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Incidence of cancer in Nairobi, Kenya (2004–2008)

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Cancer incidence rates are presented for the Nairobi Cancer Registry, a population-based cancer registry (PBCR) covering the population of the capital city of Kenya (3.2 million inhabitants in 2009). Case finding was by active methods, with standard and checks for accuracy and validity. During the period 2004–2008 a total of 8,982 cases were registered comprising 3,889 men (an age standardized incidence rate (ASR) of 161 per 100,000) and 5,093 women (ASR 231 per 1,00,000). Prostate cancer was the most common cancer in men (ASR 40.6 per 100,000) while breast cancer was the most common among women (ASR 51.7 per 100,000). Cervical cancer ranked the second most common cancer among women in Nairobi with an ASR of 46.1 per 100,000, somewhat lower than those of other registries in East Africa region. Breast and cervical cancers accounted for 44% of all cancers in women. Cancer of the oesophagus was common in both sexes, with a slight excess of cases in men (sex ratio 1.3). Unlike other regions in East Africa, the rate of Kaposi sarcoma was relatively low during the period (men 3.6/100,000; women 2.0/100,000). Although incidence rates cannot be calculated for the early years of the registry, the increase in relative frequency of prostate cancer and declines in frequency of Kaposi sarcoma may indicate underlying trends in the risk of these cancers.

Information on cancer patterns in Sub-Saharan Africa is very sparse. Cancer-specific mortality statistics are available for only three countries, but they were considered of only medium quality in two (Mauritius and Reunion) and of low quality in the Republic of South Africa.[1] National estimates of cancer incidence and mortality are predominantly based on data from population-based cancer registries (PBCR), most of which cover relatively limited subnational populations.[2] In Kenya, there are two PBCR: one in Eldoret (recoding data on cases arising in Uashin Gishu County) and the second in Nairobi (registering cancer cases in residents of Nairobi County). Nairobi Cancer Registry was established in the year 2001 and is located in the Centre for Clinical Research (CCR), Kenya Medical Research Institute (KEMRI). Nairobi is a large cosmopolitan and multicultural city made up of seventeen constituencies, with residents from both high and low socioeconomic classes. All major Kenyan ethnic groups are represented in the city, including sizeable population of Asians, Europeans and Somalis. According to the 2009 census, the population of Nairobi county was 3,138,639 (1,605,230 males and 1,533,139 females).[3] In this report, we highlight the results from the registry for the five-year period 2004–2008.

Key words: cancer, population-based registry, Nairobi

Abbreviations: AFCRN: Africa Cancer Registry Network; ASR: Age Standardised Rate; IACR: International Association of Cancer Registries; IARC: International Agency for Research on Cancer; ICD-O: Internal Classification of Diseases for Oncology; KEMRI: Kenya Medical Research Institute; KS: Kaposi Sarcoma; PBCR: Population Based Cancer Registries; SEER: Surveillance, Epidemiology and End Results program

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Material and Methods

The registry covers the population of Nairobi County, therefore includes all cancer cases that are residents of Nairobi. A resident is defined as anyone who has continuously lived/worked in Nairobi for a period of at least six months and excludes persons who visited the city for purposes of accessing treatment. Although many cancer cases are referred to Nairobi hospitals for further diagnosis and management, only residents of Nairobi County are included in the registry database.

The sources of information were governmental and private hospitals and diagnostic laboratories, the Nairobi Hospice and death certificates mentioning cancer as the contributory cause of death. The hospitals covered include one major governmental hospital (Kenyatta National Hospital) and more than15 private hospitals, some of which are large hospitals with specialist oncology services. Scientific and ethical approvals were obtained from the KEMRI Scientific Steering Committee and Ethics Review Committee. Letter of authority was obtained from the Ministry of Health and authorization to access medical records sought from each of the institutions before data collection was carried out. Data collection was done by trained cancer registrars whose duties include case finding, abstraction, data cleaning and coding. The major source of the data was the medical records departments, where disease index cards and patient-care registers were used to identify cancer cases. However a few hospitals had computer-based disease indices, which

