

**MODELLING CANCER OCCURRENCES IN THE EAST AFRICAN
COMMUNITY COUNTRIES THROUGH INFODEMIOLOGY**

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COMMUNITY COUNTRIES THROUGH INFODEMIOLOGY**

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DECLARATION

I declare that this thesis is my original work, and as far as I am aware, it has not been presented for the award of a degree in any university.

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DEDICATION

This thesis was only completed with the constant support and direction of many individuals, notably my mother, brother, and sister. Their continuous inspiration and support have shone light through my life's difficulties. They and everyone who has supported me get my sincere dedication to this thesis.

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ABSTRACT

This study addresses the information-seeking behaviour and production of cancer in East African Community (EAC) countries through infodemiology. The study analysed cancer information searching trends and informetric patterns from 2004 to 2023, examined the relationship between cancer search trends and occurrences, established the association between search trends and informetric patterns, and modelled cancer information demand and supply in EAC countries. The study was guided by Millers' monitoring and blunting theory, Health Belief Model and Wilson's 1996 model of information behaviour. The study adopted a convergent parallel mixed-methods research design. Both quantitative and qualitative data were collected and analysed. Information-oriented purposive sampling was used to sample the countries. Convenience sampling was adopted for demand-based infodemiology using Google Scholar and PubMed while purposive sampling was used for supply-based infodemiology. Data collection involved web scraping and search engine queries using Google Trends and Harzing's Publish or Perish. Ethical considerations included anonymisation, minimisation, responsible data use, and ethical clearance. The findings illustrate peaks in information interest during specific months, particularly August, September and October, likely driven by health awareness campaigns and events. There was a high interest in information on breast, cervical, and prostate cancers, preventive measures, and awareness of different cancer types. Predominant regions and cities for information-seeking included Kijabe, Nairobi, Eldoret, Nanyuki, Kisumu, and Mombasa in Kenya; Kampala, Ishaka, Arua, and Kasangati in Uganda; Dar es Salaam, Mbeya, and Kigoma in Tanzania; and Kigali and Kibaha in Rwanda. Cancer research showed a rising trend in scholarly publications in the period under review. Journal articles dominated the research, with Google Scholar indexing a broader range, including theses and preprints, while PubMed focused more on traditional research articles and clinical trials. The research themes initially focused on women's health and general cancer epidemiology, shifting towards specific cancer types and screening practices. Themes like cervical cancer screening and patient care emerged, reflecting changing research dynamics and healthcare needs. The research demonstrated varying levels of citation and impact within the academic community. In Kenya, 56% of the articles had been cited; in Uganda, 55% received citations. In Tanzania, 60% of articles were cited, while in Rwanda, 57% were cited. The authorship patterns in cancer research publications revealed notable variations. In Kenya and Uganda, most articles were authored by a single author (27.24% and 29.26%, respectively). In Tanzania and Rwanda, research was mainly co-authored, with most articles having four authors (33.57% and 32.17%, respectively). The cancer information search trends and incidences showed high search volumes corresponding with high incidence rates for breast cancer in Kenya, prostate cancer in Uganda and breast and prostate cancers in Tanzania and Rwanda. Kenya exhibited a positive correlation between web searches and publications ($r = .323$). In Uganda, this correlation was moderately strong ($r = .435$). Tanzania showed a significant positive correlation ($r = .788$). At the same time, Rwanda presented the strongest significant correlation ($r = .862$). The study proposes the *Health Connect Centre* Web application to address the interplay between information demand and supply. The Web app integrates user-friendly interfaces, a robust search core API, and comprehensive backend systems. Other recommendations include enhanced public awareness campaigns, community engagement, tailored information resources, and collaborative research initiatives. Policy implications stress targeted health communication and digital accessibility. Integrating infodemiology improves healthcare delivery by optimising resource allocation and public health messaging. Theoretical implications validate frameworks' relevance in understanding information dynamics.

Keywords: Cancer, Infodemiology, Information demand, Information supply, East Africa Community

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LIST OF ABBREVIATIONS AND ACRONYMS

AICKH	:	African Inland Church Kijabe Hospital
AMPATH	:	Academic Model Providing Access to Healthcare
CHAI	:	Clinton Health Access Initiative
DALYs	:	Disability Adjusted Life Years
EAC	:	East African Community
EACC	:	East African Cancer Consortium
EACRN	:	East African Cancer Registry Network
EHR	:	Electronic Health Records
FHIR	:	Fast Healthcare Interoperability Resources
GCO	:	Global Cancer Observatory
GOK	:	Government of Kenya
HALYs	:	Health-Adjusted Life Years
HBM	:	Health Belief Model
HIT	:	Health Information Technology
HIV	:	Human Immunodeficiency Virus
HPV	:	Human papillomavirus
HTTP	:	Hypertext Transfer Protocol
ICT	:	Information and Communication Technology
IoT	:	Internet of Things
KENCANSA	:	Kenya Cancer Association
KICI	:	Kenya International Cancer Institute
LADP	:	Lightweight Directory Access Protocol
NACOSTI	:	National Commission for Science, Technology and Innovation
NCD	:	Non-Communicable Diseases

ORCI	:	Ocean Road Cancer Institute
RSS	:	Really Simple Syndication
RSV	:	Relative Search Volume
SDG	:	Sustainable Development Goal
SMTP	:	Simple Mail Transfer Protocol
SOAP	:	Simple Object Access Protocols
SPSS	:	Statistical Package for the Social Sciences
US	:	United States
UCI	:	Uganda Cancer Institute
UMC	:	Univic Medical Centre
UNESCO	:	The United Nations Educational, Scientific and Cultural Organization
USAID	:	United States Agency for International Development
WHO	:	World Health Organisation
WKCCRC	:	Western Kenya Cancer Care and Research Centre
XML	:	Extensible Markup Language

DEFINITION OF TERMS USED

Demand-based infodemiology gauges health information demand, by analysing online searches and discussions (Seyyed Hosseini et al., 2018). This study, examines cancer-related queries and topics within the East African Community using Google Trends.

Epidemiology is the study of the distribution and determinants of health-related events, including diseases such as malaria, HIV/AIDS, and cancer, in specified populations (Smith & Johnson, 2022). It emphasises the significance of comprehending both the occurrence and underlying factors of health-related phenomena within defined groups. In the context of this study, this entails investigating the prevalence of cancer and its contributing factors among populations within the East African Community countries.

Google Trends is a tool provided by Google that allows users to analyse the popularity of search queries across various regions and periods. It provides insights into the relative search interest for specific keywords or topics, allowing users to track trends, compare search volumes, and identify patterns in online search behaviour.

Infodemiology is an interdisciplinary field that studies the distribution and determinants of health information in electronic media, aiming to inform public health and healthcare policies (Eysenbach, 2006). In this study, infodemiology serves as a vital tool to analyse the dissemination and reception of health-related information, particularly regarding cancer, through digital platforms.

Information production refers to the creation or generation of new knowledge, data, or content that contributes to the overall body of information available to individuals or organizations (Latulippe & Klenk, 2020). It can take various forms, including scholarly articles, reports, databases, videos, podcasts, social media posts, and more. The goal of

information production is to provide valuable and relevant content that addresses the specific needs, interests, or inquiries of users.

Information seeking refers to the process individuals undertake to search for, access, and acquire information to fulfil their needs or satisfy their curiosity (Tubachi, 2018). It encompasses various activities, such as querying search engines, consulting books or articles, seeking advice from experts, or engaging with online platforms. Information seeking behaviours can be influenced by factors like the nature of the information needed, personal preferences, technological proficiency, and environmental factors.

Informetrics quantitatively analyses information processes, covering production, dissemination, and utilisation (Parker et al., 2023). Utilising mathematical and statistical methods, it examines patterns and trends in information activities like scholarly publishing and citation patterns. Informetric studies seek to grasp information system dynamics, gauge the impact of information resources, and guide decision-making across academia, industry, and government.

Modelling refers to the development of computational algorithms or frameworks that analyse data related to the demand and supply of health information online (Galetsi et al., 2020). This includes creating mathematical representations or statistical models to understand patterns, trends, and correlations between user queries (demand) and available information sources (supply).

Supply-based infodemiology analyses health information supply in electronic media, assessing quantity, quality, and accessibility from diverse sources (Zeraatkar & Ahmadi, 2018). In the study, it examines cancer-related information from Google Scholar and PubMed in the East African Community countries.

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

This chapter discusses the background of the study, contextual setting, statement of the problem, aim of the study, the research objectives, the research questions, significance of the study, justification of the study, scope and delimitation of the study, limitation of the study and dissemination strategies.

1.1 Background of the study

The global disease burden substantially challenges population health and productivity, impacting economic stability and life expectancy across regions (Blyth et al., 2019). Quantifying disease burdens in populations often involves metrics like Disability-Adjusted Life Years (DALYs) (Dai et al., 2020) and Health-Adjusted Life Years (HALYs) (Feng et al., 2020), which assess losses due to premature death and disability. DALYs specifically sum Years of Life Lost (YLL) due to premature death with Years Lost due to Disability (YLD) for particular conditions (Nurchis et al., 2020), while HALYs extend insights by integrating risk factors, morbidity, and mortality data. In 2017, circulatory diseases accounted for 15% of the global disease burden, followed by cancer (9%), newborn ailments (7%), and mental disorders (5%) (Roser & Ritchie, 2021). The shifting disease burden, with increasing attention on non-communicable diseases (NCDs) and mental health, challenges public health experts to prioritise resources effectively (Spearman et al., 2021).

