care is provided at dispensaries and medical clinics (See Figure 7). The next level is the health centers and sub-district hospitals. Third level care is provided at district hospitals and provincial general hospitals. There are two national hospitals; Moi Referral and Teaching Hospital in Eldoret and Kenyatta National Hospital, located in Nairobi.²¹ (See Figure 8).

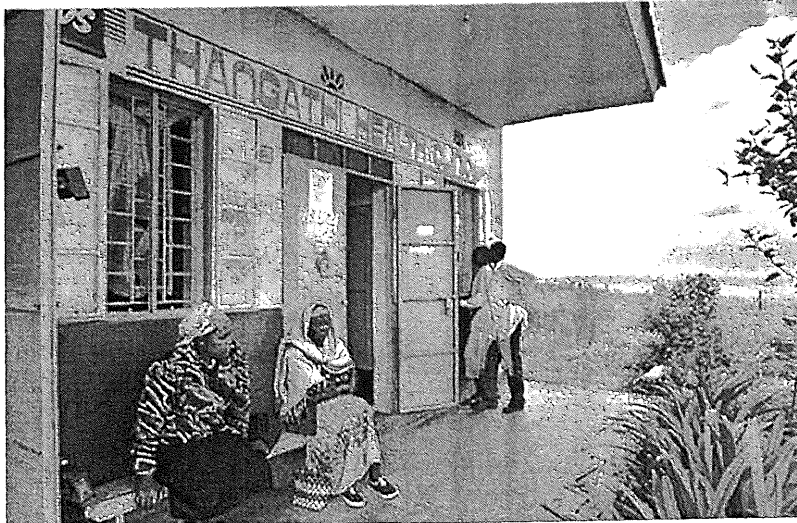


Figure 7. Government Clinic in Thangathi, Kenya.

Source: <http://www.worldproutassembly.org/malaria-2.jpg>

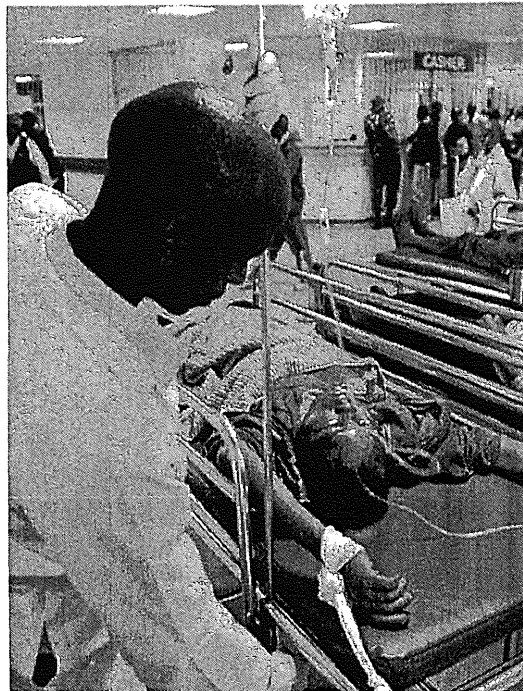


Figure 8. A Physician Adjusting the Drip of an Injured Patient at Kenyatta National Hospital in Nairobi, Kenya.

Source: www.daylife.com/photo/045u45B6Bx2xs

Only 30% of the rural population has access to health facilities within 4km, while such access is available to 70% of urban dwellers.²² The arid and semi arid north and north eastern areas of Kenya are underserved due to limited number of health facilities (See Table 2).

Table 2. Government Health Facilities in Kenya, 2004⁹

Province	Hospitals	Health Centers	Dispensaries	Total	Facilities/ 100,000 pop	Pop 2004
Nairobi	7	33	59	99	18.6	2,656,997
Central	15	56	234	305	13.1	4,012,433
Coast	16	45	185	246	15.3	2,866,931
Eastern	18	59	307	384	16.5	5,070,098
N/Eastern	3	9	38	50	6.5	1,358,301
Nyanza	15	79	187	281	11.3	4,857,210
R/valley	33	114	554	701	15.5	8,169,849
Western	8	65	64	137	9.4	3,816,448
TOTAL	115	460	1628	2203	13.9	32,808,267

The quality of health services is reputedly low due to inadequate supplies and equipment as well as lack of personnel²² (See Table 3).

Table 3. Health Workforce in Kenya²³

Indicator	Value (year)
Dentistry personnel density (per 10 000 population)	<1 (2002)
Number of dentistry personnel	1,340 (2002)
Number of nursing and midwifery personnel	37,113 (2002)
Number of other health service providers	1,000 (2004)
Number of pharmaceutical personnel	3,094 (2004)
Number of physicians	4,506 (2002)
Nursing and midwifery personnel density (per 10 000 population)	12.00 (2002)
Other health service providers density (per 10 000 population)	<1 (2004)
Pharmaceutical personnel density (per 10 000 population)	1.00 (2004)
Physicians density (per 10 000 population)	1.00 (2002)

The Ministry of Health is the major financier and provider of health services in Kenya. Out of over 4500 health facilities in the country, the Ministry of Health controls and runs about 52% while the private sector, the mission organizations and the ministry of local government run the remaining 48%. The public sector controls about 79% of the health centers, 92% of the sub-health centers and 60% of the dispensaries. The non-governmental organization (NGO) sector is dominant in health clinics, maternity and nursing homes (94%) and medical centers (86%). Both the public and the NGO sector have an almost equal representation of hospitals.²²

There are public/government hospitals and private hospitals. The provision of health services in government hospitals is either free or subsidized on a cost sharing basis.¹⁶ Approximately 0.9% of Kenyans have private health insurance coverage with private firms either through their employers or individual initiatives. Therefore, 99.1% of

Kenyans are responsible for their own healthcare costs. National and foreign health insurance firms and health maintenance organizations (H.M.O.'s) are located in lucrative urban areas, leaving the rural population uninsured.

