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## Cancer referrals at African Inland Church Kijabe Hospital, Kiambu County (2014–2020) and the impact of COVID-19

Moses Kamita<sup>a,\*</sup>, Peter Bird<sup>b</sup>, Beryl Akinyi<sup>b</sup>, Rosemary Wangari Kamau<sup>c</sup>, Robert Carter<sup>b</sup>, Sarah Muma<sup>b</sup>, Mary Adam<sup>d</sup>, Timothy Makori<sup>e</sup>, Jonine D Figueroa<sup>f</sup> and Francis Makokha<sup>a</sup>

<sup>a</sup>Research and Innovation, Mount Kenya University, P.O. Box 342-01000, Thika, Kenya; <sup>b</sup>Oncology Department, AIC Kijabe Mission Hospital, P.O. Box 20-00220, Kijabe Kenya; <sup>c</sup>Pathology Department, AIC Kijabe Mission Hospital, P.O. Box 20-00220, Kijabe Kenya; <sup>d</sup>Research Department, AIC Kijabe Mission Hospital, P.O. Box 20-00220, Kijabe Kenya; <sup>e</sup>ICT Department, AIC Kijabe Mission Hospital, P.O. Box 20-00220, Kijabe Kenya; <sup>f</sup>Usher Institute and CRUK Edinburgh Centre, University of Edinburgh, Teviot Place, EH8 9AG, UK

\*Corresponding author: Tel: +254703439294; E-mail: [kamitamoses@yahoo.com](mailto:kamitamoses@yahoo.com), [mkamita@mku.ac.ke](mailto:mkamita@mku.ac.ke)

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In Kenya, cancer is the third leading cause of death. The African Inland Church Kijabe Hospital (AICKH) is a level 4 missionary hospital. The hospital serves the Kenyan population in many areas, including cancer care, and some of these services were affected during the coronavirus disease 2019 (COVID-19) pandemic. We aimed to leverage a recently established hospital-based cancer registry of patients treated at AICKH between 2014 and 2020 to describe the cancer cases and patient referral patterns seen at AICKH during the COVID-19 pandemic in 2020. A cross-sectional retrospective survey was conducted through medical records abstraction in the surgery, breast clinic, palliative care and pathology departments. A total of 3279 cases were included in the study, with females accounting for 58.1% of the cases. The top-three cancers overall were breast (23.0%), oesophagus (20.5%) and prostate (8.6%). There was a minimal increase in the number of cancer cases in 2020 (1.7%) compared with 2019, with an increase of 19.3% in 2019 compared with 2018. In conclusion, AICKH is one of the few hospitals in Kenya where a large number of cancer patients seek healthcare, and referral of cancer cases changed in 2020, which may be due to the COVID-19 pandemic. Future efforts can leverage this registry to determine the impacts of cancer diagnosis and treatment on survival outcomes.

**Keywords:** AIC Kijabe, cancer cases, cancer registry, hospital-based cancer registry.

### Introduction

In 2020, the World Health Organization's International Agency for Research on Cancer (IARC), reported an increase in new cancer cases by almost 20 million worldwide.<sup>1</sup> This increase is mainly attributed to the aging population and increased risk factors, including smoking, drinking and sedentary lifestyles. It is estimated that in 2018, Kenya had >42 000 new cases, representing an age-standardized incidence rate of 149.2. In the same year, >27 000 people died of cancer, representing an age-standardized mortality rate of 103.2. While the incidence rates reported are lower compared with the incidence rates reported in North America (360.7), the mortality rates are much higher than reported in North America (87.1).<sup>2</sup> Unlike in developed countries where cancer screening programs and registration are well streamlined, Kenya and many other low- and middle-income countries still suffer from late-stage cancer diagnosis and a lack of proper documentation of cases.<sup>3</sup>

Data on the cancer burden in Kenya is scarce due the lack of dedicated resources for surveillance. Cancer registries have shown to be a good source and curator of cancer cases and provide an efficient way to identify cancer incidences and provide support in making decisions on the right cancer control programs to be undertaken.<sup>4</sup> Although efforts have been put in place in the establishment of population-based cancer registries (PBCRs) in different counties within Kenya, the gains cannot be fully attained without complementing the efforts with hospital-based cancer registries (HBCRs). HBCRs are better placed to provide clinical information on a case and continually update diagnostic, treatment and survival data as the patient visits the hospital. Cancer registries that are hosted in hospitals have the benefit of data that is rich in the mode of diagnosis, the clinical characteristics of the tumour, received treatment and follow-up status. In addition, the HBCR plays a critical role in providing data to the available PBCRs.<sup>5</sup>

Kenya has a mix of public, private and missionary hospitals, all of which are classified into six levels. The higher the tier, the

more specialized the care. Levels 1–5 are managed by the county governments, while level 6 hospitals are managed by the national government.<sup>6</sup> Through this system, patients are referred from one level to the next. Patients may be escalated from lower to higher levels if they are getting worse or deescalated if they are improving. Although private and missionary hospitals are not managed by either county or national governments, they are all accredited by the government and classified using the same system as the public health facilities.<sup>7</sup> All health facilities are required to submit reports on incidences to the ministry of health by completing mandatory registries supplied by the Kenyan Ministry of Health.

The African Inland Church Kijabe Hospital (AICKH) is a non-profit level 6 hospital that was founded by missionaries from the African Inland Mission in 1915, and it is one of the missionary hospitals that is required to report on incidences to the Ministry of Health in Kenya. However, even though the hospital is a key referral facility receiving cancer patients from all over Kenya, it is not included among facilities that contribute data to the national cancer registry.