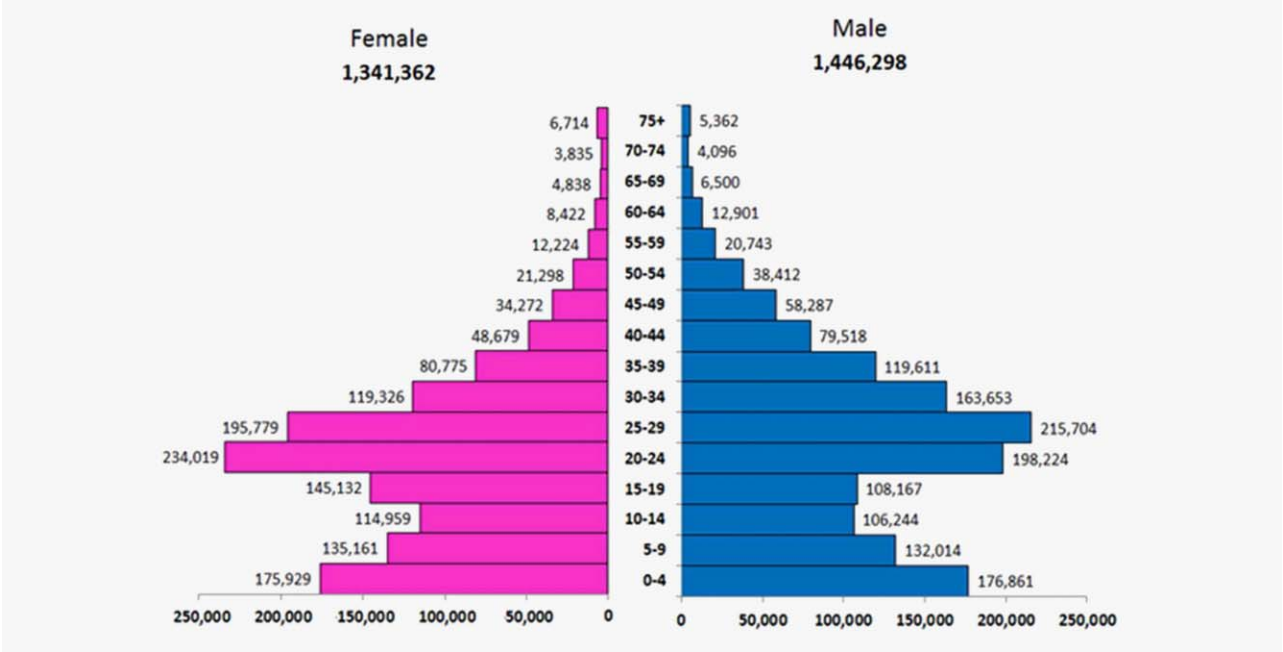

Figure 1. Population pyramid, average annual population, Nairobi, 2004–2008. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

were also used to identify cancer cases. In both cases, the hospital personnel were involved to provide the cases file numbers and files. Data was also collected from radiotherapy units, haematology and histology laboratories, outpatient clinics, medical wards, imaging units, autopsy reports and the hospice.

Relevant information on cancer cases was abstracted onto predesigned registration forms and submitted to the Cancer Registry office where checks on completeness and accuracy were done before data entry using the CanReg-5 software, an open-source tool developed by International Agency for Research on Cancer (IARC) designed to input, store, check for duplicate registrations (as well as the validity and consistency of coded data) and to analyse PBCR data.[4]

Death certificates mentioning cancer were identified in the office of civil registration of births and deaths, and those apparently for Nairobi residents abstracted onto the registration form. The forms were matched against the registry database, and for cases already registered, status at last contact was updated. Unmatched forms were traced back to the clinical records, and, for those deaths which proved to actually be from cancer, the case was registered. Cases that were not in the data base, and could not be traced in the hospitals (most of which were deaths at home) were not registered as DCO (death certificate only) cases because of the known inaccuracy of place of residence and cause of death information on death certificates.