In 1966 the National Hospital Insurance Fund (NHIF) under the National Health Insurance Fund Act was created by the government to reform the health insurance sector

“through the development of innovative financing mechanisms that guarantee the accessibility of basic packages of health services to all, based on need and not ability to pay”²⁰

NHIF's core function is to collect contributions from all Kenyans age of 18 and older that earn an income of over KES 1000 (USD \$12) and pay hospital benefits out of the contributions to members and their declared dependants (spouse and children). The NHIF works to provide access to quality and affordable healthcare. NHIF operates under the social principle that *"the rich should support the poor, the healthy should support the sick and the young should support the old."*²⁴

Under the current law of the 1998 NHIF Act, NHIF membership is mandatory for all civil servants and formal sector employees. The formal sector comprises those employers registered with the registrar of companies. As of 2006, monthly contribution rates through payroll deductions range from KES 120 (USD 1.60) for a monthly income of KES 5000–5999 (USD 66.67–80.00) to KES 320 (USD 4.27) for an income above KES 15 000 (USD 200.00). For those in the informal sector and retirees, membership is open and voluntary. The self-employed and informal sector workers pay a flat-rate contribution of KES 160 (USD 2.13) per month for their entire nuclear family. This contribution rate

corresponds to an income range of KES 7000–8000 (USD 93.33–106.67) for formal sector workers.

The informal sector consists of semi-formal employees, often organized in large regional or national associations, such as taxi, matatu (van drivers) and jua kali* associations or farmer cooperatives (See Figure 9).



Figure 9. Jua Kali Blacksmith, Kamakunji Market, Nairobi, Kenya

Source: Sidney Kasfir retrieved from http://www.artafrica.info/Pdfs/artigo_14_en.pdf

Domestically employed workers such as house helpers and gardeners form another large segment, as do the self-employed who include farmers, fishermen, pastoralists, and hawkers (street vendors).

* Jua Kali means “hot sun” and is the Swahili term for informal sector workers, as they operate in little stalls and workshops as vendors, manufacturers, mechanics etc.

Whereas contributions from formal sector employees are deducted from the monthly payroll, informal sector members have to make upfront annual payments of KES 1920. Previously, the contribution covered primarily the costs of bed occupancy for inpatient care, and the remaining costs had to be borne directly by the patient. Since 2004, extension of the benefit package has been underway to cover up to 100% of inpatient care, depending on the hospital's services and the negotiated daily rebate.²⁵

There are future plans to restructure the NHIF to provide universal compulsory social health insurance coverage for every Kenyan citizen. In addition, The Kenyan government is converting its existing 2.9 million-member National Social Security Fund (NSSF), a provident fund for private-sector workers, into a more comprehensive national social insurance pension plan. Only one million members are active contributors therefore a vast majority of the labor force is excluded from pension coverage.²⁶ Under the National social insurance pension plan, eligibility will extend to any person with a monthly or seasonal income. The new benefits will include lifetime old-age, invalid, and survivors' pensions, a maternity and funeral grant.⁷

HEALTHCARE POLICY

In 1994, the Kenyan government approved the Kenya Health Policy Framework as the blue print for the development and management of health services in the country. The policy is aimed at responding to the decline in health sector budgetary allocation, inefficient utilization of resources, inequitable resource allocation, and inadequate managerial skills at district level. However, the issue of oral health provision was not addressed.

The absence of an oral health policy in Kenya and its non-inclusion in the first National Health Sector Strategic Plan (NHSSP I 1999-2004) has made it difficult to provide sustainable quality oral health within a framework of increasing poverty levels and scarce resources. Problems such as limited access to oral care and decreased numbers of graduating dentists were not addressed; therefore, the Ministry of Health organized a workshop on “National Oral Health Policy” formulation in Nairobi from 14th to 16th August 2001.²⁷ As a result of this workshop, Kenya’s National Oral Health Policy (NOHP) was completed and launched in August 2002.³ USD 8.3 million from government funds, donors, and NGOs was invested in this 12-year plan to slow the increasing burden of oral disease and insure equitable access to oral healthcare. The national oral health policy called for the development of suitable information and communication, education materials, increase of mobile dental clinics and training of community health workers.²⁸ The overall goal of the NOHP was to integrate into the NHSSP I, through activities that ensure access to appropriate and coordinated quality oral healthcare services that aim to improve the oral health status of Kenyans.²⁷

At the 2004 Planning Conference for Oral Health in the African Region, the NOHP reported achievements made include:

- Projected equitable distribution of dentists and other oral health personnel;
- Notable, but minimal, increase in annual budgetary allocation for oral health financing;
- Procurement of at least 8 dental units yearly for government hospitals countrywide;
- Support for higher training programs for oral health workers;

- Increased funding for procurement and supply of dental materials; and
- Support for the proposed national oral health survey

Also discussed during the 2004 conference was the integration of oral health into general healthcare delivery.³ Despite some improvement in oral health status, there is still a significant number of Kenyans who are unaware that oral health is closely linked to general health. The signs and symptoms of many life-threatening and chronic diseases appear in the mouth first when they are still cost-effective to treat and control. Chronic oral diseases such as caries, gingivitis and periodontitis are preventable with the provision of regular preventive oral health services and appropriate daily self care.²⁹ Improved oral health has the potential to decrease money spent to care for systemic problems.

Periodontal disease has been linked to premature, low-birthweight babies. Studies have found that expectant mothers with periodontal disease are up to seven times more likely to deliver premature, low-birthweight babies. Also, oral infection has been implicated in respiratory ailments.³⁰ The mouth is filled with over 500 bacterial species which are normally kept under control with good oral hygiene such as daily brushing and flossing. When harmful bacteria grow out of control, they can cause serious gum infections and provide a pathway into the bloodstream. Bacteria in periodontal disease can travel from the mouth to the lungs and lower respiratory system, where it can aggravate respiratory conditions, particularly in patients who already have other diseases.³⁰

Oral healthcare is a low priority on Kenya's political agenda. Budgetary allocations to oral health programs are minimal with only 0.0016% of the total health budget earmarked

for dental healthcare.³¹ Therefore, Kenyans face high out-of-pocket expenses for oral care and there are no healthcare safety nets or organized insurance programs for subsidizing these costs. Currently, the government provides minimal oral health services such as extractions at public health facilities.

DENTAL CARE WORKFORCE

Dentists. In 2004, the dentist: population ratio was 1:387,000³ compared to what is recommended by the World Health Organization (WHO) — 1:5,000. An increase in the number of graduates from local and foreign dental schools changed the ratio to 1:53,000 in 2006 (See Table 4). Currently, there are 636 dentists serving the Kenyan population with most specializing in oral and maxillofacial surgery (See Table 5).