In a bid to contain the spread of coronavirus disease 2019 (COVID-19), the Kenyan government enacted measures such as social distancing, strict curfew and a ban on travelling from rural areas to the Nairobi metropolitan area.<sup>8</sup> These measures resulted in increased bus fare and inaccessibility of healthcare for most patients who reside far from specialized hospitals such as the AICKH. However, it is unknown whether COVID-19 had an impact on the number of cancer patients being seen or treated at the AICKH.

This study aimed to establish the number of cancer cases to determine the baseline measure of all-cause and specific cancer cases in the AICKH between 2014 and 2020. The collected data were then used to establish an HBCR in the hospital, which will then be actively maintained. The registry will not only help inform areas of priority, but will also help inform which treatment options are working, early detection and, most importantly, survival for the major cancer types. The registry will also help the hospital collect information that can be used to educate physicians and assess facility utilization.

## Methods

### Study site

The AICKH is a non-profit missionary hospital that was founded by the African Inland Mission in 1915. The hospital offers a wide range of cancer-related services, including screening, chemotherapy, surgery and palliative care for different types of cancer. Although the hospital is privately owned and managed, it serves patients from every corner of the country. The hospital is located within the Rift Valley escarpment in Kijabe ward, Lari subcounty, Kiambu County in Kenya and has a bed capacity of 363, serving patients from all over Kenya. Kiambu County borders Nairobi and Kajiado Counties to the south, Machakos to the east, Murang'a to the northeast, Nyandarua to the northwest and Nakuru to the west (Figure 1). The hospital is the only level 6 missionary hospital in the country, positioning it at the same level with national hospitals such as Kenyatta National Hospital.<sup>9</sup> The AICKH is one

of the largest private hospitals in Kenya and the only level 6 hospital in Kiambu County. The hospital therefore plays a key role in the management of cancer cases in the country in general, and particularly in Kiambu County. As a missionary hospital, it offers healthcare to a wide spectrum of patients, from the rich to the most vulnerable. In addition, the hospital has a good reputation in breast and oesophageal cancer management and therefore attracts a large number of referrals for these two cancers.

### Survey design

A cross-sectional retrospective survey was conducted at the AICKH from January 2014 to December 2020. For the cases from January 2014 to August 2019, data were obtained from the patient files within the hospital. This was before the AICKH migrated from physical to electronic patient data record keeping. These departments included the pathology department, breast cancer clinic, palliative care department and surgery department. From the pathology department, we received a list of all the patients whose samples were sent to pathology for processing and their reports contained the term 'carcinoma'. All the files were pulled from the health records department to check whether the patient had cancer and data were abstracted from those files that met the inclusion criteria. The records at the palliative care unit covered all the cancer patients who either visited the hospital as outpatients for chemotherapy or symptom management, were self-referred from the community, were referred from other hospitals or were discharged through the department after being attended to in the inpatient department of the AICKH. In the surgery department, all patients who underwent any surgical procedure related to cancer were extracted from the database, while in the breast cancer clinic, all the cases reported during the period of interest were extracted from a prospectively collated database in the clinic. For the patients seen from September 2019 to December 2020, cases were retrieved from the electronic medical records (Smartcare).

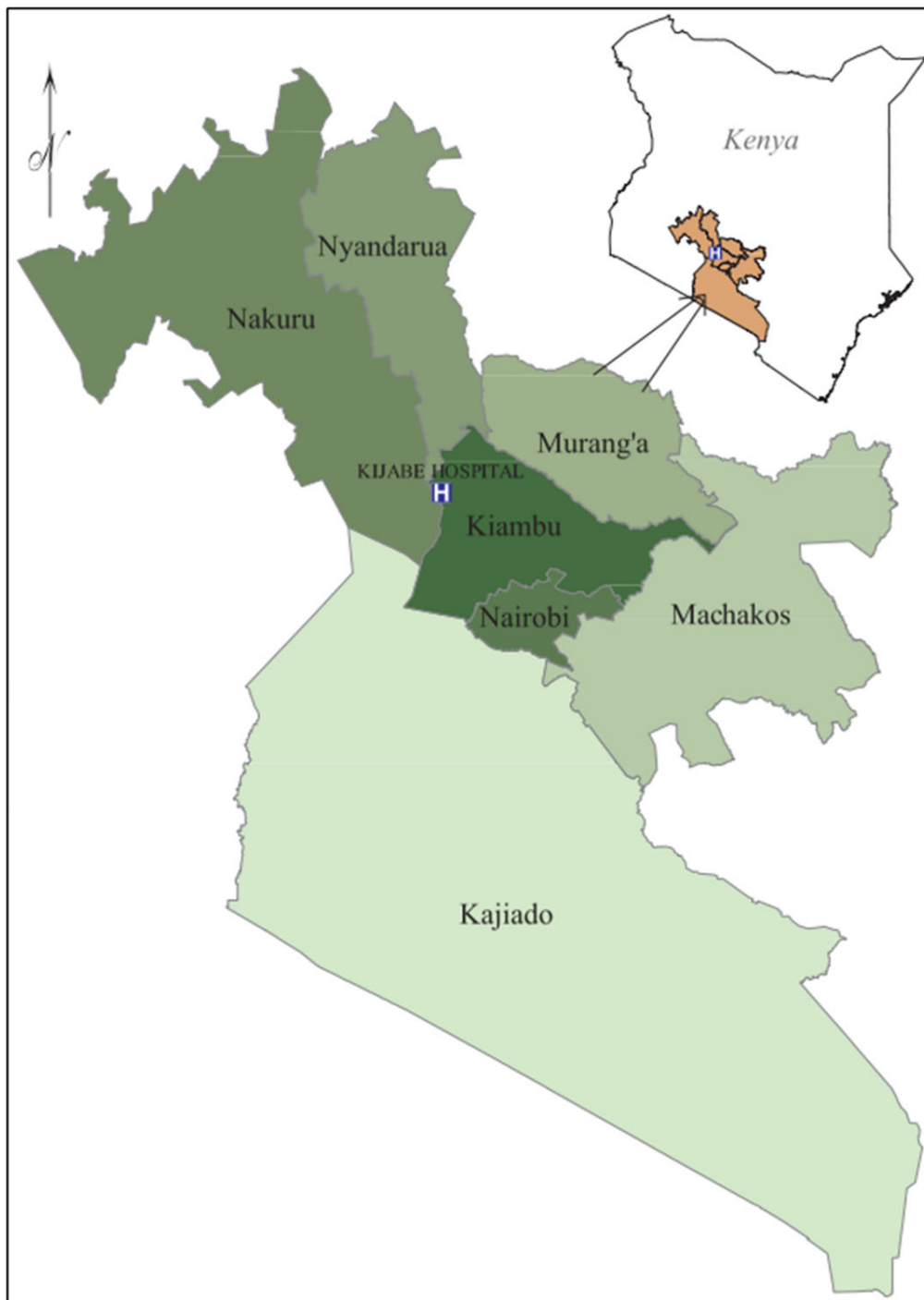
The patient's hospital number was used as a unique identifier and all the cases were combined in an Excel spreadsheet (Microsoft, Redmond, WA, USA) for duplicate checking, generating a list of unique cases that was then used to retrieve files in the records department. From the files, data such as the patient's name, age, marital status, sex, residence, cancer's primary site and histology were extracted.