Tumour site (topography) and histology (morphology) were coded based on the International Classification of Diseases for Oncology (ICD-0 3).[5] The pairs of codes were converted automatically within the CANREG system to the appropriate code in the 10th revision of the International Classification of Diseases (ICD-10), which is used for tabulation of results. The registry defined multiple primary cancers according to the 2004 IARC/IACR rules and they were recorded and tabulated accordingly. The registry adhered to IACR/IARC guidelines with respect to the preservation of confidentiality in connection with or during the process of collection, storage, use and transmission of identifiable data

Population data

The censuses of 1999 and 2009 provided the number of residents of Nairobi by age group and sex. Based on the annual growth rate in the population in each sex and five-year age group, annual intercensal estimates were prepared for the years 2000–2008. Using the population estimates for year 2004–2008, the average annual population of the registry area (Nairobi county) for the five year period was 2,787,660 (1,446,298 males and 1,341,362 females). Figure 1 shows the composition by sex and five year age group of the population.

Data analysis

Results are presented as numbers of cases registered, and as crude and age standardised incidence rates, per year, for the 5 year period (2004–2008). Age standardisation was carried out by the direct method using the "world standard population"[6] to obtain the World ASR per 100,000 populations.

Results

During the five year period (2004–2008) a total of 8,982 cases of cancers (ICD -10 codes: C00-C95) were registered among Nairobi residents, 3,889 cases in men corresponding to age-standardized incidence rate of 161 per 100,000 and 5,093 cases in women, corresponding to age-standardized incidence

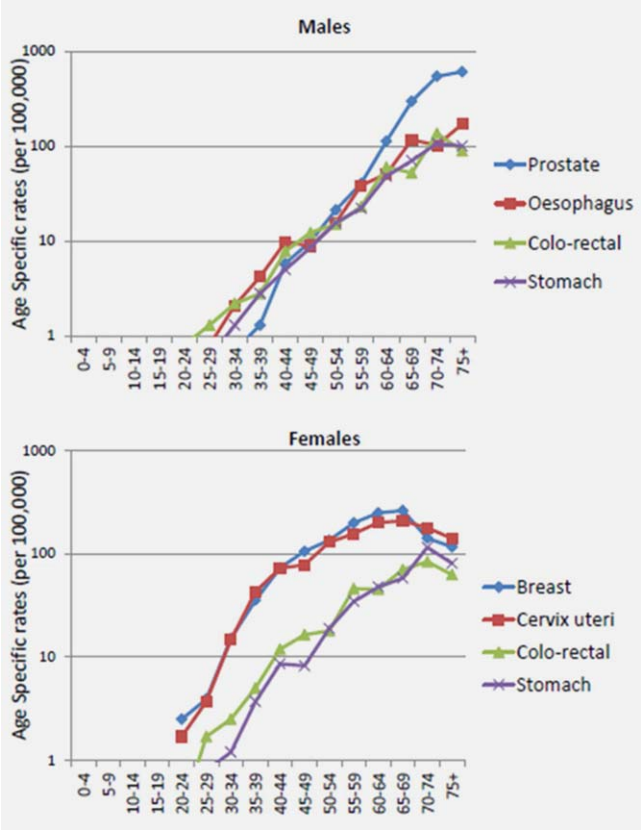

Figure 2. Age-specific incidence rates (per 100,000 population) for the period 2004–2008. [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

rate of 231 per 100,000 (Table 1). Prostate cancer was the most commonly diagnosed cancer among men, comprising 15.6% of all cases, with age-standardized rate of 40.6 per 100,000. This was closely followed by cancer of oesophagus (8.6% of all cancers, ASR 15 per 100,000), large bowel (7.6%, ASR 12.1 per 100,000), stomach (6.2%, ASR 11.1 per 100,000), oral cavity (5.2%, ASR 8.4 per 100,000) and liver cancer (4.9%, ASR 7.2 per 100,000). In women breast cancer was the most common cancer accounting for 23% of all cases, with an age-standardized incidence rate of 51.7 per 100,000. Cervical cancer ranked second (21.1% of cancers, age-standardized incidence 46.1 per 100,000). These two cancers comprised 44% of all female cancers. Cancer of oesophagus was the third most cancer in women (4.9%, 14.8 per 100,000), followed by large bowel (4.8%, 12.4 per 100,000), stomach (3.8%, 11.3 per 100,000) and ovarian cancer (3.4%, 8.9 per 100,000). Figure 2 shows, on a semilogarithmic scale, the age-specific incidence rates of top four cancers among men and women, respectively.