Table 4. Number of Dentists in Kenya³²

Dentists (year of data 2006)	
Number of registered dentists	656
Number of active dentists	636
Percentage of active dentists who are male	30%
Percentage of dentists working in general practice	Not known
Percentage of dentists working in public salaried service	30%
Dentist to population ratio	53,000

Table 5. Number of Specialists in Kenya³²

Specialists (2005)	
Orthodontists	5
Oral and maxillofacial surgeons *	19
Prosthodontics	4
Periodontics	5
Paediatric dentistry *	10
Restorative dentistry	8
Biomaterials	5
Community and preventive dentistry *	2
Dental radiology	1
* Training for these specialties has been offered in Kenya since 2002 Most specialist training is taken abroad – usually for 3 to 4 years.	

More than 80% of the country's dentists work in urban areas (See Fig 10 & 11). About 90% of all the dentists practice around Nairobi and Mombasa, the two biggest cities in Kenya.²⁸



Figure 10. A Dental Clinic in Nairobi, Kenya

Source: <http://picasaweb.google.com/noellecorinne/KenyaFavorites>

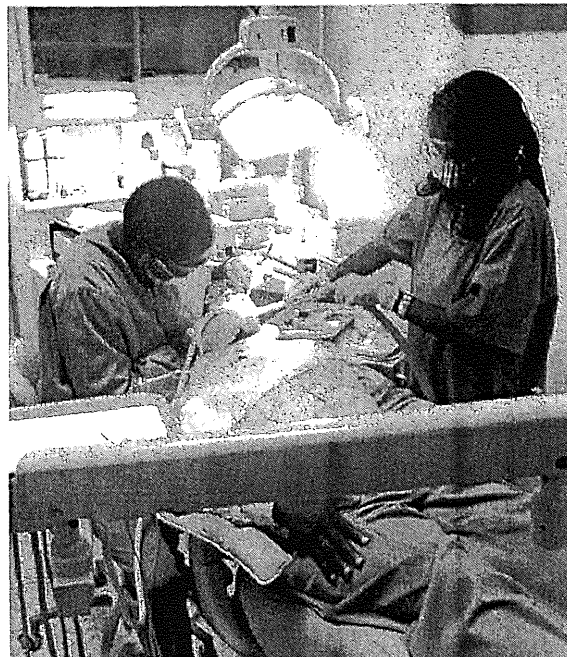


Figure 11. Patient Receiving Dental Care at a Kenyan Dental Clinic

Source: <http://picasaweb.google.com/noellecorinne/KenyaFavorites>

Dentists earn less than physicians and they are not allowed to advertize their services. In addition, the treatment facilities in government hospitals are inadequate and dental supplies are lacking. As a result, more and more dentists are moving to industrialized countries like South Africa, Britain and the U.S. and public oral health education and disease prevention opportunities are minimal. In East Africa, the use of dental services is still poor, with recent results indicating that only 26 ml of toothpaste is consumed per person per year. Eighty-five percent of the people have never seen a dentist, while only 66% brush their teeth regularly.^{28, 33}

Founded in 1968, the Kenya Medical Association with over 200 members is a voluntary professional organization open to all medical and dental practitioners registered in Kenya. Its main objectives are to promote the practice of medicine in Kenya and support continuing professional development.

Registration and Fees. Applicants are required to pass the appropriate board examination (internship qualifying exams and assessment exams) before registration or license to render is issued. The current board fees structure for dentists and physicians is displayed in Table 6.

Table 6. Kenya Dental Association Fees Schedule³⁴

Fees Schedule	
Registration as medical or dental practitioner	KES 5,000.00 (USD\$ 63.17)
Certificate of good standing	KES 10,000.00 (USD\$ 126.34)
License to render medical or dental practice	KES 10,000.00
License for private medical or dental practice	KES 10,000.00
Kenyans	
Full-time general practice	KES 10,000.00
Full-time private practice	KES 15,000.00(USD\$ 189.51)
Part-time specialist practice	KES 7,500.00(USD\$ 94.76)
Non-Kenyans	
Full-time general practice	KES 15,000.00
Full-time private practice	KES 20,000.00 (USD\$ 252.68)
Part-time specialist practice	KES 10,000.00

ALLIED DENTAL CARE PERSONNEL

The Kenyan government employs dental health officers (allied dental care personnel) (See Table 7) to provide basic services including simple restorations, extractions and oral hygiene education.

Table 7. Allied Dental Care Personnel in Kenya³²

Dental Care Professionals (2006)	
Hygienists	
Number of registered hygienists	1
Dentist to hygienist ratio	656
Percentage of hygienists who are male	0%
Community Oral Health Officers (Therapists)	
Number of COHOs	130
Dentist to therapist ratio	5
Percentage of therapists who are male	70%
Laboratory Technicians	
Number of registered technicians	126
Dentist to technician ratio	5
Percentage of technicians who are male	95%

Very little information exists about Kenyan allied dental workforce but what is known is that there is no registration board, regulatory agency or licensure. Furthermore, continuing education is not mandatory for any dental technologists, dental hygienists, community oral health officers, laboratory technicians or dental nurses.

Dental Technologists. There are 180 dental technologists in Kenya and although they are not officially qualified to do intra-oral work, about 100 are in private practice making dentures and some crown and bridgework on contract for dentists in the urban areas. Approximately 80 others are salaried in the government hospitals and clinics, especially in the rural areas. These rural clinics often operate without dentists because even when dentists are available, much of their time is occupied with administrative roles. The

dentists' clinical efforts are focused almost exclusively on oral health procedures, i.e. restorations, root canal treatments, extractions and surgical procedures and they do not have the time (or the specialized skills) for removable appliances. The dentists do very little denture work and therefore rely on the dental technologists, who are better equipped to provide denture service directly. The Kenyan Dental Technology Association is seeking an avenue to attain accredited clinical training for dental technologists doing this work.³⁵

Dental Hygienists. Kenya lacks an institution that educates dental hygienists. There is currently one hygienist who was trained in the U.S.A. for 3 years, completing a diploma. She is registered with the Nursing Council and currently works at the School of Dental Sciences. The only Kenyan healthcare workers that resemble the dental hygiene role in the United States are the community oral health officers.