Among these global concerns, cancer has emerged as a significant health threat due to its high mortality rates and complex information needs. The World Health Organization (WHO) highlights that a new pressing health challenge emerges annually, prompting it to track global disease trends as part of Sustainable Development Goal (SDG) 3, prioritising health and well-being for all by 2030. One of SDG 3's targets is to reduce premature mortality from NCDs by

one-third through prevention, treatment, and mental health promotion (Ghebreyesus, 2021). WHO collaborates with health sector stakeholders to address disease burdens, particularly NCDs like cancer, which demand attention due to their severe implications for health systems and the economy. Non-communicable diseases, such as cardiovascular diseases, respiratory disorders, cancer, and diabetes, often require long-term healthcare, with approximately 41 million deaths annually attributable to NCDs, representing 71% of all global deaths (WHO, 2023). Of these, nearly 15 million deaths occur among individuals aged 30–65, particularly impacting economically productive populations.

Cancer information-seeking behaviour has become crucial as awareness and information are increasingly linked to preventive actions, early diagnosis, and patient empowerment. Seeking health-related information enables individuals to make informed lifestyle choices and understand disease risks, with studies emphasising a strong link between cancer information acquisition and preventive behaviours like screening (Adjei-Boakye et al., 2018; Drummond et al., 2019; Shen et al., 2019). Accessible and high-quality cancer information has been identified as a powerful tool in managing cancer incidences, as awareness can lead to earlier diagnoses, better treatment options, and improved survival rates (Hyatt et al., 2022). Access to information has been greatly enhanced by the rapid spread of information and communication technology (ICT) tools, which enable faster access to health data. These tools include software for health data mining, the growing use of smartphones, and advancements in online health information resources (Stern et al., 2021).

However, the effectiveness of cancer information dissemination remains a significant challenge, especially in resource-limited regions where non-communicable diseases are prevalent, and health infrastructure is often under-resourced. The WHO estimates that 77% of all NCD-related deaths occur in low- and middle-income countries, where resource constraints often limit early screening and timely treatment (WHO, 2023). In sub-Saharan Africa, the

burden of cancer is predicted to rise by over 92% between 2020 and 2040, a trend exacerbated by limited health resources and inadequate cancer awareness (Hamdi et al., 2021). Early detection and control programs in African countries, such as the University of North Carolina-Zambia partnership and collaborations between the Muhimbili University of Health and Allied Sciences (Tanzania) and Crumlin Children's Hospital (Ireland), are steps toward addressing cancer-related healthcare needs, but many regions still lack comprehensive control plans (Parham et al., 2015; Strother et al., 2017). Cancer control strategies prioritising prevention, early detection, and treatment are essential, as they can significantly lower cancer mortality and improve the quality of life in affected populations (Ngwa et al., 2022; Stefan et al., 2013). Information dissemination through cancer registries and databases is crucial in cancer control. Cancer registries serve as repositories for harmonised cancer-related data, enabling easier access for researchers, healthcare providers, and policymakers (Bray et al., 2015; Piñeros et al., 2021). By making cancer-related data more accessible, these repositories support informed decision-making and help track cancer trends, risk factors, and treatment efficacy across different populations. The accessibility of information influences health-seeking behaviour, with studies suggesting that the availability of relevant, timely information can empower individuals and communities to engage in preventive practices and seek early diagnosis (Habtu et al., 2018).

In recent years, ICT advancements have facilitated the availability and accessibility of cancer information, supporting a more engaged approach to health-seeking behaviour. OmniSearch software and similar health mining tools have allowed for improved health data retrieval. At the same time, the increase in smartphone usage has simplified access to cancer-related information, even in remote areas. Health information technology has also enhanced health information demand and supply monitoring, allowing health organisations and governments to respond to changing information needs in real time (Stern et al., 2021). Through ICT,

individuals can now access a wealth of cancer information online, encouraging them to take preventive health actions that can reduce the risk of cancer and improve overall public health outcomes.

The importance of understanding cancer information-seeking behaviour is particularly relevant as cancer continues to rise as a leading cause of death globally, with nearly 10 million deaths reported in 2020 alone. This places cancer as one of the most severe global health threats, as it accounts for one in every six deaths worldwide (De-Martel et al., 2020; Deo et al., 2022; Mery et al., 2020). Cancer incidence rates are high, with breast, lung, and prostate cancers among the most prevalent types, while lung and liver cancers lead to mortality rates (Ferlay et al., 2019; Mery et al., 2020). Accurate and accessible cancer information is essential to tackling this growing health challenge, as early detection and informed health-seeking behaviour can play crucial roles in reducing cancer mortality. Information-seeking behaviour studies show that access to relevant information is closely linked to preventive health actions and better health outcomes, particularly in screening and treatment options (Adjei-Boakye et al., 2018; Shen et al., 2019).

The demand for cancer information is growing globally as individuals, healthcare providers, and policymakers recognise the need for timely, accurate information on cancer risks, prevention, and treatment options. As cancer information-seeking behaviour becomes essential to public health strategy, leveraging technology and improving information dissemination methods are critical to enhancing cancer prevention and control efforts globally. Improved access to cancer information can empower individuals to take proactive steps in managing their health, reducing the overall burden of cancer and contributing to better health outcomes at both individual and community levels.

1.2 Contextual setting

Kraef et al. (2020) state that Africa has experienced an increased disease burden in the last ten years, particularly concerning non-communicable diseases. It is predicted that Africa will experience an increase in mortality rates due to non-communicable conditions by 2030 (Bray et al., 2018; Eastin et al., 2018; Gouda et al., 2019). This is so because most people in Africa are exposed to risk factors for non-communicable diseases. Yet, limited intervention measures have been put in place to mitigate the occurrence of the disorders (Allen et al., 2021). Some of the risk factors include alcohol and tobacco abuse, unhealthy eating habits and physical inactivity (WHO, 2016). In addition, WHO (2021), expounds that the proportion of deaths in Africa that are linked to NCDs rose from 23million (24%) in 2000 to 34 million (37%) in 2020. In East Africa, Tanzania has the highest death rate from NCDs, with 44 percent. It is followed by the Democratic Republic of Congo (34%), Rwanda and Uganda (33%), Burundi (32%), South Sudan (29%) and Kenya, which has 27 percent of deaths attributed to NCDs (WHO, 2020). The WHO's NCD progress monitor in 2020 indicated that most of the East African countries have developed and implemented NCD control guidelines (Kraef et al., 2020). Kenya and Tanzania have also set targets for developing policies and action plans to deal with non-communicable diseases (GOK, 2021; UNESCO, 2021). However, no country has achieved the public education and physical activity awareness campaign targets to deal with NCD (Meghani et al., 2021).

The EAC is characterised by a range of diverse healthcare systems that face various challenges and opportunities. For instance, Kenya and Uganda have implemented national cancer control strategies and established cancer registries to systematically collect and manage cancer data (GOK, 2021; WHO, 2021). Tanzania has developed a National Cancer Control Programme to reduce cancer morbidity and mortality through early detection and treatment (Lyimo et al., 2020). Rwanda has integrated cancer care into its broader health system, focusing on

accessibility and affordability (Park et al., 2021). However, despite these initiatives, challenges such as inadequate funding, limited infrastructure, and a shortage of trained healthcare professionals persist (Barker et al., 2019). Public health data management in the EAC is often hindered by fragmented systems and inconsistent data collection methods, complicating efforts to accurately track cancer incidence and prevalence (Kraef et al., 2020). Efforts are underway to enhance data management through regional collaborations and the adoption of digital health solutions, aiming to strengthen cancer surveillance and inform public health policies across the EAC (Mokaya et al., 2021).

In the East African Community, the burden of cancer is increasing, with more people (60%) dying of cancer than from malaria, as was initially the case (Eastin et al., 2018). The highest number of new cancer cases in the East African Community in 2020 was Cervix uteri (17%). This was followed by breast cancer (14%), prostate cancer (7%), colorectal cancer (6%) and oesophagus cancer (5%) (International Agency for Research on Cancer, 2020). From a gender perspective, males were affected by prostate cancer (19%), Kaposi Sarcoma (8%), as well as Colorectal and Oesophagus cancer (7%). Females, on the flip side, were affected by cervix uteri cancer at 27%, breast cancer (22%), Colorectal (5%, and Oesophagus and ovary cancer (4%). According to Craig and Jani (2021), cancer in Kenya is the third highest cause of death. The new cancer cases in Kenya increased from thirty-seven thousand (37,000) to forty-eight thousand (48,000) between 2012 and 2018. In Tanzania, there has been an increase in cancer occurrences yearly, with forty-two thousand (42,000) new cases, while Uganda is reported to have 34,000 new cases annually (Cross et al., 2023). In the larger Eastern African region, Ethiopia is said to have the highest number of new cancer cases, with seventy-seven thousand three hundred and fifty-two (77,352) patients (International Agency for Research on Cancer, 2020). This data shows that many people have been affected by cancer directly or through family members and friends. Different mechanisms have been set up to fight cancer. One of

the mechanisms is the adoption of information technology via a growing field known as cancer informatics (USF Health Morsani College of Medicine, 2021). Cancer informatics is the interconnection of computer science, information science and health science to acquire, store and use cancer information (Zhang et al., 2019). It uses tools like computers, clinical guidelines and communication systems. It falls in the broad concept of health informatics, which is the systematic application of information and technology in health practices, research and learning.