### Inclusion criteria

The study included all adult patients ( $\geq 18$  y of age) who were managed for cancer during the study period and included all new and recurrent cases. All the retrieved files, physical or electronic, were reviewed to determine whether the patients met the criteria for inclusion to the study.

### Data variables

The major data variables that were obtained from the patient files included their age, county of origin, year of diagnosis or first encounter and the primary anatomical site where the cancer was found.



**Figure 1.** A map of counties bordering Kiambu County.

### **Comparative data from other hospitals in Kiambu County**

To establish the key role played by the AICKH within Kiambu County, we compared data we collected from six major hospitals

within Kiambu County covering 2014–2018 and compared these with the cancer cases managed in the AICKH within the same years. The six hospitals were Thika, Gatundu and Kiambu level 5 hospitals, Tigoni level 4 hospital and Nazareth Hospital.

**Table 1.** Descriptive characteristics of adult cancer cases treated at the AICKH from 2014 to 2020

| Primary site <sup>a</sup>        | ICD codes | Male     |      |             |        | Female   |      |             |        | Total    |      |             |        |
|----------------------------------|-----------|----------|------|-------------|--------|----------|------|-------------|--------|----------|------|-------------|--------|
|                                  |           | Cases, n | %    | Age (years) |        | Cases, n | %    | Age (years) |        | Cases, n | %    | Age (years) |        |
|                                  |           |          |      | Range       | Median |          |      | Range       | Median |          |      | Range       | Median |
| Lip, oral cavity and pharynx     | C00–14    | 60       | 4.4  | 18–88       | 50     | 51       | 2.7  | 18–88       | 57     | 111      | 3.4  | 18–88       | 53     |
| Oesophagus                       | C15       | 397      | 28.9 | 22–98       | 62.0   | 274      | 14.4 | 24–98       | 64     | 671      | 20.5 | 22–98       | 63     |
| Stomach                          | C16       | 89       | 6.5  | 30–84       | 63.0   | 61       | 3.2  | 20–92       | 60     | 150      | 4.6  | 20–92       | 63     |
| Colon, rectum and anus           | C18–21    | 77       | 5.6  | 20–86       | 60.0   | 92       | 4.8  | 21–94       | 56     | 169      | 5.2  | 20–94       | 58     |
| Liver                            | C22       | 52       | 3.8  | 34–99       | 60.5   | 18       | 0.9  | 21–79       | 53     | 70       | 2.1  | 21–99       | 59     |
| Pancreas                         | C25       | 21       | 1.5  | 44–84       | 66.0   | 25       | 1.3  | 31–102      | 59     | 46       | 1.4  | 31–102      | 59.5   |
| Larynx                           | C32       | 48       | 3.5  | 24–89       | 64.0   | 0        | 0.0  |             |        | 48       | 1.5  | 24–89       | 64.0   |
| Lung                             | C33–34    | 16       | 1.2  | 25–79       | 58.0   | 11       | 0.6  | 22–89       | 61     | 27       | 0.8  | 22–89       | 61     |
| Bones                            | C40–41    | 31       | 2.3  | 18–81       | 51.0   | 11       | 0.6  | 28–84       | 56     | 42       | 1.3  | 18–84       | 55     |
| Breast                           | C50       | 20       | 1.5  | 20–94       | 59.0   | 735      | 38.6 | 21–92       | 48     | 755      | 23.0 | 20–94       | 49     |
| Cervix                           | C53       |          |      |             |        | 251      | 13.2 | 24–88       | 52     | 251      | 7.7  | 24–88       | 52     |
| Ovary                            | C56       |          |      |             |        | 54       | 2.8  | 23–81       | 55     | 54       | 1.6  | 23–81       | 55     |
| Prostate                         | C61       | 283      | 20.6 | 27–114      | 71.0   | 0        | 0.0  |             |        | 283      | 8.6  | 27–114      | 71.0   |
| Kidney                           | C64–66    | 9        | 0.7  | 47–90       | 58     | 9        | 0.5  | 20–66       | 45     | 18       | 0.5  | 20–90       | 57     |
| Bladder                          | C67       | 51       | 3.7  | 29–95       | 63.0   | 21       | 1.1  | 24–90       | 61     | 72       | 2.2  | 24–95       | 63     |
| Skin                             | C44       | 20       | 1.5  | 25–77       | 50.5   | 25       | 1.3  | 22–93       | 49     | 45       | 1.4  | 22–93       | 50     |
| Brain and central nervous system | C70–72    | 20       | 1.5  | 23–77       | 38     | 25       | 1.3  | 29–80       | 51     | 45       | 1.4  | 23–80       | 44     |
| Thyroid                          | C73       | 13       | 0.9  | 29–66       | 47.9   | 47       | 2.5  | 21–84       | 49     | 60       | 1.8  | 21–84       | 49.5   |
| Blood                            | C42       | 17       | 1.2  | 22–77       | 50.0   | 18       | 0.9  | 30–96       | 53     | 35       | 1.1  | 22–96       | 50     |
| Other and unspecified            |           | 151      | 11.0 | 18–88       | 57.0   | 176      | 9.2  | 19–90       | 56.5   | 327      | 10.0 | 18–90       | 57     |
| Total                            |           | 1375     | 41.9 |             |        | 1904     | 58.1 |             |        | 3279     |      |             |        |