Community Oral Health Officers (COHOs). Community Oral Health Officers are based at district and provincial hospitals to give basic dental care to Kenyans.³⁶ COHOs work in government dental clinics as well as private practice. Although there are no specific regulations guiding such practice, COHOs must successfully complete a 3-year diploma course at the Kenya Medical Training College in Nairobi. The title is not protected, and they do not have to register with a regulatory board. Specific duties³⁶ of a COHO include:

Oral health education

- COHOs plan, organize, execute and coordinate oral health education according to the identified needs of the community.
- COHOs make regular visits to the schools, carry out dental check-ups on school children and give them oral health education.

Collecting information on community's oral health status

- COHOs carry out surveys within the community to help determine oral health status and report to relevant authorities for necessary action.

Management and administration of community's oral health

- COHOs order dental materials, simple equipment and instruments for use within the community.

Clinical oral health services

COHOs:

- diagnose and treat common dental conditions and refer patients to a dentist as needed.
- perform minor surgery such as emergency tooth extraction and refer patients for more specialized management by a dentist.
- carry out temporary fillings.
- perform prophylaxis, scaling and polishing of teeth.
- place fissure sealants and apply topical fluorides.
- write out prescriptions for analgesics and antimicrobials.

Evaluation of oral health services

COHOs:

- submit monthly reports of their work to the officer-in-charge at the district hospital.
- continuously and innovatively carry out education on a daily basis.
- perform any other duties that may be assigned to them from time to time by the officer-in-charge at the district hospital

Dental Laboratory Technicians. Dental lab technicians work in the government dental clinics and private dental practice. Technicians must successfully complete a 3-year diploma course at the Dental Training College, Nairobi. The title is not protected, and they do not have to register with a regulatory board.

Dental Nurses. Dental nurses provide assistance to dentists by doing duties such as sterilizing instruments and preparing them for use. Some dental nurses are trained at the workplace while others go abroad to train in universities such as the University of London, Guy's Hospital.³²

DENTAL CARE PERSPECTIVES

The number of people living below the poverty line is estimated to have increased from 11.3 million (48.4% of the population) in 1990 to 17.1 million (55.4 % of the population) in 2001. Forty-six percent of Kenyans live below the poverty line of 1 dollar a day; 85% of the poor live in rural areas. The distribution of income and wealth is skewed in favor of the wealthy. Disparities between urban and rural conditions are striking; urban households are more likely to have access to basic services such as regular dental cleanings.^{7, 18}

Government. Dental healthcare delivery in Kenya involves a department or clinic in the major district level hospitals where the main services provided are extraction and periodontal treatment. There are no facilities available for services such as restorations, crowns, etc which are considered to be luxuries.

Individual. For the majority of Kenyan middle to low income earners, dental healthcare also consists of visiting a government dental clinic for extractions. There is a lack of

emphasis on other dental healthcare norms such as regular dental check-ups and restorative care. This is because individual incomes are used for food shelter and clothing. Private dental care is very expensive. For example, an oral prophylaxis costs about KES 3,000 (USD \$37.90) which is out of reach to most low income earners with a monthly minimum wage of KES 3,500(USD \$44.22) However, high income earners and other wealthy Kenyans can access and pay for dental care.

ORAL HEALTH STATUS

A nationwide oral health survey has yet to be carried out in Kenya, but major cities such as Nairobi have taken part in a considerable amount of research while most rural areas are understudied.³⁸ Surveys reveal the most common community dental concerns to be oral diseases such as caries, oral cancer, periodontal disease, fluorosis and noma (cancrum oris or gangrenous stomatitis).

Dental Caries and Fluoride. Data on caries prevalence is insufficient and out out-of-date; the studies done are on different age groups and communities with no current follow up on prior studies (See Table 8).

Table 8. DMFT Scores in Kenya^{23, 39}

Age	Mean DMFT Score	Year
3-5	3.0	1997
6-8	1.7	1987
12	0.9-1.8	1986
12-18	3.0	1993
18-24	1.9	2006

Past studies have revealed high dental caries prevalence in Kenyan school children, with very few children seeking dental treatment.⁴⁰ A 2006 study done on the North Eastern province in Kenya found that out of 141 subjects, 43.3% presented with caries. The percentage of females with dental caries was higher than that of the males (72.1% and 27.9% respectively). The mean DMFT score was highest in the 45 to 54 year age group; 11.4, an increase from the previous 5.9 score in 1985-86. The lowest mean DMFT score was in the above 65-year age group (1.6).^{23, 38} In 1991, the per capita consumption of sugar (centrifugal sugars-cane and beet sugars only) was 20.7 kg but this rose to 22.6 kg in 2005. In fact, due to dietary changes, the amounts of sugary foods and drinks have increased in Kenya contributing to the development of dental caries in school children.³⁹ (See Fig 12)

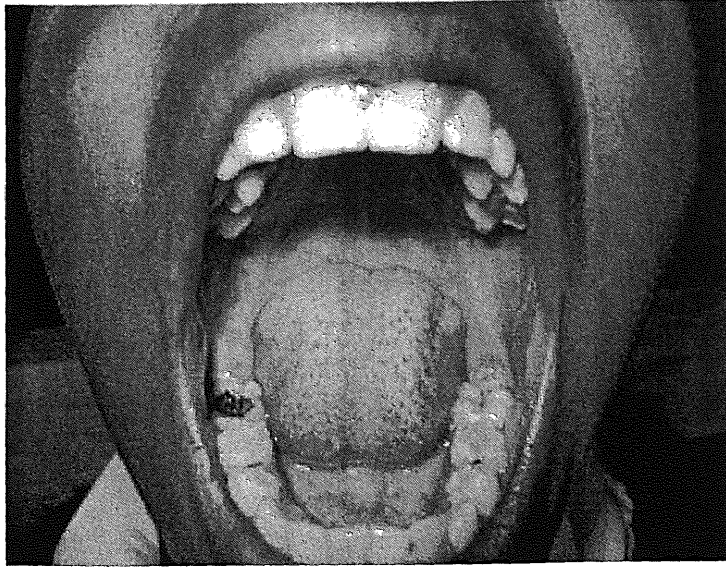


Figure 12. School Boy Presenting With Dental Caries at Eric Dental Clinic, Mutomo, Kenya