In men, there was a steady increase in incidence with age for all the cancers, with the rate of increase being higher for prostate cancer, and the incidence of this cancer being particularly high at ages 65 years and above. In women, the increase in the rates of both cervix and breast cancer was less marked in older, postmenopausal women, and there were even small declines in incidence in the oldest age groups.

Discussion

Cancer registration in Kenya is in a fairly early stage of development. Until recently, the only systematic data available was based on the records of the pathology department in Kenyatta National Hospital, Nairobi.[7] The first PBCR to be established was the Eldoret cancer registry in 1998 located in the western part of Kenya covering a relatively rural population. Four years later, in 2001 Nairobi cancer registry was set up, covering a large urban population. Nairobi is a cosmopolitan city and the central hub for trade and industry. It is a multicultural urban dwelling with major Kenyan ethnic groups represented in the city, including Kikuyu, Luo, Luhyia, Kalenjin, Kisii and Kamba among others. In addition to the Kenyan African ethnic groups, there is a sizeable population of Asians (people who trace their origins to India and Pakistan), Europeans, and Somalis. People migrate into the city from different parts of the country in search of jobs and businesses. The healthcare services are more established in Nairobi than in any other part of the country. There is one government referral hospital that admits a large number of cancer patients annually.[8] Radiotherapy is available in four private hospitals that have one to two linear accelerators each. Histopathology services are available in the major hospitals and in several stand-alone private histopathology laboratories.

The registry uses active case finding methods where trained registry personnel actively search for eligible cases in all possible sources. Patient demographic information is captured in the medical records documents, and the registry staff retrieves and abstracts information only for Nairobi residents. Every effort is made to obtain the true place of residence of cancer patients, although, since this depends on accurate information being provided by patients to admissions clerks it is possible that some nonresident subjects are misclassified. A few individuals, resident in Nairobi, will have gone abroad for treatment—however, they will have been be registered if they had been seen (*e.g.*, for diagnosis and assessment) in a Nairobi hospital prior to doing so. Cases identified *via* death certificates ("DCN" cases) are only registered if a clinical record with a cancer diagnosis can be found. This is because many deaths registered as due to "cancer" proved not to have the disease when the clinical records were found; home deaths, for which the certificate may be completed by non-medical officials, were found to be especially inaccurate.

Table 2 shows the comparison of age standardized incidence rates in Nairobi, in four other African registries, and in the black population of the SEER registries of the USA[9]. The average annual age-standardized incidence rate was 161 per 100,000 among males and 231 per 100,000 among females in the period 2004–2008. These results are comparable with those observed in Kampala (male 181; female 215 per 100,000) and Malawi (male 226; women 238 per 100,000), although much lower than those in Harare Zimbabwe (male 244.5; female 299

Table 1. Incidence of cancer in Nairobi county (2004–2008)