Primary sites according to their International Classification of Diseases (ICD) code.

## Data analysis

Quality control checks were performed to prevent double entry and to ensure accurate entry of the data. All-cause and specific cancer cumulative cases were estimated by the year of diagnosis. The year of diagnosis or the first encounter with the hospital was determined as the year of cancer diagnosis. For recurrent cases, the year the first diagnosis was made was taken to be the year of diagnosis. Once data abstraction was done, the forms were checked for completeness before entering the data into the CanReg5 software, which is an open-source tool from the International Agency for Research on Cancer.<sup>10</sup> Standard descriptive analysis was performed to understand the distribution of all-cause and specific cancers by sex and age.

## Results

### Distribution of cancer cases by type

From the different departments, we received a total of 4314 files. After removing the duplicates and excluding those that did not meet the inclusion criteria, 3279 cases of cancers (Internation

Classification of Diseases, Tenth Revision codes: C00–C95) qualified for further analysis. The cases included 1375 (41.9%) males and 1904 (58.1%) females, giving a male:female ratio of 1:1.4. The mean age for both genders was 56.9 y (range 18–114). Oesophageal cancer was the most diagnosed cancer among men, accounting for 28.9% (n=397), followed by prostate cancer (20.6% [n=283]), stomach cancer (6.4% [n=89]), colon, rectal and anal cancers (5.6% [n=77]) and liver cancer (3.8% [n=52]). In women, breast cancer was the most common cancer, accounting for 38.6% (n=735), followed by oesophageal cancer (14.4% [n=274]), cervical (13.2% [n=251]), colon, rectal and anal cancers (4.8% [n=92]) and stomach cancer (3.2% [n=61]). Overall, breast (23.0% [n=755]), oesophageal (20.5% [n=671]) and prostate (8.6% [n=283]) cancers were the top-three cancers managed at the AICKH. The proportions of the other cancer types are shown in Table 1.

### Distribution of cancer cases by county of origin

The AICKH is one of the major missionary hospitals that offers both surgical and chemotherapy courses of cancer treatment. Analysis by the patients' county of residence indicated that

**Table 2.** Number of adult cancer cases treated from 2014 to 2020 at the AICKH by the counties where patients reside

| County of residence | Cases, n | %     |
|---------------------|----------|-------|
| Kiambu              | 820      | 25.01 |
| Nairobi             | 532      | 16.22 |
| Nakuru              | 347      | 10.58 |
| Nyandarua           | 189      | 5.76  |
| Murang'a            | 183      | 5.58  |
| Machakos            | 171      | 5.22  |
| Kajiado             | 114      | 3.48  |
| Nyeri               | 93       | 2.84  |
| Makueni             | 76       | 2.32  |
| Kitui               | 74       | 2.26  |
| Unknown             | 60       | 1.83  |
| Laikipia            | 60       | 1.83  |
| Kirinyaga           | 61       | 1.86  |
| Narok               | 51       | 1.56  |
| Other               | 448      | 13.66 |