Health informatics has emerged as the newest trend to study the vast data in the healthcare industry. Big data in the context of health refers to the enormous volumes of data created by several sources, including social media, wearable technology, and electronic health records. Electronic Health Records (EHRs) offer an over abundance of data regarding a patient's medical history, including demographic data, medical problems, and treatment histories (Keskin et al., 2020). According to Zhou et al. (2020), large volumes of health-related data, including physical activity levels, heart rates, and sleep patterns, are produced by wearable technology, such as fitness trackers and smartwatches. Other sources include social media and the Internet of Things (IoT), which details people's lifestyles, eating habits, mental health statuses, and daily routines (Chen et al., 2021; Gandomi & Haider, 2015). Big data can advance healthcare innovation, save costs, and enhance patient outcomes (Rao & Srivastava, 2018). Extensive data analysis enables the identification of patterns and trends that joint data analysis may not unravel. Liu (2018), explains that big data can be used to analyse health data to predict disease outbreaks, get medication and identify risks for developing chronic diseases. Chen et al. (2021) assert that big data offers health insights that can assist in transforming the health sector. In health informatics, big data is crucial for advancing medical research, improving patient care, and boosting the overall efficiency of the healthcare system. Mavragani and Ochoa (2019) indicate that big data is used to study epidemiology, medical research, public awareness

and how people seek health information. The data that is analysed is mainly acquired from Internet sources. As a result, infodemiology was developed (Brigo et al., 2015).

Infodemiology is an interdisciplinary discipline that integrates public health, computer science, and information science expertise to analyse the distribution and determinants of health-related events using data and information (Brigo et al., 2015). This entails studying how diseases spread, using social media and the Internet to track the spread of health information and operating data analyses to examine factors that influence health-related events. Infodemiology is an area that is rapidly developing and is increasingly being used to support public health and healthcare initiatives. It is divided into two: demand and supply-based infodemiology. Demand-based infodemiology focuses on understanding and measuring the demand for health information within a population (SeyyedHosseini et al., 2018). Supply-based infodemiology focuses on understanding and measuring the supply of health information (Zeraatkar & Ahmadi, 2018). In this study, the demand side of infodemiology analyses cancer information-seeking behaviour while the supply side analyses the research output (knowledge creation) about the East African Community.

1.3 Statement of the problem

Cancer is one of the leading non-communicable diseases causing many deaths in most developing countries. Developed countries have instituted different interventions to deal with the disease. Most of these interventions are based on scientific evidence in terms of knowledge of cancer, which is generated from research (Nguyen et al., 2022). Some interventions include formulating national cancer policies and plans, fostering primary and secondary prevention initiatives, providing early detection services, conducting training programmes that help identify cancer target groups and conducting cancer research (Wambalaba et al., 2019).

According to Ayandipo et al. (2020), African countries have inadequate monetary resources to deal with health issues. These inadequacies include the lack of good health infrastructure and research funding to deal with cancer. Due to the high expenses of accessing cancer treatments in Africa, most affected Africans travel to wealthy nations to seek remedies. Also, cancer is not a priority in Africa's health agenda, so it competes for resources with other health needs (Pramesh et al., 2022). As stated by the World Health Organisation (2017), some interventions African countries can consider are developing a cancer awareness policy, building cancer centres and health facilities, training programmes to identify cancer-prone populations, and researching cancer and its prevention.

One of the challenges facing the East African community in dealing with cancer has been the lack of public awareness and limited health information-seeking behaviour (Njuguna et al., 2020). This has led to a poor uptake of the minimal programmes set up to deal with cancer. For example, breast cancer screening has been on the frontline in the East Africa Community, but few people turn up for the screenings due to fear and lack of trust in health facilities (Joffe et al., 2018). The East African Community also lacks efficient initiatives for cancer prevention, diagnosis, and treatment (Njuguna et al., 2020). Moodley et al. (2015), opine that the EAC countries must develop public education initiatives to raise knowledge of cancer, its symptoms, and its indications. Ngwa et al. (2022), posit that the EAC has lately tried to fight cancer by offering training and research on the most cutting-edge cancer therapies. In addition, they have boosted the number of experts with the required training to deal with cancer. According to Ghebregziabiher (2019), Kenya has the International Cancer Institute (KICI), whereas Uganda has the Uganda Cancer Institute (UCI), both of which provide training on cancer-related topics. The Kenya International Cancer Institute is one of the leading institutions for cancer treatment and research in EAC. The two institutions (KICI and UCI) have carried out

research and training to advance understanding of cancer and offer more efficient approaches to the disease's prevention, diagnosis, and treatment.

Clauser et al. (2019) observe that cancer care can be anchored on information technology and systems solutions. Information technology will improve access and sharing of the vast information available on cancer and enhance the surveillance of the disease. Health Information Technology (HIT) provides tools like electronic reminders and electronic access to information. These can provide information and evidence-based recommendations at the point of care. Research by Sittig (2006) projected that by 2015, cancer care would be delivered through technology, primarily through mobile devices and the Internet. These technologies would be used to provide information, diagnosis and treatment. De-Choudhury et al. (2014) assert that people search for health information virtually. Research indicates that almost half of America's population has searched for cancer information online (Phillips et al., 2018; Qaseem et al., 2019). Eysenbach (2003) asserted that the Internet will influence cancer care and treatment by 2030. The result will be enhanced patient-doctor communication, Web-based information and community of interest (virtual support group). Through information technology, information seeking becomes easy, and retrieval is faster. Several tools have been developed to facilitate the storing and accessing of health information. Some examples of the tools include Google Health™ and HealthVault. Despite these advancements, the knowledge of cancer remains minimal (Pramanik et al., 2020). Also, the integrity of the cancer information on the Web is wanting (Zimmerman & Shaw, 2020).

Through the advancement of information technology, what seemed immeasurable is now possible to measure using the new tools. For example, it is possible to measure health information distribution by monitoring the health information trends by studying the gaps between health information supply and demand from a specific period using ICTs. This is done by conducting an infodemiological study (Eysenbach, 2006). Currently, this can be done using

tools like Google Trends, which is an ICT tool that Google has developed to facilitate enhanced information seeking. It was officially launched in 2006, though it has data from 2004. Google Trends can assess cancer information-seeking behaviour by analysing the search terms people use when seeking cancer information. By examining the volume and frequency of searches for specific cancer-related terms, researchers can gain insight into the types of information people seek and how their interests may change over time. In the days and weeks following significant cancer-related news events like announcing a new cancer treatment or publishing research findings, searches for cancer-related terms significantly increased (Kaleem et al., 2019). Kaleem's study also found that the number of searches for cancer-related phrases varied by geographic location, with more significant searches occurring in areas with high cancer incidences and mortality.

A study by SeyyedHosseini et al. (2018) indicates that there is a gap between the supply and demand of cancer information and also that there have been relatively few scientific studies linking the two. Understanding consumers' and patients' knowledge and search interests in cancer is made more difficult because there are currently no documented studies conducted in the EAC regarding information demand and supply. Understanding how well-informed consumers and patients are about cancer and how interested they are in finding out more about it provides crucial insights into their information-seeking behaviours and the kinds of information they value, which can help healthcare professionals and educators tailor their communication strategies and provide more patient-centred care (Friedman et al., 2018). Secondly, it can help healthcare providers discover knowledge gaps and improve patient education and training initiatives, leading to more educated and involved patients and, ultimately, improved patient outcomes (Lench et al., 2019). Thirdly, it can help scientists find new topics to investigate and enhance the planning and execution of clinical trials (Garcia et al., 2019). Finally, it can aid in developing effective programmes by policymakers to improve

cancer awareness, prevention, and treatment (Kirwan & Tierney, 2019). Understanding the link between health information and the prevalence of cancer is crucial. It is still unknown precisely how health information impacts the chance of acquiring cancer despite advancements in cancer epidemiology (Kim et al., 2018). This is especially important given the expanding amount of health information that patients and consumers may access online (Khazaezadeh et al., 2018). To estimate cancer incidence appropriately, it is essential to grasp how health information affects patient behaviour and outcomes thoroughly. This necessitates multidisciplinary cooperation between experts in infodemiology and health informatics (Khazaezadeh et al., 2018). It will be feasible to create efficient methods for lessening the burden of cancer by obtaining a more thorough grasp of the link between health information and cancer development. This study examined how people in the East Africa Community countries seek and use cancer information to predict cancer incidence using infodemiology.

1.4 Aim of the study

The study aimed to understand the patterns and dynamics of cancer information search behaviour and the supply of information in East African Community countries using infodemiology methods. It sought to develop a model that connects cancer information demand with supply, providing valuable insights to inform public health strategies and improve the accessibility and relevance of cancer information.

1.4.1 Objectives of the study

The specific objectives of the study were to:

- i. Analyse the cancer information search trends in the East African Community countries from 2004 to 2023;
- ii. Examine the informetric pattern of cancer information in the East African Community countries from 2004 to 2023;

- iii. Analyse the relationship between cancer information search trends and cancer occurrences in the East African Community countries;
- iv. Establish the association between cancer information search trends and cancer informetric patterns in the East African Community countries; and
- v. Model cancer information demand and supply in the East African Community countries.

1.5 Research questions

The research questions for the study were:

- i. What are the trends of cancer information search in the East African Community countries from 2004 to 2023?
- ii. How has the volume and type of cancer-related publications from the East African Community countries evolved from 2004 to 2023?
- iii. What are the patterns of collaboration networks among authors of cancer-related publications in the East African Community countries from 2004 to 2023?
- iv. How have cancer-related publications from the East African Community countries been cited between 2004 and 2023?
- v. What are the predominant themes covered in the titles and abstracts of the cancer-related publications on the East African Community countries from 2004 to 2023?
- vi. How do the themes of the cancer-related publications on the East African Community countries reflect evolving research?
- vii. What is the correlation between the trends in cancer information searches and cancer incidences in the East African Community countries between 2004 and 2023?
- viii. To what extent can the analysis of cancer information search trends between 2004 and 2023 provide insights into the prevalence and distribution of cancer cases in the East African Community countries?