Source: www.whocollab.od.mah.se/.../kenyalakarbank.html

Western foods, full of refined sugars, are replacing nutritious traditional dishes. Also contributing to dental caries are some traditional Kenyan foods and substances. For example, the Somali community has a high tendency for consumption of sugar-sweetened tea; and many adult males frequently consume the sugar while chewing *Khat* (*Cartha edulis*) as a pastime and for refreshment.³⁸ *Khat* also known as *Qat* or *miraa* is a leafy narcotic substance that is popular in several countries in East Africa and the Arabian Peninsula. *Khat* can be consumed as a liquid in the form of tea or smoked like tobacco. However, the most common mode of ingestion is by chewing the fresh leaves. Consumption of *Khat* can lead to adverse oral effects including oral mucosal lesions, dryness of the mouth, discoloration of teeth, poor oral hygiene and periodontal disease.⁴²

In Kenya, 10.75 days of household expenditure are needed to purchase the annual average dosage (182.5g) of the lowest cost of toothpaste as compared to 0.037days in the

United Kingdom.⁴³ Kenyans have been using *miswak* as a natural toothbrush substitute for years. *Miswak* is a pencil sized stick 15-20 cm long with a diameter of 1-1.5 cm that is prepared from the root, stem, twigs or bark of the *Salvadora persica* tree or other suitable plants such as the olive or walnut tree. The stick is chewed or tapered at one end until it becomes frayed into a brush. Carl and Zambon⁴⁴ reported that dental caries was relatively rare among Kenyan primary school children who were using only *miswak* as an oral hygiene tool. They found that caries were mostly present in older persons and usually involved the maxillary and mandibular second and first molars, which are difficult to reach for cleaning with *miswak*.

Kenya is one of the countries in the world where fluoride occurs in highest concentrations in rocks, soil, surface water and ground water. The highest water fluoride concentrations occur in certain springs, boreholes, and some lakes in the Rift Valley. In 2002, Gikinuju et al.⁴⁵ found that the highest fluoride concentration was 0.85 ppm in Laikipia District and the lowest was 0.08 ppm in Murang'a District. By region and district, the mean fluoride concentration ranged from 0.12 ppm for rivers in Laikipia to 0.24 ppm for rivers in Nairobi, with 0.32 ppm in the Upper Basin of the Athi River.

High fluoride intake can lead to dental and skeletal fluorosis. Kenyans are exposed to high fluoride level from drinking contaminated water found in boreholes which are an important source of water between rainy seasons (See Figure 13).



Figure 13. Maasai Patient Presenting With Severe Dental Fluorosis

Source:http://www.safaridentist.org/gallery_menu/images/watermark.php?path=../../gallery_images/DSC_0008

The prevalence and severity of dental fluorosis is high even in low-fluoride areas (<1 ppm). Fluoride levels in some Kenyan lakes such as Lake Nakuru are as high as 2.4 ppm. Skeletal fluorosis has been reported among persons drinking borehole water with fluoride levels reaching as high as 18.29 ppm. For safety, the Kenya Bureau of Standards recommends a maximum of 1.5 mg fluoride/L (1.5 ppm) in drinking water.^{45,46}

An example of the effort the government is putting towards decreasing dental and skeletal fluorosis is the Catholic Diocese of Nakuru (CDN) defluoridation program. After the drought of 1984, the CDN created a water program to serve the civil districts of Nakuru, Baringo, Koibatek, Kericho (now a separate diocese since 1995), Bomet, and Buret in 1985. The CDN objectives include drilling of deep wells, constructing water schemes and rain water harvesting tanks and provision of safe water. The water provided

by the program was unsafe for drinking or cooking due to high levels of fluoride therefore in 1998 the CDN defluoridation program was established.⁴⁷ The CDN uses simple and low-cost defluoridation units; bone char as an absorption medium on household and community scale. Figure 14 below shows a household filter (left) and a remote community filter (right).



Figure 14. Types of Defluoridation Filters Used in Kenya

Source: www.eawag.ch/.../ws/projects/fluoride_removal

Periodontal Disease. The extent and severity of periodontal destruction in the adult Kenyan population is strikingly similar to the findings from very diverse populations in the U.S.A., Japan, China, Tanzania, and some Sri Lankan populations. A 1988 study showed that regardless of age, pockets ≥ 4 mm were seen on less than 20% of tooth

surfaces, whereas in the 10-85 age group the surfaces had a loss of attachment of > 1 mm.^{48, 49} No current information could be found.

Oral Cancer. In Kenya many HIV positive persons have orofacial lesions as the primary manifestations of the disease and only a few studies have been performed to document this observation. HIV/AIDS is most prevalent among young and middle-aged Kenyans, the most productive segment of the population. An estimated 700 Kenyans die daily of HIV/AIDS-related causes.^{50,51} A retrospective study done at the Kenyatta National Hospital in Kenya showed that of 22,788 malignancies, 821 cases (3.6%) were oral cancer. There was a small male predominance (M: F = 1.3:1) and the most preferred site for oral cancer was the tongue but with a significant number involving the maxilla and mandible.⁵² The prevalence of different oral lesions in Kenya is shown in Table 9.

Table 9. Prevalence of Oral Lesions in Kenya⁵³

Lesions	Prevalence (%)
Leukoedema	26.0
Melanosis	12.7
Leukoplakia	10.6
Palatal Keratosis	6.4
Frictional Keratosis	5.5
Preleukoplakia	4.1
Borderline Leukoplakia	2.4
Cheek/Lip biting	1.3
Snuff dippers lesion	0.4

Noma. Noma, associated with immunosuppression, flourishes where poverty is greatest, nutrition is poor, and general and oral hygiene are neglected. Noma often starts as an ulcer on the oral mucosa or as necrotizing ulcerative gingivitis and commonly after a bout of measles, malaria or other disease. It quickly develops into massive necrosis, moving from the inside outward, often involving major portions of the face.⁵⁴ (See Figure 15).