**Table 3.** Number of adult cancer cases diagnosed from 2014 to 2020 at the AICKH by the year of incidence

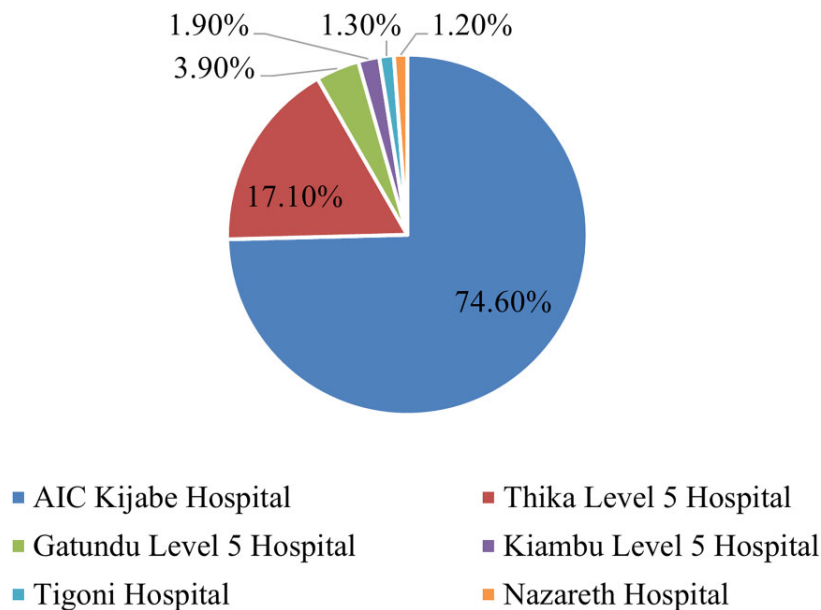
| Year of Incidence | Cases, n | Change from previous year, % |
|-------------------|----------|------------------------------|
| 2014              | 189      |                              |
| 2015              | 339      | 79.4                         |
| 2016              | 289      | -14.7                        |
| 2017              | 452      | 56.4                         |
| 2018              | 590      | 30.5                         |
| 2019              | 704      | 19.3                         |
| 2020              | 716      | 1.7                          |

all 47 counties in Kenya are represented, with Kiambu (n=820 [25.0%]), Nairobi (n=557 [16.47%]), Nakuru (n=347 [10.58%]), Nyandarua (n=189 [5.76%]) and Murang'a (n=183 [5.58%]) counties being the top-five counties (Table 2). In Kiambu County, we previously collected cancer data from the Thika level 5 hospital<sup>11</sup> and from the Gatundu and Kiambu level 5 hospitals.<sup>12</sup> Combining these results with data from other facilities that manage cancer patients in the county (Tigoni and Nazareth Hospitals) with the data collected from the AICKH, the AICKH accounts for 74.6% of all the cancer cases managed from 2014 to 2018 (Figure 2).

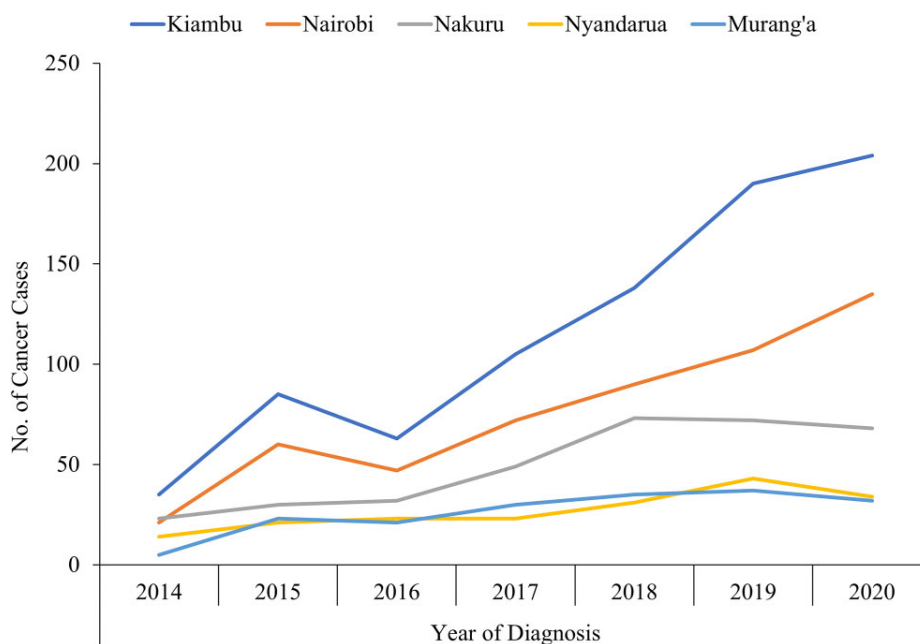
**Trend of cancer cases over time**

GLOBOCAN has shown a 13.8% increase in the number of cases in Kenya based on Nairobi registries, from 37 000<sup>13</sup> in 2014 to 42 116 in 2020.<sup>1</sup> This is also reflected in the number of cancer cases recorded in the AICKH for the period under review. In 2014, the number of cancer cases recorded was 189, increasing to 590 in 2018 and to 716 by 2020 (Table 3). Among the five counties with the highest number of cancer patients, there was a gradual increase in the number of patients coming from Kiambu, Nairobi and Nakuru, while the number of patients from Murang'a and Nyandarua counties did not show much of an increase over the years (Figure 3). In terms of primary sites, oesophageal and breast cancer showed a progressive increase over the 7 y under review compared with the other cancer types (Figure 4).

At the AICKH there was a 55.7% increase in cancer cases seen from 2017 to 2019. However, this increase 1.7% in 2020 compared with cases reported in 2019 (Table 3). There was a calendar period difference in the number cancer cases diagnosed in 2020, with numbers falling by >45% from September to December



**Figure 2.** Cancer cases diagnosed at different hospitals within Kiambu County between 2014 and 2018 (N=2573).



**Figure 3.** Trends in the number of cancer cases from top-five counties for all adult cancer cases recorded in the AICKH from 2014 to 2020.