- ix. What associations can be established between the observed cancer information search trends and the informetric patterns of cancer-related information from 2004 to 2023 in the East African Community countries?
- x. What insights can be gained from modelling the interplay between the demand and supply of cancer information from 2004 to 2023 in the context of the East African Community countries?

1.6 Assumption of the Study

The research made several assumptions. First, it assumed that most people in the East African Community countries search for cancer information online. This fits the demand-based infodemiology's ambit (Mackey et al., 2022). It includes the examination and clicks on the Internet and social media. Internet users search for words based on interest or pressing needs. The quests give a baseline insight into the information-seeking behaviours of Internet users. The second assumption is based on the supply-based infodemiology. The study assumes that information-seeking behaviour influences the publishing of scientific articles on cancer. Also, it may affect the development of blog posts and other social media posts on cancer. The supply-based infodemiology is currently assessed by translated works, republished works, and policies created (Mackey et al., 2022).

Another assumption is on the level of digital literacy within the EAC countries. This assumption is intricately tied to the foundational principles of infodemiology, recognising that the efficacy of online information-seeking behaviours and their impact on information supply hinge on a baseline of digital literacy within the population (Cohen et al., 2022). It presupposes that a significant EAC country's population has the requisite skills to access, navigate, and comprehend information on the Internet. Digital literacy becomes a pivotal factor shaping the success of demand-based infodemiology, where individuals are expected to utilise online

resources to seek cancer information adeptly (Radovanović et al., 2020). This proficiency is indispensable for interpreting search behaviours, clicks, and interactions, forming the bedrock of demand-based infodemiology assessments.

Moreover, the assumption of digital literacy is connected to the supply-based infodemiology aspect, wherein the creation and dissemination of scientific articles, blog posts, and social media content on cancer are influenced by individuals' ability to contribute to these platforms meaningfully (Stern et al., 2021). Evaluation of supply-based infodemiology presupposes a certain level of digital literacy among content creators and consumers alike. While acknowledging the assumption of a baseline digital literacy level within the EAC, it is imperative to recognise potential variations across different demographic groups, considering factors such as socioeconomic status, educational backgrounds, and regional disparities that may influence individuals' active engagement in online information-seeking and contribution to the digital information landscape (Cuyvers et al., 2024).

The study made the following philosophical assumptions. Ontological presumptions may be connected to the nature of cancer and the methods through which cancer information is created, shared, and used in cancer infodemiology. One ontological principle is the idea of an objective world and the significance of using evidence-based practices. According to this viewpoint, unquestionable truths regarding cancer may be learned through scientific investigation and evidence-based practices (WHO, 2020). Another ontological principle refers to the complexity of cancer and its effects on people and society. According to this viewpoint, cancer is a complicated illness with several origins and consequences, as well as physical, emotional, social, and economic elements that must be considered while analysing and treating the condition.

The second is the epistemological supposition, which describes the fundamental ideas concerning the nature of knowledge and how it is attained. It is the framework for a study's technique and strategy (Cuthbertson et al., 2020). These presumptions may relate to ideas about what constitutes reliable evidence, how subjectivity affects how we learn things, and how the researcher and the topic of the study interact. Epistemological presumptions may relate to the data sources used to develop the model, the methods used to analyse the data and how the model is utilised to generate predictions or guide decision-making in estimating cancer incidence using infodemiology. One of the study's epistemological premises is that people interested in learning more about cancer or dealing with health problems connected to the disease seeks information about it, and their information-seeking activity can shed light on cancer-related issues in a population. Another epistemological assumption is that the Internet is the primary source of health information for many individuals, and it is possible to monitor and analyse the availability and dissemination of this information through computational methods (American Cancer Society, 2017). Also, the study assumes that the distribution of cancer information can be used as a proxy for health outcomes and can provide insights into the distribution of disease in a population. Lastly, the study epistemologically assumes that the quality of information available online is reliable and that this information can be used to model cancer occurrences.

Further, axiological assumptions refer to the values, beliefs, and ethical considerations that inform the research process and shape the interpretation of results. In modelling cancer occurrences through infodemiology, axiological assumptions may include concerns about using personal health data, the implications of the results for policy and practice, and the ethical implications of using digital data sources to inform health decisions. For example, this study assumes that the privacy and confidentiality of individuals seeking health information online is been protected and that personal health information is not used for purposes beyond those

specified in the study. Another axiological assumption was that it is possible to study health information objectively and without bias despite the potential influence of individual, societal, and cultural values on health information-seeking behaviour.

Finally, there is the consideration of the methodological assumption for the research, which shapes the research problem and can influence the validity and reliability of the results. One methodological assumption in this research is positivism, which is the belief that reality is objective and can be studied objectively through scientific methods. This assumption is often associated with a focus on quantifiable data and statistical analysis and a belief that accurate measurement is the best way to understand complex phenomena (Al-Ababneh, 2020). Another assumption relevant to cancer research is constructivism, which holds that reality is shaped by how individuals perceive and interpret their experiences. This assumption is often associated with a focus on subjective experiences and qualitative methods, such as interviews and focus groups, which can provide insight into people's meanings and interpretations of cancer information.

1.7 Significance of the study

This research is optimised to contribute to the body of knowledge on the theory of information-seeking behaviour and information supply through the triangulation of ideas in both concepts in the context of information sciences. Orlu et al. (2016) assert that while research has been done on information-seeking activity, more needs to be done to establish a relationship between information supply and health information-seeking behaviour. As a result, this study added to or improved existing theories on the demand for and delivery of health information. The study shed light on the variables affecting people's motives, attitudes, and perceptions of available resources while searching for and using cancer information. This contributed to developing a thorough knowledge of the information-seeking process and its influences on it (Luo et al.,

2022). The theories being developed on how knowledge affects health behaviour and outcomes may also benefit from this study. For instance, if the study discovers that having access to high-quality information on cancer is related to improved health outcomes, this may imply that making accurate and pertinent information available is crucial for encouraging good behaviours and avoiding or managing cancer. The data gathered was utilised to assist in formulating theories on how information affects health behaviours and outcomes through the empirical findings from the research on health information-seeking interest and information supply in the EAC. The study aided in finding informational gaps for cancer patients and their families. These gaps offered crucial information on the information requirements of this demographic and contributed to the creation of efficient health communication theories.

Numerous studies (for instance, Alsaedi et al., 2022; Head, 2016; Malin & Fortunato, 2022; Matheus et al., 2020; Newcomer & Brass, 2021; Valle-Cruz et al., 2020) confirm that research evaluative studies help companies boost efficiency, transparency, and policy formation. This study is essential for developing policies because it sheds light on how health information affects how the public views and behaves about cancer. For instance, infodemiology research may uncover discrepancies in disseminating cancer-related knowledge, which may help guide policy initiatives to lessen health inequities (Kim et al., 2018). The study can also shed light on how public attitudes and behaviours around cancer are shaped by health communication. The study contributed to creating effective health education campaigns and disseminating information through the proper channels by studying the diffusion and impact of health information. This study aims to offer pertinent data to EAC policymakers in the health sector, especially in cancer management. The regional health ministries may also utilise the results to construct infodemiology and cancer management plans.

The research is based on infodemiology, a current approach that strives to help society solve health problems using the available resources. According to Li et al. (2020), there is an increase in user-generated data on the Web and social media that needs to be mined and analysed for valuable insights. The findings of the study on cancer information demand and supply were used to develop an algorithm that can be used by health practitioners, cancer patients and general users to improve cancer intervention in the EAC. The system can also assist health workers and academicians in understanding the information needs, trends and patterns, which can later help improve healthcare.

1.8 Justification of the study

Infodemiology has contributed to the surveillance of health knowledge by analysing health information needs, retrieval and supply. The first infodemiological studies conducted were on flu management using social media data (Benis et al., 2021; Cai & Sousa-Pinto, 2022; Eysenbach, 2006; Mavragani, 2020). This has shifted to other chronic diseases, including cancer and COVID-19 (Adelhoefer et al., 2021; Jang et al., 2021; Lee et al., 2023). Unfortunately, most of these studies have been conducted to address health issues in developed countries like China, Canada and the United States. There needs to be more knowledge on how infodemiology can help developing countries, particularly Africa. Therefore, there is a need to investigate infodemiology's role in an African perspective. In the EAC, infodemiological research leans more on health misinformation and current COVID-19 issues (Fulk et al., 2022; Kwanya, 2014). Nevertheless, the infodemiological studies on chronic diseases like cancer are limited and are outnumbered by the studies on other conditions like influenza. Therefore, the place of infodemiology in cancer management in the EAC is currently unknown. Conducting this study provided insight into how individuals in the EAC seek out and use information about cancer, including their motivations, attitudes, and perceptions of the available resources.

Also, a study on modelling cancer occurrences through infodemiology can help to identify gaps in the current knowledge base and suggest directions for future research. For example, if the survey finds that specific populations are underserved or have limited access to cancer information, this could indicate the need for further research on addressing these disparities. The findings of this study were instrumental in bridging the existing knowledge gap on cancer information demand and supply in the EAC. This study is crucial as currently, people are generating more data in online spaces that can be analysed to get insights and leverage from it, especially health-related data.

1.9 Scope and delimitation of the study

Conceptually, this study modelled cancer occurrences in the EAC through infodemiology. The analysis was conducted to determine users' cancer information-seeking behaviour in the EAC. The researcher examined all concepts around demand-based infodemiology and cancer information supply. For demand-based infodemiology, the research analysed cancer information search in Google while information supply, the study analysed cancer information published in Google Scholar. This helped to reveal cancer information demand and supply in East Africa.