		MALES					FEMALES				
					Incidence (per 1,00,000)					Incidence (per 1,00,000)	
	ICD 10	No. cases	%	MV%	Crude	ASR	No. cases	%	MV%	Crude	ASR
Lip, oral cavity and pharynx	C00–14	383	9.8%	88	5.3	14.5	227	4.5%	89	3.4	11.0
Oesophagus	C15	333	8.6%	86	4.6	15.0	248	4.9%	89	3.7	14.8
Stomach	C16	243	6.2%	83	3.4	11.1	193	3.8%	79	2.9	11.3
Colon, rectum and anus	CI8–21	296	7.6%	85	4.1	12.1	242	4.8%	84	3.6	12.4
Liver	C22	192	4.9%	87	2.7	7.2	115	2.3%	86	1.7	5.5
Pancreas	C25	67	1.7%	67	0.9	3.6	69	1.4%	63	10	4.1
Larynx	C32	109	2.8%	85	1.5	5.7	18	0.4%	88	0.3	0.7
Lung (incl. trachea)	C33–34	99	2.5%	68	1.4	5.4	53	1.0%	74	0.8	3.2
Kaposi sarcoma	C46	194	5.0%	84	2.7	3.6	100	2.0%	82	15	2.0
Breast	C50						1154	22.7%	88	17.2	51.7
Cervix uteri	C53						1073	21.1%	88	16.0	46.1
O&U part of uterus	C54–55						180	3.5%	87	2.7	10.7
Ovary	C56						175	3.4%	81	2.6	8.9
Prostate	C61	606	15.6%	86	8.4	40.6					
Kidney etc.	C64–66	38	1.0%	83	0.5	1.3	45	0.9%	73	0.7	1.5
Bladder	C67	53	1.4%	84	0.7	3.8	26	0.5%	87	0.4	1.4
Eye	C69	216	5.6%	96	3.0	4.9	255	5.0%	96	3.8	6.2
Brain, central nervous system	C70–72	83	2.1%	70	1.1	2.8	97	1.9%	77	1.4	3.1
Thyroid	C73	17	0.4%	87	0.2	0.6	60	1.2%	91	0.9	2.8
Lymphoma	C81–88,C90	206	5.3%	94	2.8	6.7	142	2.8%	95	2.1	7.1
Leukaemia	C91–95	105	2.7%	89	1.5	2.7	71	1.4%	98	1.1	2.8
Other & unspecified		170	4.4%	76	2.4	6.3	155	3.0%	80	2.3	7.8
All sites		3889	100%	85.7	53.8	160.8	5093	100%	87	75.9	230.7

per 100,000). The percentage of cases with morphological verification of diagnosis (overall 85.7% in males, 87.0% in females) is rather higher than in the other registries of sub Saharan Africa (the corresponding figures for Harare, if DCO cases are excluded, are 67% and 69% respectively). While this might indicate under-ascertainment of cancers diagnosed clinically, it might equally be the result of more available diagnostic pathology in the Nairobi hospitals. In 2006 the registry published a report covering the early years of 2000–2002.[10] At that time some hospitals had not provided access to data collection in their facilities, and there was limited awareness about the importance of cancer registries. The percentage of cases morphologically verified was 94%.

The high rates of prostate cancer and oesophageal cancer in men are similar to observations elsewhere in East Africa. Cancer of the oesophagus is the most common cancer in Eldoret—16.9% of male cancers,[11] and hospital-based studies done in Tenwek hospital (western Kenya) showed the same thing, with a male: female ratio of 1.6:1.[12] The study showed that 6.3% were aged below 30 years of age, indicating that this malignancy is common in young people. The reasons for the high burden of esophageal cancers in several parts of Eastern Africa and Southern Africa are not fully understood. Tobacco and alcohol have been shown to be clear risk factors in South Africa,[13] but obviously do not explain the high rates in East Africa compared with other regions. Many other hypotheses have been advanced, including nutritional deficiencies secondary to poor dietary patterns such as consumption of a maize-based diet that is low in fruits and vegetables, snuff use, poor oral hygiene, and the contamination of maize with fungi that produces fumonisins, a cancer initiating agent in experimental animals.[14,15] Incidence rates of lung cancer are rather low (ASR per 100,000 of 5.4 in men, 3.2 in women), although somewhat higher than the estimated rates for the East Africa region in Globocan of 3.8 and 2.2 respectively [16]. Prevalence of daily tobacco use in Kenya is 20% among males, and <1% among females[17]. However, although prevalence (in men) appears quite high, the intensity of smoking (number of cigarettes per day) is probably low. Smoking Kenyan consumers retain their habit of purchasing

Table 2. Comparison of age standardized incidence rates; Nairobi and other registries in Africa and SEER-USA[9]