2020. However, these fluctuations were not seen in the cases coming from the top-three counties, indicating that the decrease was from counties far from the AICKH (Figure 5). There was a decrease in April that coincides with the time when the first case of COVID-19 was announced. Interestingly, a reduction in the number of cases was noted in the months following the months that had high COVID-19 positivity rates (Figure 6).

## Discussion

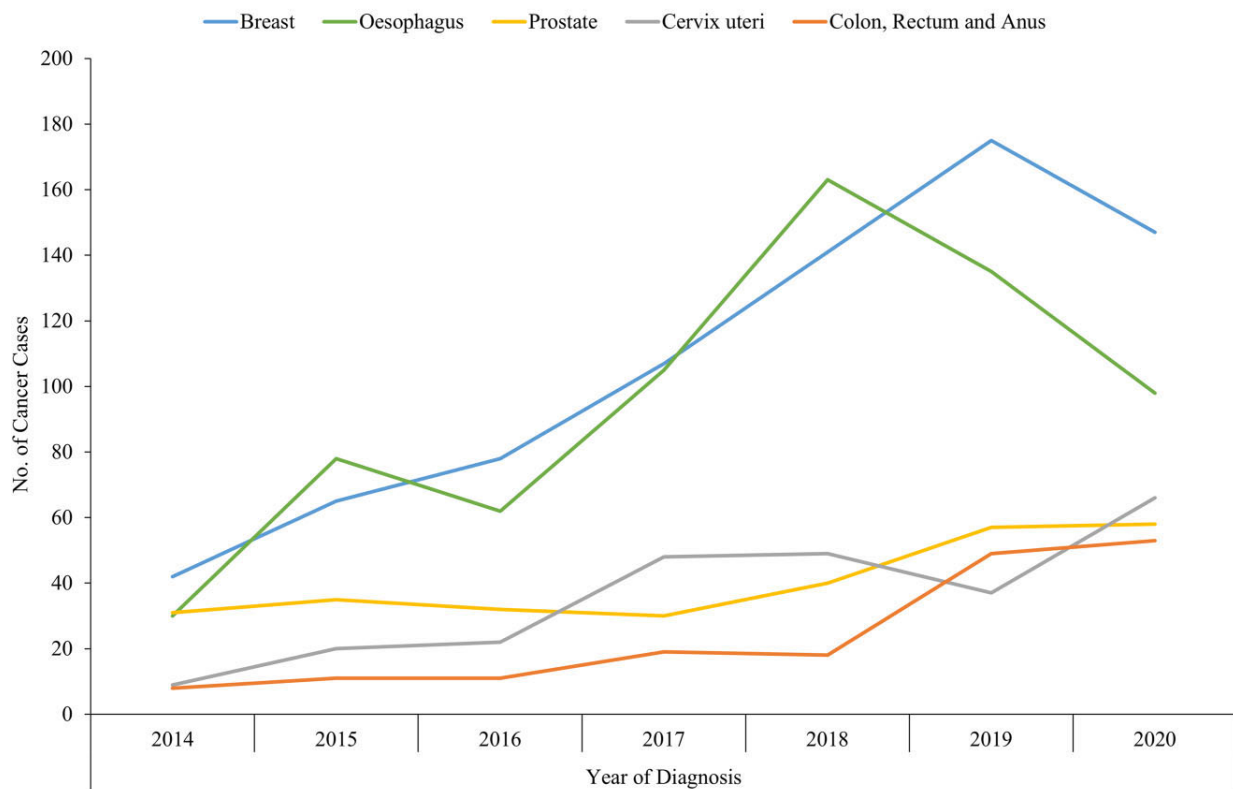
Information on cancer trends is an important component in the planning and monitoring of cancer-related programs. Such information helps in designing cancer preventive measures and planning for detection initiatives and treatment strategies. For a hospital, an HBCR provides the hospital administration with information on the hospital-specific cancer burden, enabling the development of hospital-specific cancer programs as well as targeting individual patients. Having a hospital registry also ensures that there is proper patient follow-up.<sup>14</sup> The current study aimed to establish the number of cancer cases and thus a baseline measure of all-cause and specific cancer cases in the AICKH between 2014 and 2020, helping the hospital lay the foundation for a functional cancer registry.

Our data showed that there were more female patients than male patients, with female breast cancer as the leading cancer overall, followed by oesophageal, prostate, cervical and colon, rectal and anal. This is consistent with current reports showing breast cancer is the most common cancer worldwide.<sup>15</sup> The types and frequencies are slightly different from the most common cancers in Kenya, where breast, cervical, prostate, oesophageal and colorectal, in that order, are the most common cancers

for both sexes.<sup>1</sup> That oesophageal cancer is number two at the AICKH may be explained by the fact that the hospital is a well-known centre of excellence in stenting and oesophageal cancer-related management. In addition, oesophageal cancer was among the four leading cancers in Kenya in 2020 as reported by GLOBOCAN<sup>1</sup> and third in areas such as Meru County.<sup>16</sup>