Geographically, the study focused on the East African Community countries: Burundi, the Democratic Republic of Congo, Kenya, Rwanda, South Sudan, Tanzania, Uganda and Somalia. The EAC has several initiatives and programmes to address cancer management in the region. One key initiative is the East African Cancer Registry Network (EACRN), established in 2010 to improve cancer surveillance and control in the EAC member states (East African Cancer Registry Network, 2015). The EACRN aims to standardise regional cancer registration practices, enhance data quality and completeness, and support cancer research and policy development. Another initiative is the East African Cancer Consortium (EACC), established

in 2013 as a collaborative effort between the EAC and the African Union Commission (East African Cancer Consortium, 2015). The EACC aims to strengthen cancer control efforts in the region through research, capacity building, and the development of regional cancer control plans. From the seven (7) EAC countries, the researcher anticipates covering four (4) countries, namely, Kenya, Tanzania, Uganda and Rwanda. These countries are selected because they have cancer registries established at different times and are supported by the International Agency for Research on Cancer (IARC) (Fadlelmola, 2019). Uganda was the first to develop a cancer registry in 1968, Kenya (2001), Tanzania (2016) and Rwanda in 2018 (Okobia,2019). Burundi created the registry in 2016 and later collapsed. South Sudan, Somalia and the Democratic Republic of Congo have never initiated cancer registry management and were not used for this study.

Additionally, the EAC countries have distinctive characteristics. The diversity in demographics, encompassing age, ethnicity, and lifestyle variations, is crucial for comprehending the intricate influences on cancer information search patterns (Schlumbrecht et al., 2023). Similarly, the countries' varied healthcare infrastructure, ranging from well-established systems to those facing challenges, provides valuable insights into the impact of healthcare resources on cancer management (Omotoso et al., 2023). Cultural and behavioural issues play a pivotal role in cancer risk and outcomes, making the investigation of infodemiological aspects, such as information-seeking behaviour and health literacy, imperative. Conducting the research using the EAC countries gives insights into how societal factors influence cancer information seeking and production (Keino & Carrel, 2023).

The diverse levels of digital access and literacy in the EAC countries highlight the significance of studying infodemiology. Understanding how information dissemination, primarily through digital platforms, shapes cancer-related knowledge and behaviours is essential for tailoring

communication strategies (Calleja et al., 2021). Unique epidemiological patterns in each country, influenced by differences in environmental exposures, genetic predispositions, and lifestyle factors, emphasize the need for tailored preventive and intervention strategies. Analysis of these patterns contributes to a more targeted and practical approach to cancer control (Akinyemi et al., 2021). These facilitate a more robust and contextually informed foundation for generalising findings by incorporating diverse characteristics and contextual factors within the EAC countries. This approach ensures that the research contributes to understanding cancer occurrences in the EAC and the broader field of infodemiology and cancer control, allowing for meaningful and applicable generalisations to diverse populations and healthcare contexts.

1.10 Limitations of the study

This research encompasses different fields; hence, it is interdisciplinary. It combines information Communication Technology, Information Sciences and Health Informatics. The fields embrace other theories and models that explain phenomena differently. This brought a challenge to how the concepts are interpreted and presented. The researcher ensured all concepts are interpreted through thorough research to minimise possible biases and conflicts. The tendency was minimised by considering multiple perspectives and sources of information. Also, the researcher used rigorous and standardised methods to gather and analyse data.

There is also a shortage of literature on modelling cancer occurrences through infodemiology, especially in the context of the EAC. This limited the perspectives the researcher can access, interrogate and integrate. Also, the concept of infodemiology is a recent approach to research. This may exhibit limited scientific research, hence a challenge in getting current authoritative information material in the field. To address this limitation, the researcher used all possible sources, including Websites and mass media content, to better understand the concepts.

The research was conducted in the four countries of the East Africa Community. This being a wide geographic area, there may be a challenge in capturing all the aspects of cancer in the countries. The researcher ensured that all the countries are given enough time for data collection. The researcher used tools that enable maximum data mining from the research concepts.

1.11 Dissemination strategies

Ross-Hellauer et al. (2020) assert that the Internet and technology have changed how researchers disseminate their research findings. This has made print journals move online and scholarly books more accessible online. Nonetheless, not all research can be fully disseminated online. Therefore, traditional print dissemination remains, even with the migration to online channels. The findings of this study were published in both print and online. The strategies that were used to disseminate the results include:

Peer-reviewed journals

The findings of this study were published in both open-access and subscription-based journals with high impact. Journals are effective ways to disseminate scientific research and enhance the visibility of research. The articles were derived from the main aim of the study. The journals where the findings were submitted were those in information sciences and health sciences.

Conference papers

The research findings were presented at conferences. The researcher developed conference papers on cancer occurrences and infodemiology and offered them at local and international conferences. The conferences targeted was in areas of health informatics and information-seeking behaviours.

Social networking platforms

The study findings were disseminated via social media and academic networking platforms. Yammine et al. (2018) averred that researchers use social media to share their findings. The findings of this study were disseminated using ResearchGate and Academia.edu, which are professional academic social networks. Also, the results were disseminated using Facebook, which currently allows posting of research in documents and files.

Institutional Repository

The complete thesis was submitted to the Technical University of Kenya library for archiving, preserving and sharing. This enhanced the visibility of the research findings to reach the staff and students both in the university vicinity and remotely. Also, all the journal articles and conference papers derived from the thesis were archived in the institutional repository.

Public lecture

The researcher aims to spread the findings to a comprehensive coverage. She came up with a public lecture to engage the public on issues of cancer management through infodemiology. Through the lecture, the researcher shared the findings on cancer information-seeking behaviours and interventions to assist in dealing with cancer.

Briefing notes

The researcher developed a brief note based on the findings to share with health policymakers. The brief note was based on informetric patterns of cancer information in EAC. The brief note can be used to assist policy development.

Mass media article

To maximise the reach of the findings, the researcher intends to publish a news article in one of the major newspapers in Kenya. The article included the results of cancer information search

behaviours and the model that can be used to detect cancer occurrence based on searched information.

1.12 Chapter summary

This chapter introduced the context and significance of analysing cancer information search behaviour and supply within the EAC. The research focused on the years 2004 to 2023, aimed at understanding how cancer-related information is sought and provided across EAC countries using infodemiology methods. The approach is pivotal for enhancing public health strategies and improving access to relevant cancer information. The study identified a gap in knowledge regarding cancer information-seeking behaviour and its supply in EAC. The research sought to bridge the gap by modelling cancer information's demand and supply dynamics, which is crucial for informing public health policies and interventions. The study assumed that online searches were a primary source of cancer information, digital literacy influenced information-seeking and supply, and reliable online information could proxy health outcomes. The objectives were to analyse trends in cancer information searches, examine publication patterns, explore the relationship between search trends and cancer incidences, and develop a model connecting information demand with supply. It also addressed potential limitations due to the interdisciplinary nature of the study and geographic scope. The significance of the research lies in its potential to inform cancer management strategies, contribute to health communication theories, and guide the development of effective health education campaigns in the EAC. Dissemination of findings included peer-reviewed journals, conference presentations, social media, institutional repositories, public lectures, briefing notes, and mass media articles, ensuring a broad impact and accessibility of the research outcomes. Through the comprehensive approaches adopted, the study aimed to offer valuable insights into cancer information dynamics, supporting better public health decisions and interventions in the EAC.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

A literature review is a comprehensive and systematic analysis of existing research on a specific topic (Gupta et al., 2022). It provides an overview and synthesis (Alblooshi et al., 2021; Bodolica et al., 2020; Mahapatra & Dash, 2021) of the current state of knowledge and identifies gaps in the research that must be addressed. It provides the background information on a topic, identifies trends and patterns in the study, and evaluates the strength of the evidence supporting a particular research question. Cooper (2021) asserted that a well-executed literature review should adhere to certain principles, including a comprehensive search of relevant literature, a critical evaluation of the quality and relevance of the studies included, and a clear and systematic synthesis of the findings.

The information resources used for this research concentrated on the study's objectives. The literature review is discussed using the objectives of the study, which are to analyse the cancer information search trends, examine the informetric pattern of cancer information, explore the relationship between cancer information search trends and cancer occurrence, infer the association between cancer information search trends and cancer informetric patterns; and model cancer information demand and supply in the East African Community. The chapter also presents the theories and models used by the study to develop the conceptual framework showing the relationships between the study variables.

2.1 Health informatics

According to Michigan Technological University (2020), the healthcare sector produces at least thirty (30) percent of the global data, and it is anticipated to increase to thirty-six (36) percent by the year 2025. This data explosion has catalysed the rapid expansion of the health informatics industry. Health informatics entails efficiently using health data, information, and

knowledge for scholarly investigation and decision-making within the healthcare industry. Health informatics harnesses the potential of big data analytics, artificial intelligence, and healthcare systems by integrating healthcare management and information technology. These resources facilitate informed decision-making by health ministries and healthcare professionals. This, in turn, supports the growth of the healthcare sector. Health informatics also involves researching the conception, creation, and use of information technology for improving healthcare (Pradhan et al., 2021). Some of the disciplines in health informatics are computer science, information sciences, bioinformatics, data sciences and behavioural informatics. Lakhan (2022), argued that the word “informatics” is also used in certain quarters to refer to the application of library science to data management in healthcare. Lakhan further asserted that health informatics encompasses the theory and practical components of information processing and communication based on knowledge and experiences from processes in the healthcare sector.