Site	ICD (10th)	Kenya, Nairobi (2004–2008)	Uganda, Kyadondo (2003–2007	Zimbabwe, Harare African (2003–2006)	Malawi, Blantyre (2003–2007)	Tunisia, North (2003–2005)	USA, SEER: Black
Male							
Prostate	C61	40.6	42.5	62.4	15.7	11.4	178.6
Oesophagus	CI5	15	15.6	22.2	37.6	0.5	6
Large bowel	C18–21	12.1	8.2	13.4	3.2	10.8	4.3
Stomach	C16	11.1	8	11.7	2	5.8	10.4
Oral cavity	C00–08	8.4	2.8	2.3	2.6	2.6	5.9
Liver	C22	7.2	11.4	16.7	7	1.7	11.6
Larynx	C32	5.7	2.5	4.6	0.6	6	7.4
Lung	C33–34	5.4	5.2	10.1	1.2	30.6	66.8
Eye	C69	4.9	2.7	5.5	7.4	0.5	0.3
Non-Hodgkin lymphoma	C82–85,C96	4	9.6	8.8	12.6	5.7	14.4
Kaposi sarcoma	C46	3.6	29.5	37.3	91.8	0.7	2.7
Nasopharynx	C11	3.5	2.2	0.7	0.3	3.5	0.9
Bladder	C67	2.8	2.6	9.4	13.3	12.9	11.9
Leukemia	C91–95	2.7	2.3	2.6	0.9	3.6	9.4
All sites	C00–95	161	180.8	244.5	226.4	129.9	446.6
Female							
Breast	C50	51.7	32.9	33.9	14.3	30.9	88.9
Cervix uteri	C53	46.1	54.3	86.7	76.3	4.6	5.6
Oesophagus	C15	14.8	11.5	15.3	23	0.3	1.3
Large bowel	C18–21	12.4	9.9	11.3	3.4	9.4	27
Stomach	C16	11.3	5.9	14.2	2.5	3.2	3.2
Ovary	C56	8.9	6.9	10.9	4.3	4	9.1
Oral cavity	C00–08	6.9	2.2	2.5	2.7	1.5	3.3
Corpus uteri	C54	6–3	5.6	10	1.4	3.4	17–6
Eye	C69	6.2	3	5.4	9.8	0.2	0.6
Liver	C22	5.5	8.7	13.9	4.4	1.1	2.4
Non-Hodgkin lymphoma	C82–85,C96	3.7	7.2	10	9.4	3.8	11.3
Lung	C33–34	3.2	5.1	6.4	0.2	2.6	33.8
Other skin	C44	3	2.7	4.5	4.3	5.7	1
Thyroid	C73	2.8	3.2	4.7	2	3.3	12.5
Leukemia	C91–95	2.8	1.4	3.1	0.8	2.8	7.1

sticks of cigarettes as opposed to full packets [18], and the annual cigarette consumption is just 144 per capita (compared with, for example, 1028 per day in USA, 1104 per day in Egypt and 2786 per day in Russia)[19]. Cancer of the oral cavity is rather more frequent than in the other African registries; quite likely, this relates to the relatively large population of south Asian origin, amongst whom the incidence of oral cancer is high due to habits of chewing tobacco. While the incidence of cancer of the nasopharynx is not very high, it is greater than observed elsewhere in sub Saharan Africa. The occurrence of modestly raised rates of nasopharyngeal carcinoma (NPC) in Kenya has been known for many years.[20] On the other hand, the incidence of Kaposi sarcoma (KS) is very much lower than in the other three sub-Saharan registries (Table 2). In part, this may relate to the rather lower prevalence of HIV/AIDS (6.2% among adults in 2012, compared with 7.2% in Uganda and 14.7% in Zimbabwe[21]) to a lower background prevalence of KSHV (KS was not common in central Kenya prior to the epidemic of HIV/AIDS[20]) and to more widespread availability of antiretroviral therapy.[22]Breast cancer is the leading cancer among women in Nairobi, with an incidence (ASR 51.7 per 100,000) that is the highest so far recorded in an African cancer registry. Nairobi is a modern city, with a burgeoning middle class, and indicators of breast cancer risk, such the fertility rate (2.8 in Nairobi,[23] compared with 4.5 nationally, and 4.9 for sub Saharan Africa[24]) are in keeping with this relatively high rate. Nevertheless, the incidence of cervix cancer remains elevated—nine times greater than in the US black population. In Eldoret, a rather more rural population, the situation is reversed, with breast cancer second in frequency (13.6% of cancers in women) to cervix cancer (17.4%)[11]. There are no organized screening programs for either cancer, and few women in Kenya have ever had a pap test[25] although some sporadic campaigns of screening, particularly among HIV-positive women, have been carried out.[26,27]