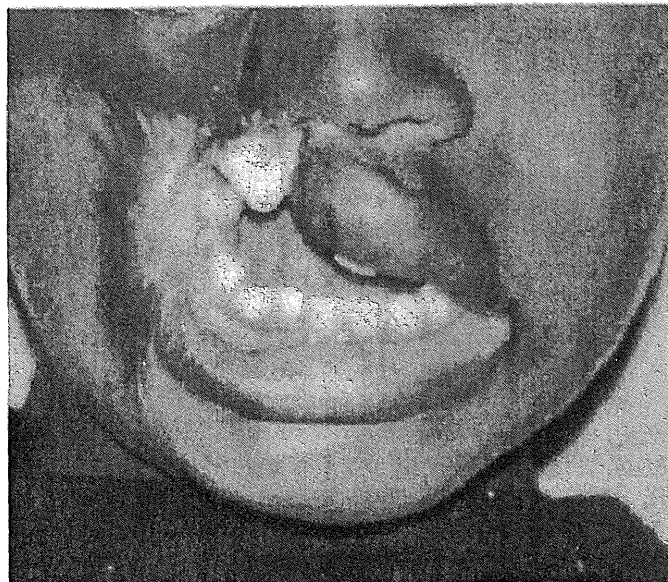


Figure 15. Example of a Patient Presenting With Noma

Source: African Health Monitor, January-June 2008

Occurring almost exclusively in children, 80% of persons suffering from Noma are less than 10 years old. The prevalence of noma is likely to increase as poverty increases and many children remain malnourished or undernourished with compromised immune systems.⁵⁵ The disease is virtually unknown in Europe and North America but is still found in developing countries.

Ceremonial extractions. Causes of tooth loss in Kenya include dental caries, periodontal disease, orthodontic treatment, trauma as well as traditional practices. There are various ethnic groups such as the Kalenjin, Luo and Luhya that still practice extraction of canines and lower incisors during initiation customs. A 1988 study⁵⁶ found that periodontal diseases were the principal cause of the loss of incisors, except the lower incisors, for which ritual extractions accounted for the major cause of loss. Ritual extractions were observed most frequently in the older age groups: beyond 44 years of age, more than 50% had experienced ritual extractions, while virtually none of those below the age of 35 had done so. This is because the younger generations are moving away from cultural traditions and embracing modern practices. Table 10 shows some examples of extractions and practices performed by six ethnic groups from Kenya.

Table 10. Ethnic Groups Known to Practice Ceremonial Manipulation or Extraction of Teeth⁵⁷

Ethnic Group	Teeth Affected	Purpose
Luo	Extraction: 22-27	Rite of Passage
Luhya	Extraction: 23-26	Rite of Passage
Kamba	Upper teeth were filed into sharp conical projections	<ul style="list-style-type: none"> • To enhance the beauty of the women • To make the cutting of food easier
Maasai & Somali	Extraction: primary canine tooth buds in infants Gums burned prior to tooth eruption (Somali)	<ul style="list-style-type: none"> • Tooth buds thought to be abnormal • To prevent diarrhea, vomiting, febrile illnesses
Kalenjin	Extraction: 24 & 25	Rite of Passage

RECOMMENDATIONS

Insufficient number of dentists. Although there has been a substantial increase in the number of graduates from dental schools, most dentists cluster in the urban areas where they can make more money, creating a shortage of care in the poor rural regions.³ A more practical solution to overcome the burden of oral disease is implementing dental hygiene education and practice. A program can be established at one of the two dental schools and government scholarships can be awarded to highly qualified persons to also study dental hygiene abroad with the caveat to return to Kenya to practice. The current allied dental care personnel (COHOs, dental nurses and lab technicians) are sometimes unqualified to serve the public and usually have other duties to perform in addition to assisting the dentist. These allied dental care personnel also have to practice under the supervision of a dentist or physician therefore are limited in terms of locations they can practice.

Dental hygienists are prevention specialists who recognize that the connection between oral health and total health can prevent disease. They treat problems while they are still manageable and save critical healthcare funds so there are enough resources to treat everyone. Licensed dental hygienists, by virtue of their comprehensive education and clinical preparation, are well prepared to deliver oral healthcare services to the public, safely and effectively, independent of dental supervision.⁵⁸

Lack of access. A majority of the dentists in Kenya practice around the main cities and as a result patients from rural areas have to travel miles to obtain dental care. A dental hygienists primary focus is on preventive care. Therefore dental hygienists are the oral health professionals best poised to address issues of access. They are competent to provide educational, preventive and therapeutic services in a variety of settings more

accessible to patients: residences of the homebound, public health and school based programs, community clinics, and more. This can be achieved through unsupervised or collaborative practice.⁵⁹ In the U.S. Colorado, Maine, Nevada, and Washington have unsupervised or collaborative practice, which means that a dental hygienist can initiate treatment based on his or her assessment of patient needs without the specific authorization of a dentist. The dental hygienist can treat the patient without the presence of a dentist, and maintain a provider-patient relationship without the participation of the patient's dentist of record.⁶⁰ The dental hygienist can then channel the patient to a dentist for more advanced care.

Public uneducated on oral health. The underserved population in Kenya need to be educated on importance of good oral care and the effects oral diseases have on the whole body. The signs and symptoms of many potentially life-threatening and chronic diseases appear in the mouth first. Dental hygienists routinely screen for these signs and symptoms during oral health examinations and explain their observations to patients, urging them to follow up with a medical or dental visit for a definitive diagnosis. When necessary, dental hygienists also provide therapy for the oral manifestations of systemic diseases.³⁰

High cost of dental care. The cost of dental care in Kenya is considerable and oral healthcare is a low priority for the Kenyan government. Major indirect costs include absenteeism from school, work-loss and loss of economic productivity.⁶¹ The government needs to realize that promotion of oral health is a cost-effective strategy to reduce the burden of oral disease and ultimately improve quality of life. An international survey of WHO oral health statistics showed that the number of decayed, missing or filled teeth

(DMFT) appeared to be lower in countries where dental hygiene had been implemented.⁶²

As part of dental hygiene services³⁰ that will decrease the DMFT scores, dental hygienists may:

- perform oral healthcare assessments that include the review of patients' health history, pharmacologic history, dental charting, oral cancer screening, and evaluation of periodontal disease / health;
- expose, process, and interpret dental radiographs;
- remove plaque and calculus from above and below the gingiva using dental instruments;
- apply cavity-preventive agents such as fluorides and sealants to the teeth;
- administer local anesthetic agents and / or nitrous oxide and oxygen analgesia;
- educate patients on proper oral hygiene techniques to maintain healthy teeth and gums;
- counsel patients about plaque control and developing individualized at-home oral hygiene regimens;
- administer smoking cessation programs; and
- counsel patients on diet and nutrition for maintaining optimal oral health.
- conduct oral health needs assessments and plan population based primary oral healthcare.