2.1.1 Health informatics and cancer

Cancer is among the most severe global health challenges currently distressing many people worldwide. Diagnosing, treating and managing this disease requires advanced methods and technologies. Currently, health informatics supports cancer management efforts by contributing tools and data-driven strategies that assist in understanding and operating the disease (Chen & Decary, 2020).

By analysing the structured and unstructured big data on cancer in healthcare, health informatics provides valuable support to ongoing cancer management initiatives. Long et al. (2022) opined that advancements in information sciences and technologies have led to improvements in cancer research and care, with more scientific research emerging from what is currently known as cancer informatics. Cancer informatics applies information sciences, data

science and information technologies to study diverse aspects of oncology. Its main areas are cancer information resources, technologies and tools needed to enhance cancer information acquisition, storage, usage and retrieval. According to Warner and Patt (2020), cancer informatics generates insight from all cancer data and uses the insight to improve cancer management. The main goals of cancer informatics are to 1) organise data in a manner that is clear and helpful to doctors, researchers, and patients; 2) utilise data to improve cancer treatment and care; and 3) use data analysis to produce new insights on cancer (Warner & Patt, 2020). Wang (2021), posit that cancer informatics entails cancer surveillance informatics which involves collecting and synthesising data about cancer in diverse ways analysing captured data, gathering evidence from clinical trials, putting information into practice, assessing the results of changes in practice, and creating new hypotheses for investigation. Cancer informatics handles and examines big data on cancer to reveal patterns, biomarkers, and predictors of therapy response that might aid clinical decision-making and support personalised medical methods (Jouhet et al., 2013). The analysed data comes from multiple sources like electronic health records, imaging, pathology reports, treatment trials, information searches and scientific research. Figure 1 shows schema of cancer data, informatics methods and tools, and applications.

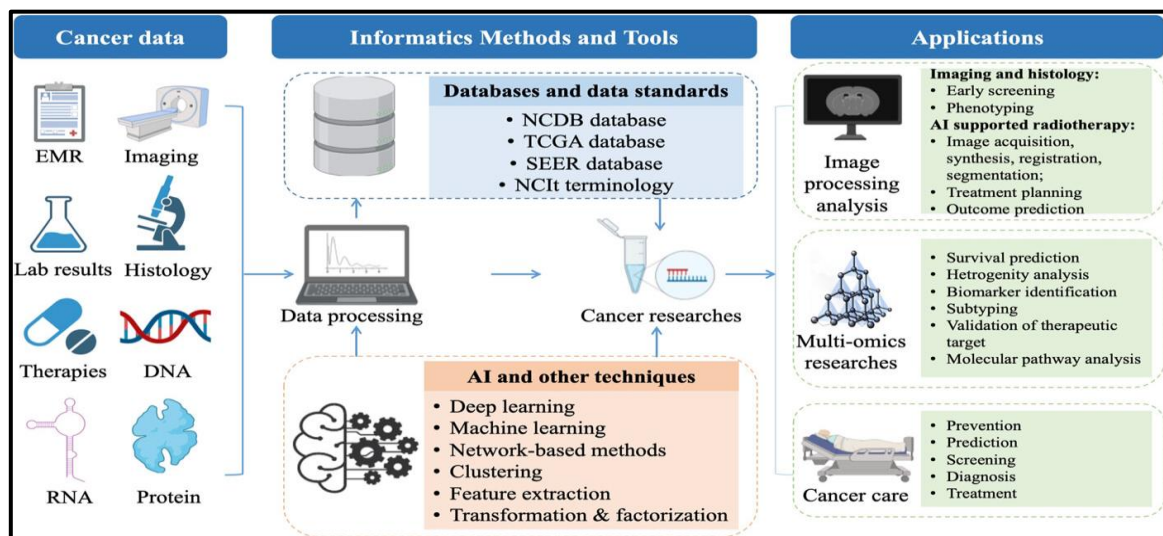


Figure 1: Summary of the main components of cancer informatics (Long et al.2022)

Cancer informatics is a growing field in Africa and holds great potential in improving cancer care and management (Kabukye et al., 2022). However, African countries face numerous challenges, including limited infrastructure, resources and data accessibility necessary to leverage cancer informatics. Despite these challenges, using cancer informatics to respond to the rising cancer burden in Africa has considerable prospects (Jaddaoui et al., 2020). Some potential applications of cancer informatics in African countries are improving data collection and integration, telemedicine and telepathology solutions, collaborative research networks, mobile health applications, and capacity-building programmes. Africa can utilise the power of cancer informatics to improve cancer prevention, diagnosis, treatment, and research by harnessing these opportunities and overcoming the obstacles. This eventually improves patient outcomes and lessens the effect of cancer on the continent.

2.1.2 Opportunities and challenges in cancer informatics

Cancer informatics has revolutionised the understanding, diagnosis, and treatment of cancer. It offers many opportunities to harness the power of data and technology to advance cancer care and improve patient outcomes. However, along with these opportunities, several challenges must be addressed to fully realise the full potential of cancer informatics (Long et al., 2022). Some options for cancer informatics are personalised medications, clinical decision support, research collaboration and knowledge sharing, and population and health epidemiology.

Through a wide range of information, personalised and precision medicine aims to lay the groundwork for actionable health management (Ho et al., 2020). Using cancer informatics, personalised treatment plans may be created by integrating patient-specific data, such as genetic profiles and information searches. Cancer informatics can locate molecular biomarkers, forecast therapy and occurrence results, and assist physicians in adjusting patient treatment

using sophisticated analytics and machine learning algorithms which provide clinical decision support.

According to Sutton et al. (2020), cancer informatics provides resources and decision-support systems that aid medical practitioners in making clinical choices. These systems analyse patient data, physician advice, and research findings to offer real-time suggestions and treatment alternatives. By minimising variability and enhancing patient care, clinical decision support systems can improve the consistency and accuracy of clinical judgements. Quality of decision relies on research collaboration and knowledge sharing.

Cancer informatics helps researchers to work together, share data, and quicken information transfer (Sweeney et al., 2023). Collaboration among academics globally and large-scale data analysis are made possible through integrated platforms and data-sharing networks. This partnership advances cancer research and results by fostering the development of novel biomarkers, therapeutic targets, and treatment approaches gleaned from other populations. Cancer informatics enables the study of population-level data to comprehend cancer incidence, prevalence, and trends (Hong et al., 2022). Large databases may be analysed to help academics and public health experts pinpoint high-risk populations, track the prevalence of cancer, and create specialised preventive and screening initiatives. Public health strategies and initiatives to minimise the effects of cancer on communities can be informed by this population-level approach.

A robust and comprehensive approach to understanding, preventing, and managing cancer at both the individual and population levels is made possible by the opportunities provided by cancer informatics, which harmoniously align with the principles of modelling cancer occurrences through the lens of infodemiology. The potential for personalised medicines is based on creating individualised treatment regimens using patient-specific data, such as

information searches. This strategy, consistent with infodemiology, emphasises the need to utilise various data sources to tailor therapies to specific patient characteristics. Another option is clinical decision support systems, which directly improve decision-making while replicating infodemiological fundamental focus on evidence-based decisions resulting from in-the-moment analysis of patient data, physician input, and research results. Cancer informatics strongly emphasises research collaboration and information exchange, which interlocks well with an infodemiological focus on exchanging and analysing data from various sources. The main ideas of infodemiology are embodied in cancer informatics' focus on population-level epidemiology, as seen by its use in researching cancer prevalence, high-risk groups and influencing focused preventative activities.

Some of the challenges of cancer informatics relate to data integration and interoperability, data quality and accuracy, scalability and computational infrastructure, and ethical issues. These are elaborated hereunder:

Integration: A crucial aspect of cancer informatics is the integration of various and unrelated data sources, such as electronic health records, genetic data, imaging data, and information about clinical trials (Ayatollahi et al., 2019). The difficulty arises in integrating these diverse data types and guaranteeing compatibility between various platforms and systems. Standardisation initiatives and implementing interoperability standards, such as Fast Healthcare Interoperability Resources (FHIR)¹, are required (Ayatollahi et al., 2019).

Data quality and accuracy: The accuracy and quality of data connected to cancer are essential for insightful analysis and decision-making. Biased outcomes and inaccurate conclusions might stem from incomplete, inconsistent, or inaccurate data. Cancer informatics constantly

¹FHIR is a set of rules and specifications for exchanging electronic health care data.

face the challenges of ensuring data correctness, enhancing documentation procedures, and implementing data quality control mechanisms (Syed et al., 2023).

Computational infrastructure: Scalable computing systems and infrastructure are required to process large-scale cancer data (Chui et al., 2022). Huge data quantities might burden the resources already available for processing and storage. The difficulty lies in creating and maintaining a stable computing environment that can handle the expanding requirements of cancer informatics, including storage, processing, and analysis capabilities. Collaboration between research institutions can facilitate the development of network storage, which supports the scalability of infrastructure.

Ethical issues: Bringing together a battery of researchers and providing universal access to patient data require shared values to avoid unethical practices. Cancer informatics faces ethical difficulties regarding informed consent, data ownership, and possible algorithmic biases (Hong et al., 2022). Ensuring openness, justice, and equal access to cancer informatics tools and technology is essential. Ethical frameworks, regulations, and governance mechanisms must be implemented to address these issues and advance cancer informatics's ethical and responsible use.