In females, the five most common cancers were breast, cervical, oesophageal, colorectal and stomach. These figures are comparable with results from previous studies conducted in different parts of the country and the national estimates by GLOBOCAN.<sup>1</sup> In a study conducted at the Kenyatta National Hospital (KNH) and Moi Teaching and Referral Hospital (MTRH) for the years 2008–2012, it was reported that cervical, breast, ovarian, chronic leukaemia, endometrial and stomach cancers were the most common cancers at KNH while breast, cervical, Kaposi's sarcoma, non-Hodgkin's lymphoma and ovarian cancers were most common at the MTRH.<sup>17</sup> In another study conducted in Tenwek Hospital, in Bomet County, from 1999 to 2007, the most common cancers in women were oesophageal, stomach, cervical, breast and uterine.<sup>18</sup> Similarly, Korir et al.,<sup>19</sup> in a study on the incidence of cancer in Nairobi, observed that the most common cancers in that population were breast, cervical, oesophageal, large bowel and ovarian. Breast cancer being the leading cancer in women agrees with the current status in the world, where breast cancer has been declared the leading cancer both by incidence and mortality.<sup>15</sup>

In males, the top-five cancers were oesophageal, prostate, stomach, colorectal and bladder. The trend differs from the top-five cancers by type as reported by GLOBOCAN and other studies in Kenya, which report prostate cancer as the leading cancer in men.<sup>1,17,20</sup> The AICKH has an established structure for surgical needs, such as stenting, that are unique to oesophageal



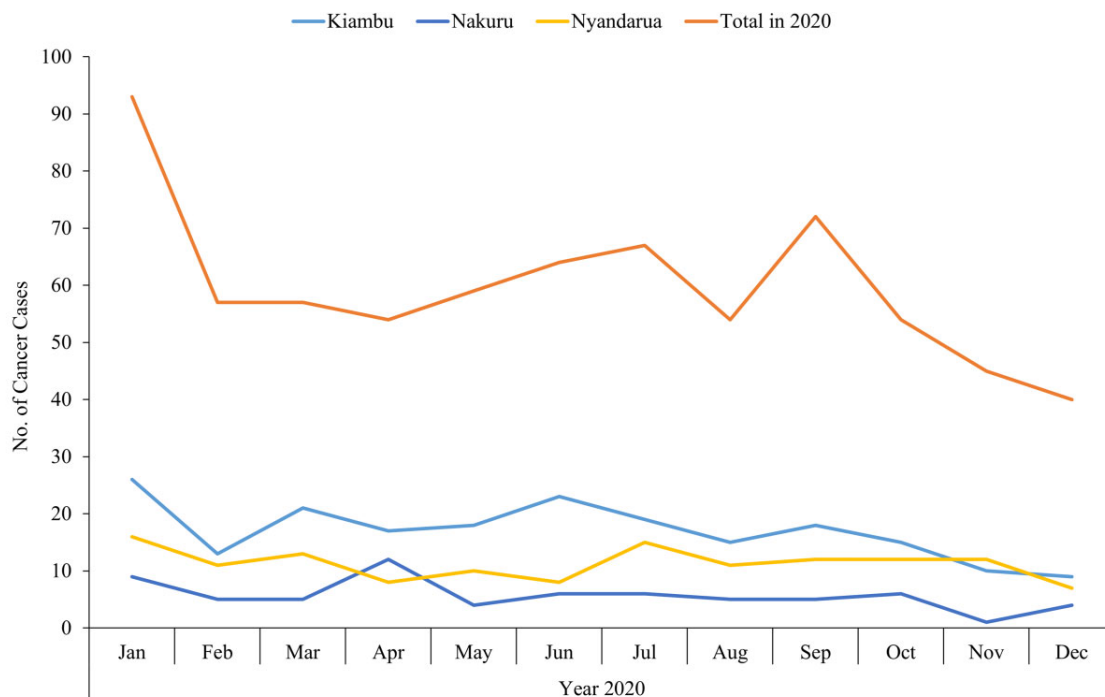
**Figure 4.** Trends in the top-five adult cancer cases at the AICKH by year from 2014 to 2020.

cancer patients, and this may explain the extraordinarily high number of oesophageal cancer cases compared with other centres.

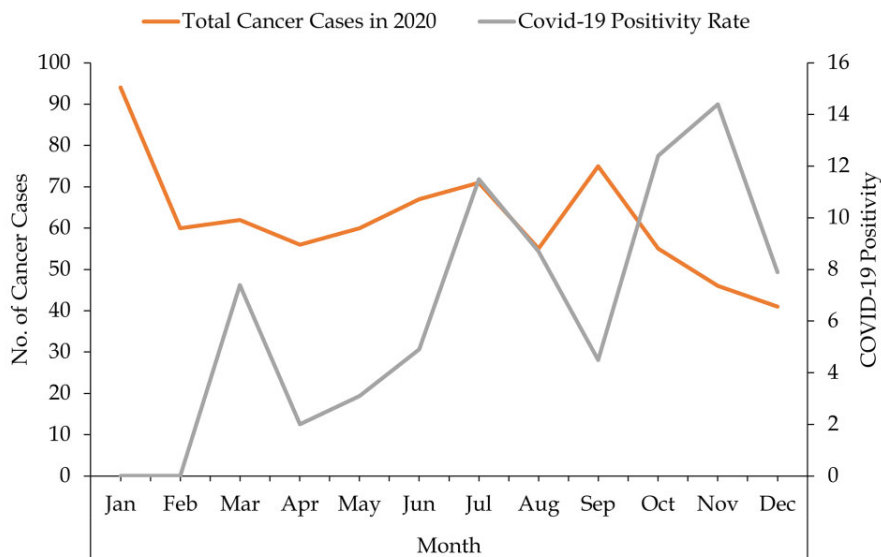
The AICKH receives referral cases from all parts of the country and, as shown in our analysis, all counties. The highest number of patients came from Kiambu County, where the hospital is located. Other counties neighbouring Kiambu also recorded a high number of patients, mainly due to the proximity of the hospital and the level of services offered. In addition, over the years there has been an increase in the number of patients seeking cancer care at the hospital. This is due to the increased oncology services being offered at the AICKH and enhanced funding by the National Health Insurance Fund (NHIF), which now covers both surgical and chemotherapy costs. As a result of this increase, when the number of cases from Kiambu<sup>11,12</sup> in other studies is compared with the number of cases managed at the AICKH, the analysis shows that the AICKH accounted for almost 75% of the cases recorded in six major health facilities in Kiambu County between 2014 and 2018. This highlights the importance of the AICKH in the management of cancer cases in the county and as a facility of choice for most cancer patients. Our analysis showed that the AICKH has recorded an increasing number of cancer cases every year. Many factors likely resulted in this increase, including an ageing population, an increasing prevalence of cancer risk factors<sup>21</sup> and improved awareness and access to care as a result of inclusion of cancer care by the NHIF.<sup>22</sup>