CONCLUSION

The dental problems in Kenya have yet to be completely documented; therefore, the extent of dental disease remains unknown. A dental needs assessment needs to be carried out in communities throughout the country before an effective oral health policy can be developed and implemented. Numerous studies have shown that dental caries is the major cause of tooth loss in children, while periodontal disease is the major cause of tooth loss

in adults. Research has also identified periodontal disease as a possible risk factor for heart and lung disease; diabetes; pre-mature and low birth-weight babies; and a number of other conditions. Both oral conditions are easily preventable through basic oral hygiene education such as brushing and flossing and regular professional care.

Unfortunately, most of the residents in the rural areas lack access to dentists and dental hygienists who can educate them on the importance of maintaining good oral hygiene and the link between oral health and general health. The lack of oral health knowledge of the Kenyan underserved populations needs to be addressed and one evidence-based and cost effective approach is via dental hygiene education and practice.

References

1. Thorpe, S. (2006). Oral Health Issues in the African Region: Current Situation and Future Perspectives. *Journal of Dental Education* , 70 (11), 8-15.
2. Yin, S. & Kent, M. (2008, January). Kenya: The demographics of a country in turmoil. *Population Reference Bureau*. Retrieved January 29, 2008, from <http://www.prb.org/Articles/2008/kenya.aspx>.
3. FDI World Dental Federation. (2004). *Planning Conference for Oral Health in the African Region – Nairobi Report*. Lowestoft, UK: FDI World Dental Press Ltd. Retrieved December 15, 2008, from FDI World Dental Federation: http://www.fdiworldental.org/public_health/3_1conferences.html#Nairobi
4. WHO. (2004). *WHO Oral Health Country/Area Profile Programme*. Retrieved November 3, 2008, from <http://www.whocollab.od.mah.se/exp1/globalcar1.html>
5. Kaimenyi, J. T. (2004). Oral Health in Kenya. *International Dental Journal* , 54 (6), 378-382.
6. University of Nairobi. Retrieved August 20, 2008 from: <http://www.uonbi.ac.ke/>
7. Library of Congress. (2007). Country Profile: Kenya. Retrieved December 6, 2008, from Country Studies - Federal Research Division, Library of Congress: <http://lcweb2.loc.gov/frd/cs/profiles.html>
8. Salzmann, Z. (2004). *Language, Culture, and Society: An Introduction to Linguistic Anthropology*. Third edition. Boulder: Westview Press.
9. GVEP Kenya. (September 2006). *Energy Road Map to Achieving MDG Targets*. Final Report.
10. Common Market for Eastern and Southern Africa. (2007, April). *COMESA in Brief*. 3rd edition, 1-16.
11. Ministry of Tourism. Facts and Figures. (n.d.). Retrieved October 2, 2008, from Ministry of Tourism: <http://www.tourism.go.ke>
12. UNESCO. (2006). *UNESCO Nairobi Education Sector - Fact Book on Education For All, 2006*. Retrieved December 20, 2008, from UNESCO Nairobi Education Sector : http://www.education.nairobi-unesco.org/PDFs/EFAFact-24-10_2006.pdf
13. Government of Kenya. (2008). *Education*. Retrieved August 5, 2008, from Government of Kenya:

http://www.kenya.go.ke//index.php?option=com_content&task=view&id=6&Itemid=31

14. African Studies Center. (n.d.). Retrieved October 5, 2008, from East Africa Living Encyclopedia : <http://www.africa.upenn.edu/NEH/keducation.htm>
15. Kebathi, J. N. (2008). Measuring Literacy: The Kenya National Adult Literacy Survey. *Adult Education and Development* , 71. Retrieved October 2008, from dvv international: http://www.iiz-dvv.de/index.php?article_id=802&clang=1
16. Government of Kenya. *Kenyan Facts*. Available at <http://www.kenya.go.ke>. Accessed on 21 August 2008.
17. Moi University. Retrieved October 19, 2008, from: <http://www.mu.ac.ke/academic/schools/dentistry/index.html>
18. *Country Strategy Paper and National Indicative Programme; 2008-2013 10th EDFs*. (n.d.). Retrieved October 28, 2008, from Partnership in Statistics for Development in the 21st Century (PARIS21): <http://www.paris21.org>
19. English M, Irimu G, Wamae A, Were F, Wasunna A, Fegan G, Peshu N., Health systems research in a low-income country: easier said than done *Archive of Disease in Childhood* 2008 93: 540-544
20. Kinuthia, J. (2002). *Trading in Healthcare Services in Kenya*. Nairobi: Consumer Information Network
21. Glenngård, A. H., & Maina, T. M. (2007). Reversing the trend of weak policy implementation in the Kenyan health sector? – a study of budget allocation and spending of health resources versus set priorities. *Health Research Policy and Systems* , 1-9.
22. Ngigi, A., & Macharia, D. (2006). *Health Sector Policy Overview Paper*.
23. WHO. (2008). *WHO Oral Health Country/Area Profile Programme*. Retrieved November 3, 2008, from <http://www.whocollab.od.mah.se/>
24. *NHIF: National Hospital Insurance Fund*. (2008). Retrieved December 6, 2008, from <http://www.nhif.or.ke/healthinsurance/>
25. Mathauer, I., Schmidt, J.-O., & Wenyaa, M. (2008). Extending social health insurance to the informal sector in Kenya. An assessment of factors affecting demand. *International Journal of Health Planning and Management* , 51-68.
26. International Labour Organization. (2004). *Extending Social Security and Fighting Poverty: Two reform proposals to extend social security in Kenya*. Geneva.