The fact that cancer informatics faces various challenges underscores this field's importance within modern healthcare. Standardisation initiatives, exemplified by interoperability standards to assure compatibility across platforms, must integrate diverse data sources such as electronic health records, genetic data, imaging data, and clinical trial information. Meaningful analysis and decision-making depend on the quality and accuracy of the data, which calls for ongoing efforts to increase correctness through better documentation and robust quality control procedures. Collaborative efforts among research organisations can pave the road for scalable network storage solutions. Scalability is a critical challenge as the growing volume of cancer

data strains existing computing capacity. To address issues like informed consent, data ownership, and algorithmic biases, it is crucial to find a careful balance between data accessibility and privacy. Ethical frameworks, rules, and governance structures are essential to promote the moral and equitable use of cancer informatics technologies. When these difficulties are overcome via diligent cooperation, cancer informatics can transform healthcare and research, influencing cancer management.

2.2 Health information-seeking behaviour

The way people seek information is a fundamental component of human reasoning and an essential element of their peoples' daily lives. Understanding how people seek, acquire, analyse, and use information has become more and more critical when there is an overabundance of information (Tubachi, 2018). In addition, Tubachi expounds that Information-seeking behaviour encompasses various actions, from seeking precise solutions to problems to researching new topics and learning further information. AsKundu (2017), reiterate, information-seeking behaviour entails 1) acknowledging an information need, 2) seeking information to satisfy the information need, 3) evaluating and selecting the information, and 4) using the information to make decisions or satisfy other needs. People seek information to change their level of knowledge.

Information-seeking behaviour is a complex cognitive process that includes elements of both learning and problem-solving. With the current technological advancement, information users are expected to develop new knowledge and abilities in information- seeking in response to the changing information formats, sources and tools. There are two types of information-seeking behaviours: compulsory information-seeking behaviour and discretionary information-seeking behaviour (Tubachi, 2018). Mandatory information-seeking looks for information demanded or mandated by external circumstances, such as legal duties, professional requirements, or organisational regulations. In certain circumstances, people are compelled to search for specific

information to comply with rules, perform tasks, or adhere to predetermined standards. In such cases, the information seeker begins the process with a clear particular mind as well as clarity of the set of data they must get. This entails targeted searching and evaluating sources critically and retrieving pertinent information selectively. On the other hand, discretionary information-seeking is the voluntary and self-directed search for information that people engage in because of their interests, curiosities, or thirst for knowledge (Tubachi, 2018). Discretionary information searching is motivated by internal motives and the individual's curiosity or desire for information, as opposed to obligatory information seeking, which is inspired by duty or external pressure.

Health information-seeking behaviour is where individuals search for health information that can help them make better decisions or inform behaviour that promotes general well-being (Latunji & Akinyemi, 2018). It is any behaviour exhibited by people who believe they have a health issue or are unwell to get a suitable treatment or remedy. Several factors influence how people seek health information, including technological advancement, Internet accessibility, and cultural norms (Jia et al., 2021). Ubiquitous accessibility of the Internet has changed how people look for health information. The Internet enables people to look for solutions to their medical problems, explore potential treatments, and connect with others going through similar medical issues. Nangsangna and Vroom (2019) asserted that diverse online information resources and platforms have emerged and are currently being used as valuable sources of information. Such resources and platforms include Websites, databases, social media and networking sites, and mobile applications facilitating access to information or networking between persons facing similar health challenges. Although these resources offer vast volumes of data, proving their validity and accuracy can take time and effort. The need to verify their credibility or authenticity is serious.

Health information-seeking behaviour in Africa is influenced by limited access to healthcare services, poor health literacy rates, and cultural beliefs and practices (Nangsangna& Vroom, 2019). Despite these obstacles, the desire to use mobile technology solutions to close the information gap in Africa is rising (Hampshire et al., 2021). Mobile phones are now widely used across the continent, expanding the possibilities to disseminate health information, increase awareness, and encourage behaviour that promotes good health.

According to Harrington et al. (2022), socioeconomic differences, linguistic variety, and cultural views all impact how people seek health information in the East African Community. The availability of traditional healers and community health professionals in some regions also affects how people access and interact with health information (Atwine et al., 2015). On the other hand, EAC has had considerable improvements in mobile technology, with rates of cell phone adoption rising quickly (Rwigema, 2020). Kenya has one of the highest rates of mobile penetration in sub-Saharan Africa, with a penetration rate of 61 percent, surpassing Zambia (58%), Tanzania (54%), Nigeria (47%), Uganda (43%) and the Democratic Republic of the Congo (43%) (Igadwah, 2022). Mobile health initiatives, including SMS-based health campaigns and mobile applications, have been implemented to disseminate health information in developing countries (Chib & Li, 2022).

Understanding how individuals seek information is essential, especially when modelling cancer occurrence. Seeking cancer information significantly impacts early identification, prevention, treatment options, and general well-being. Health literacy, access to healthcare, cultural attitudes, and accessible technology all influence where information seekers turn to learn about cancer symptoms, risk factors, treatment choices, and measures to lower risks. Actively searching out knowledge enables educated decision-making, which improves health outcomes. Information seeking aids researchers and public health authorities in spotting trends

and directing the creation of focused interventions, awareness-raising initiatives, and health resources catered to particular demographic requirements.

2.2.1 Sources of cancer information

The complex nature of cancer and the variety of available treatments may make obtaining the knowledge required to make intelligent healthcare decisions challenging. The best way to thoroughly grasp the condition is to collect data from various sources (Tran et al., 2021). Before making any decisions on a treatment, it is essential to assess the material critically and to double-check its integrity with a healthcare professional. Some sources those information seekers use for cancer information are the Internet, healthcare professionals, printed information resources, social networking platforms, and peers.

In the current digital era, the Internet has changed many facets of human life, and healthcare is no different. According to Daraz et al. (2019), the Internet has become an essential repository of health knowledge. The Internet has also changed how people seek and access health information as it offers information on diverse issues ranging from general well-being and treatments to preventive measures (Capone et al., 2020). Tao et al. (2017) asserted that the Internet enables people to obtain online support, interact with other users and access a wide range of health information. The health information provided on the Internet covers specific medical conditions and diseases, including cancer, which may include ailments, diagnoses, available treatments, and management strategies. The resources also aid the users to be aware of different medicines and their usage, side effects and precautions needed for their practical use. Kington et al. (2021) asserted that the Internet is widely accessible, giving people a platform to search and access health information. People increasingly use search engines, online platforms, and Websites to find health-related information. Online resources offer various information, including articles, forums, social media sites, and online communities where people may ask questions, share their experiences, and find support.

Kulkarni et al. (2022) indicated that over seven hundred thousand (700,000) Websites currently contain health information. The increase is probably brought about by a variety of factors, such as the growing acceptance of the Internet as an informational resource for individuals of all ages; online searches for health information are more common than they ever were; and demand for individualised and specific health information is rising, and people may now more easily connect with individuals who share their health issues thanks to social media sites and online health groups. Some Websites with health information are the Centre for Disease Control and Prevention, Medline Plus, World Health Organisation, Mayo Clinic and WebMD (Daraz et al., 2019). These Websites provide various health information curated by reputable health organisations, hospitals, government agencies and researchers. Accordingly, Wang et al. (2018), argue that Web-based health information can stimulate behaviour change, increase treatment compliance, improve patient satisfaction and support patient decision-making. Web-based information also has the potential to improve health information transfer from professionals to the public and other interested parties.

Health information is also obtained from articles in scientific journals. The journals usually have research articles that elaborate on multiple researchers' perspectives on diverse health issues (Pope & Mays, 2019). The articles are normally peer-reviewed for quality assurance. Some journals are accessed through subscription, while others are published on open-access platforms. Some well-known journals are the *New England Journal of Medicine (NEJM)*, *PubMed* and the *Lancet*. These journals have established reputations, extended histories, and high-impact factors. The impact factor gauges how frequently other academics cite the journal's papers. The *NEJM*, *PubMed*, and the *Lancet* have very high impact factors, indicating that readers and citations of their publications are high. Additionally, they have a long history of producing high-calibre research and have the respect of both academics and medical practitioners.

Similarly, online groups and forums such as social media have become sources of health information (Soroya et al., 2021). People participate in conversations, share personal stories and get the views of others through the forums or groups. Sometimes, people connect to support groups of people with whom they share a common health issue or interest. Some online communities include *Patientlike ME*, *Reddit*, *Disease.net* and *WebMD* platforms. These online communities are more appealing and beneficial since they provide a wide range of valuable features. These features include the ability for users to ask questions, share experiences, and seek advice from the community. Additionally, these online communities' popularity and active user base support their efficacy. Users may acquire a variety of opinions and help since a broad and active user base guarantees a wide range of experiences and knowledge (Chen & Wang, 2021). Another key benefit is the professional moderation provided by experienced individuals. By monitoring the shared material, these moderators make sure that false information and possibly dangerous advice are kept at bay, upholding the integrity and reliability of the communities (Chandrasekharan et al., 2022). Other sources that can be used to get health information are mass media. For example, during the COVID-19 outbreak, most governments used the mass media to inform citizens of preventive measures against the pandemic and how to care for themselves (Bento et al., 2020).

According to The Pew Charitable Trusts (2021), approximately eighty percent (80%) of Americans have used the Internet to search for and access health information. Although the Internet is an excellent resource for health information, it is crucial to be aware of any potential problems and challenges that can come up when accessing this data. One of the challenges is the difficulty of confirming if the information is reliable and of good quality. Cucinelli and Farban (2022) asserted that online information sources are only sometimes trustworthy or grounded. They argued that false information may spread quicker than the truth. People need to exercise caution and assess the reliability of online health information sources before using

them. Cross-referencing health data from a variety of reliable sources is encouraged. A study by the Pew Research Centre found that eighty-five million Internet users need to assess its validity to take online advice (Anderson & Rainie, 2018). Moreover, the Internet can cause information overload, making it challenging to navigate the available voluminous information materials. According to Phillips-Wren and Adya (2020), information overload creates a scenario where information seekers become stressed and need help to make the right decision. This and misinformation generate confusion and uncertainty among individuals seeking health information. The ability to distinguish trustworthy information from faulty or biased information and build digital literacy skills is crucial for people accessing information online. Unlike traditional medical publications or official healthcare organisations, anyone can publish information online without strict peer review or quality control. The ease with which anyone can publish health information increases the risk of people coming across false or inaccurate content that could harm their health or cause them to make the wrong self-diagnosis and treatment decisions (Pew Research Center, 2020). Additionally, the Internet can increase the dissemination of personal stories and unverified claims.