The COVID-19 pandemic has had both direct and indirect impacts on access to care by patients. Compared with the previous year and the number of patients expected to visit AICKH in 2020 through prediction models, there was a decrease in the number of patients in 2020. In April 2020, there was a decrease in the number of cancer patients expected to visit the AICKH. This was immediately after the national government gave directives on the measures to be taken to curb the spread of COVID-19 in Kenya.<sup>23</sup> These measures included a dusk (19:00 h) to dawn (05:00 h) curfew and cessation of movement into and out of the Nairobi metropolitan area. These directives hindered access to medical facilities, hence the reduction in the number of patients visiting the hospitals. This shows that people with cancer were unable to seek healthcare and hence there will likely be an increase in late-diagnosed cancer cases. In addition, the directives given did not caution cancer patients who were to go for surgery or chemotherapy and hence delayed or disrupted treatments.<sup>24</sup> Similar observations were made in the USA, where the COVID-19 pandemic was reported to result in reduced and/or delayed cancer care, which could lead to increased cancer morbidity and mortality.<sup>25,26</sup> In addition, a study in Bangladesh reported a 14.1% reduction in the number of women screened for cervical cancer in 2020 compared with 2019.<sup>27</sup> In Canada, a provincial population-based study reported an overall decline of 41% in the number screening tests that were conducted in 2020 compared with 2019.<sup>28</sup> Specific programs such as breast and cervical





**Figure 5.** Trends of cancer cases from top-three counties of origin at the AICKH in 2020 clustered by month of diagnosis compared with the total number of cases in the same year (red trend line).



**Figure 6.** Number of cancer cases recorded by month at the AICKH versus the COVID-19 positivity rates for the year 2020 in Kenya.

cancer screening<sup>28</sup> were also disrupted by the COVID-19 pandemic, even causing some countries, such as the USA, to suspend some of these services during the pandemic.<sup>29,30</sup>

Although the reported cancer cases in Kijabe mirror other published reports, it must be remembered that Kijabe is a tertiary referral centre with an interest in breast and oesophageal can-

cers, so these may be overrepresented. The true incidence of cancers in Kenya can only be determined by a robust national cancer registry. The National Cancer Institute of Kenya (NCI-Kenya) is making great efforts to establish a national cancer registry that will be receiving data from hospital and population-based registries across the country. To help NCI-Kenya achieve this goal,

concerted efforts are needed to help institutions in collating retrospective data. Our study facilitated the AICKH collecting retrospective data and establish a hospital-based cancer registry that we hope will be actively updated and help the hospital participate in providing data to the national registry.

## Conclusions

In summary, our analysis of cancer cases reported in the AICKH showed increasing numbers of cancer cases presenting in the facility over the years. COVID-19 likely decreased referrals at the AICKH, and whether these patterns continue or change, with an increasing number of patients seeking care later, will need to be monitored. Future efforts now that the hospital has an electronic health records system should be focused on improving the reporting of diagnostic, treatment and mortality outcomes to inform and improve cancer care and outcomes.

**Authors' contributions:** JF and FM contributed equally. FM and JF conceptualized the idea and developed the proposal. PB, BA, RWK, RC, SM, TM and MA participated in data collection and ensured data clerks had access to data in different departments in the AICKH. MK collected and analysed data and developed the first draft. All authors reviewed and approved the final draft.

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**Competing interests:** None declared.

**Ethical approval:** The study protocol was approved by both the Ethics Review Committee at Mount Kenya University (MKU/ERC/0976) and the Institutional Ethics and Research Review Committee at the AICKH (KH IERC-02718/0048/2019). A study permit was also sought from the National Commission for Science, Technology, and Innovation (NA-COSTI/P/18/3074/25549). Cancer registrars were trained on how to abstract data manually using a standardized data extraction tool (Additional File 1) and on maintaining confidentiality while handling patient files. The data abstraction was conducted within the hospital and the completed abstraction forms were kept in a secure room within the Directorate of Research and Innovation, Mount Kenya University. Patient consent was not sought since the study did not involve the patients directly and only redacted data was recorded from patient files.

**Data availability:** Deidentified data used in this study can be obtained by making a request to the corresponding author after obtaining permission from the AICKH administration.

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