27. Department of Standards and Regulatory Services (DSRS), (n.d.). *National Oral Health Policy and Strategic Plan: 2002-2012*. Retrieved November 6, 2008, from FDI World Dental Federation:
http://www.fdiworldental.org/public_health/assets/Database/Kenya/Kenya_NOHP.pdf
28. Siringi, S. (2002, September 14). *Kenya embarks on campaign to improve oral health*. Retrieved September 20, 2008, from The Lancet: <http://www.thelancet.com>
29. ADHA. Retrieved October 20, 2006, from: <http://adha.org>
30. *ADHA - Oral Health-Total Health: Know the Connection*. (2008). Retrieved December 6, 2008, from ADHA : http://www.adha.org/media/facts/total_health.htm
31. *African Countries Urged to Increase Allocation to Oral Health Care*. (2004). Retrieved December 6, 2008, from World Health Organization - Regional Office for Africa:
http://www.afro.who.int/note_press/2004/pr2004041602.html
32. Kravitz, A. S. (2007). *Survey of the Dental Workforce in the Commonwealth*.
33. Adero, B. (2006). *Kenya Faces Acute Shortage of Dentists*. Nairobi: East African Standard
34. Kenya National Bureau of Statistics. (2008). Retrieved August 5, 2008, from Kenya National Bureau of Statistics: <http://www.cbs.go.ke/>
35. The Society for Clinical Dental Technology. (2007, October 28). *Dental Care Providers and Denture services*. Retrieved October 26, 2008, from The Society for Clinical Dental Technology:
http://www.denturism.co.za/dental_care_providers.htm#_Top
36. *Kenya Medical Training College*. (n.d.). Retrieved November 28, 2008, from Department of Community Oral Health: <http://kmtac.ac.ke>
37. *Country Strategic Opportunities*. (2007). (n.d.). Retrieved October 28, 2008, from Partnership in Statistics for Development in the 21st Century (PARIS21):
<http://www.paris21.org>
38. Kassim, B. A., Noor, M. A., & Chindia, M. L. (2006). Oral Health Status Among Kenyans in a Rural Arid Setting: Dental Caries Experience and Knowledge on its Causes. *East African Medical Journal* , 100-105.

39. Ng'ang'a P.M., Karongo P.K., Chindia M.L. and Valderhaug J. Dental Caries, Malocclusion and fractured incisors in children from a pastoral community in Kenya. *East African Medical Journal*. 1993; 70: 175-178.
40. Masiga, M. A., & Holt, R. D. (1993). The prevalence of dental caries and gingivitis and their relationship to social class amongst nursery school children in Nairobi, Kenya. *International Journal of Pediatric Dentistry*, 3, pp. 135-140.
41. Ng'ang'a, P. M., & Valderhaug, J. (1992). Dental caries in primary school children in Nairobi. *Acta Odontologica Scandinavica*; 50, pp. 269-272.
42. Poul E.P. 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*. 2003; 31: 3-24.
43. Goldman, A. S., Yee, R., Holmgren, C. J., & Benzian, H. (2008, June). Global affordability of fluoride toothpaste. *Globalization and Health*, 4 (7).
44. Carl W. and Zambon J.J. Dental health of the Rendille and Samburu of the Northern frontier District of Kenya. *New York State Dental Journal*. 1993; 59: 35-39.
45. Gikunju, J. K., Simiyu, K. W., Gathura, P. B., Kyule, M., & Kanja, L. W. (2002). River water fluoride in Kenya, *Fluoride*, 35(3), 193-196.
46. Manji F, Baelum V, Fejerskov O., (1986). Dental fluorosis in an area of Kenya with 2 ppm fluoride in the drinking water. *Journal of Dental Research*; 65(5):659–62.
47. Naslund, J and Snell I. (2005) “GIS-mapping of Fluoride Contaminated Groundwater in Nakuru & Baring District, Kenya” MSc Programmes in Engineering, Department of Civil and Environmental Engineering, Division of Sanitary Engineering, Lulea University of Technology, Sweden.
48. Baelum, V., Manji, F., Wanzala, P., & Fejerskov, O. (1995). Relationship between CPITN and periodontal attachment loss findings in an adult population. *Journal of Clinical Periodontology*, 146-152
49. Baelum, V., Fejerskov, O., & Manji, F. (1988). Periodontal Diseases in Adult Kenyans. *Journal of Clinical Periodontology*, 445-452
50. Buttf, M. A., Chindia, M. L., Vaghela, V. P., & Mandalia, K. (2000). Oral Manifestations of HIV/AIDS in a Kenyan Provincial Hospital. *East African Medical Journal*, 78 (8), 398-401.
51. International Fund for Agricultural Development (IFAD), (2005-2009). *Rural poverty in Kenya*. Retrieved November 20, 2008, from Rural Poverty Portal: <http://operations.ifad.org/web/guest/country/home/tags/kenya>

52. Onyango, J. F., Omondi, B. I., Njiru, A., & Awange, O. O. (2004). Oral cancer at Kenyatta National Hospital, Nairobi. *East African Medical Journal* , 81 (6), 318-321.
53. Macigo, F.G., Mwaniki, D.L., Guthua, S.W. Prevalence of oral mucosal lesions in a Kenyan population with special reference to oral leukoplakia *East African Medical Journal*. 1995; 72(12):778-782.
54. Berthold, P. (2003). Noma: a forgotten disease. *Dental Clinics of North America* , 47 (3), 559- 574.
55. Thorpe, S. J. (2003). Development of Oral Health in Africa. *Medical Principles and Practice*, 61-64.
56. Manji, F., Baelum, V., Fejerskov, O. 1988, Tooth mortality in an adult rural population in Kenya., *Journal of Dental Research*, vol. 67 nr. 2, s. 496-500.
57. Hassanali, J., and Amwayi, P., (1993) Biometric analysis of the dental casts of Maasai following traditional extraction of mandibular permanent central incisors and of Kikuyu children. *European Journal of Orthodontics*; 15: 513-518.
58. Day, K.C., and, Doherty, J.M., (1996) *History of Dental Public Health in Virginia*. Retrieved June 8, 2008, from <http://www.vahealth.org/teeth/history.pdf>
59. Darby, M. L. (1983) Collaborative Practice Model: The Future of Dental Hygiene. *Journal of Dental Education*; 47: 589.
60. Peck, S.B. (2002). *Written Testimony: The Crisis in Children's Dental Health: A Silent Epidemic*. Retrieved June 18, 2008, from http://www.adha.org/profissues/children_oral_health/testimony.htm
61. *Why Oral Health Matters*. (2004). Retrieved December 6, 2008, from World Health Organization - Regional Office for Africa: http://www.afro.who.int/note_press/2004/pr2004041602.html
62. World Health Statistics Annual. *World Health Statistics Annual 1995*, ISBN 92 4 067950; 1996.