The data published for 2000–2002[10] was considered to be incomplete; hence incidence rates were not calculated. At that time, breast cancer was the commonest malignancy, accounting for 23.3% of cases, followed by cervical cancer (20%), oesophageal cancer (4.4%) and stomach cancer (3.8%), a pattern that is similar to that of the more complete data for 2004–2008 reported here. In men in 2000–2002, oesophageal cancer was the leading cancer (10% of all male cancers), followed closely by prostate cancer (9.4%), stomach (7.1%) and KS (6.9%). Of the head and neck subsites, oral cancers were the highest at 40.6%, followed by nasopharynx and laryngeal cancers with 20.8% and 13.8%, respectively.[28] It seems likely, then, that there has been an increase in incidence of cancer of the prostate and a decrease in incidence of KS, as has been observed in Kampala (Uganda) and Harare (Zimbabwe).[29,30] The decline in frequency of KS may represent a true decline in incidence, given the decline in prevalence of HIV/AIDS (HIV prevalence in Kenya is believed to have peaked in 1995–1996, at 10.5%, subsequently falling by approximately 40% and remaining relatively stable for the last several years) and increasing availability and use of antiretroviral therapy.

Cancer registries are an important component of programmes of cancer control[31], and a recent survey of all active PBCRs in sub Saharan Africa[32]found that most were actively engaged with health departments in their respective countries, and were frequently involved in formal planning and evaluation of cancer control activities.[32] The Nairobi cancer registry works closely with the Ministry of Health by providing data that assists in the design of an effective policy/strategy on cancer control in Nairobi. The results from the registry, together with those of Eldoret (2008–2011), were used to estimate the national cancer profile of Kenya in 2012.[2] However, it is acknowledged that this is a small sample on which to base national planning, in such a diverse nation, and the Ministry of Health, working through KEMRI, and with the support of international partners, plans to extend the network of PBCRs in the country, as well as strengthening the resources of the two registries already in place.

Cancer registration system is an essential surveillance program that should be part of any national cancer control program. Unfortunately, many countries in Africa including Kenya have not given cancer registration the priority it deserves; hence limited resources have been channeled by governments to support registries. Majority of registries rely on donor funding to support personnel and this often affects sustainability of the established registries. There is a high turnover of skilled personnel because of job insecurity and poor remuneration. Cancer registries require not only financial resources but also efficient healthcare infrastructure and government recognition of the importance of data generated from these registries. Other challenges include; unreliable population data especially in urban cities, lack of trained staff and lack of cooperation from some diagnostic facilities. To overcome these challenges Nairobi Cancer Registry staff continuously build rapport with hospital staff who facilitates access to patient records. We continue to advocate for better management of patient records, emphasizing the importance of electronic medical records, which currently are being adopted by hospitals although at a slow pace.

Despite the many challenges, cancer registries in Africa have generated invaluable data on cancer patterns and trends in different countries. There are opportunities to study cancer occurrence and outcomes using registry data. As more countries in Africa develop their national cancer control programs, there are opportunities to establish cancer registries to monitor the cancer burden in those countries. In its 58th World Health Assembly in 2005, the WHO urged member states to develop and reinforce comprehensive and evidence-based cancer control programs to curb the growing global burden of cancer.[33] The World Health Organization further emphasized the need for establishment of high-quality population-based cancer registration systems as important components of any evidence-based cancer control program since cancer registration is essential for assessing the burden of

cancer, setting priorities, and implementing and evaluating cancer control programs.[34,35] For countries setting up cancer registries it is important to engage all stakeholders (Ministries of Health, Reporting hospitals and institutions, researchers and existing cancer organizations). A population based registry does not necessarily have to cover an entire country but can cover a sample of the population.[36] Government support is essential for sustainability of the registry.

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