While personal experiences can offer valuable insights, they should be taken cautiously and not considered universally applicable medical advice (Swire-Thompson & Lazer, 2020). Everyone's health situation is unique; consulting qualified healthcare professionals for personalised guidance is essential. Moreover, not all health information available on the Internet is presented in a format that everyone quickly understands. This situation can disproportionately affect vulnerable populations who may already be facing disparities in healthcare access and health literacy. Language and literacy barriers can complicate accessing and understanding online health information (Nouri et al., 2020). Another challenge arises from the dynamic health information (Nilsen et al., 2020). Health information constantly changes due to evolving lifestyles, discoveries and individual characteristics that continuously shape

people's perception of well-being. Similarly, the dynamic character of health knowledge is driven by advances in medical research, which constantly reveal new cures and preventative measures, such as recent developments in the treatment of cancer, heart disease, and HIV/AIDS.

People frequently seek trustworthy and knowledgeable advice from healthcare professionals, such as physicians, nurses, or chemists, regarding their health issues (Atwine & Hjelm, 2017; Chua et al., 2018). The healthcare practitioners assist the information seekers by answering questions, delivering diagnoses, outlining treatment choices, and providing individualised health information. In addition to their clinical competence, healthcare practitioners are an essential source of information. They serve as patient advocates, building a relationship of trust and compassion that improves the patient experience. Healthcare professionals give patients the knowledge and tools they need to better understand their diseases, available treatments, and the effects of their health decisions by addressing their questions and concerns. Healthcare workers utilise diagnosis, a key component of medical practice, to determine the root causes of health problems. Their ability to provide precise diagnoses helps patients to start the right therapy processes. For patients to make well-informed decisions, diagnoses must be technically correct and understandable to them.

Despite abundant Internet resources, traditional printed materials are still valid for anyone looking for trustworthy health information (Williams et al., 2019). Traditionally published sources include books, booklets, brochures, and journals, providing insightful information on numerous health concerns. People from different backgrounds and with varied levels of access to technology may take advantage of these services since they are available in various settings, including libraries, community centres, healthcare institutions, and public areas. Books, a venerable source of in-depth knowledge, are a foundational component of health knowledge.

They provide in-depth coverage of medical issues, therapies, preventative measures, and general well-being. Health-related publications appeal to a diverse readership, from those seeking essential health advice to those seeking in-depth knowledge about particular diseases or wellness techniques (Chen et al., 2019). With their vast collections, libraries are critical places to get printed health information because they allow people to read carefully researched, fact-based items. Brochures and pamphlets have a special place in disseminating focused health information. These succinct resources, which frequently focus on specific health issues like nutrition, exercise, or common medical disorders, are designed to be easily understood. They operate as helpful manuals by providing plain explanations and valuable advice. Community centres and healthcare facilities regularly distribute such printed documents, reaching people looking for fast, useful information to enhance their health or handle a particular situation. These materials' ongoing usefulness depends critically on their physical presence in public spaces. These printed resources are frequently used by people as their primary source of health information, especially by those who have limited access to the Internet or digital devices. Libraries act as welcoming places where individuals of all ages may have free access to a variety of books and materials on health. Communities with varied populations frequently include community centres, which serve as a focal point for health education and awareness. Providing reliable health information to patients and visitors is a priority for healthcare institutions. The simultaneous use of printed and digital health resources presents a broader range of possibilities for those looking for information, which must be understood. In some situations, such as when people prefer physical copies, have technical restrictions, or want a more profound, unbroken connection with the text, the tactile element of conventional printed materials can be very beneficial. In a society where the need for trustworthy health information is ongoing, these traditional sources are still significant, as seen by their persistent appeal.

People frequently resort to friends, relatives, or peers with direct experience with certain health conditions, demonstrating the importance of personal ties when seeking medical assistance (Chen et al., 2021). People may learn from one another, exchange stories, and get helpful tips on preserving their well-being through this unofficial but essential support network. Social networks have enhanced the information-seeking era by offering online forums for candid conversations about health concerns (Chen & Wang, 2021). These online communities encourage information exchange while fostering relationships with people going through related circumstances and providing a range of viewpoints. While these networks widen the knowledge base, it is still important to approach the information with caution, double-check it with reputable sources, and seek the advice of healthcare specialists before making choices about one's health. Social networks are invaluable in humanity's ongoing efforts to maintain good health and make wise health-related decisions. They encourage camaraderie, facilitate learning from others, and offer real-world insights that complement formal medical advice.

2.2.2 Profile of cancer information seekers

The profile of cancer information seekers offers essential insights into the traits, causes, and preferences of people seeking cancer information (Duimel et al., 2022). Those seeking cancer information include researchers, patients, healthcare practitioners and the general public. Duimel et al. (2022) asserted that those who seek cancer information may have been personally, or through a loved one, touched or affected by a cancer diagnosis and are motivated by the need to learn more about the illness and its effects. Others can be driven by a desire to lower their chances of getting cancer by changing their lifestyle, detecting its occurrence early, and taking preventative steps. Cancer information seekers can be profiled by age and gender, education and health literacy, socioeconomic level, trustable and credible information resources, technological developments, and cultural factors.

People looking for cancer information might be of any age, although middle-aged and older persons seem more prevalent (Cancer Research UK, 2021). This is because as people age, the incidence of cancer rises, and they may seek out information to learn more about the condition, its risk factors, and available treatments. Research conducted by Eurostat (2021) found that fifty-five percent (55%) of people aged 16 to seventy-four (74) seek cancer-related information online. Early cancer awareness is crucial for young adults (20–39 years) since they are more likely to develop the disease (Miller et al., 2021). Similarly, research by Allard and Orom (2023) examined the perception of young adults on information seeking about cancer prevention measures. They found that most young adults seek cancer information to help them manage their lifestyles and reduce their chances of getting cancer. A study by Jia et al. (2021) in Ghana found that middle-aged women are the ones who use the Internet to seek health information. According to Alkhatlan et al. (2018), women are more likely to search for health information online than men because they are more concerned about their health and those of their children than men, who are more interested in entertainment information.

The other factor that characterises cancer information seeking is education. Higher education levels and health literacy significantly influence cancer information-seeking behaviour. More educated and health-literate people are more likely to seek accurate and reliable information on cancer prevention, diagnosis, and treatment (Fleary et al., 2019). According to Fleary et al. (2019), people with low health literacy levels have an equally common understanding of cancer as they cannot search for cancer-related information. He et al. (2016), explained that health literacy refers to a person's knowledge, desire, and ability to obtain, comprehend, rate, and apply health information.

People with better socioeconomic status frequently have easier access to resources like Internet connectivity, healthcare services, and informative materials (Paccoud et al., 2021). This can

have an impact on how people seek out cancer information. People at a higher socioeconomic level are more likely to have dependable access to the Internet, which acts as a portal to a vast database of health-related information. This technological edge enables people to examine various cancer resources, from credible medical Websites to the most recent research results, allowing them to make educated decisions regarding cancer prevention, treatment alternatives, and general care. Additionally, those with a higher socioeconomic class typically have easier access to complete healthcare services, such as prompt medical expert consultations, specialised treatments, and routine health examinations. Thanks to these improved healthcare interactions, patients can better grasp their health state and potential courses of action, enabling them to seek out personalised cancer information from reliable sources. Additionally, people with a higher socioeconomic status are more likely to find and be able to buy instructional resources in a variety of media, such as pamphlets, educational efforts, and community health programmes. These resources fill the information gap, encourage health literacy, and allow people to participate in health decisions actively. Ultimately, socioeconomic status impact on people's access to resources substantially affects how they seek cancer information. This underscores the need to resolve inequities to provide equitable and thorough health education for all societal groups.

The availability of reputable information sources on cancer also significantly impacts how people seek information. People are more inclined to look for information from sources they believe to be trustworthy, such as licence medical personnel, recognised Websites, and official health organisations (Kington et al., 2021). Healthcare practitioners are among the most dependable sources of knowledge on cancer. Patients and their families frequently seek the advice of medical experts, counting on their knowledge to help them through the difficulties of cancer prevention, diagnosis, treatment options, and supportive care. People feel more trusting of the information they are given because of their personal and face-to-face encounters with

healthcare experts (Birkhäuser et al., 2017). In addition to medical practitioners, trustworthy Websites and government-run health agencies are regarded as reliable sources of cancer information. Adhering to stringent criteria of accuracy, fact-based information, and moral principles makes these Websites even more credible and trustworthy. They frequently include information on cancer, including its causes, risk factors, symptoms, and available therapies. The material is commonly supported by peer-reviewed studies, scientific research, and expert consensus, further enhancing their credibility (Kington et al., 2021).

Haleem et al. (2021), opined that the accessibility and affordability of digital technology, such as smartphones, tablets, and Internet connectivity, have revolutionised how individuals seek health information. Internet platforms' ease of use and promptness have significantly influenced how people look for information. These developments have empowered people by giving them easy access to an overabundance of materials, allowing them to make better decisions regarding cancer support, treatment, and prevention. But to guarantee that people can access trustworthy and accurate cancer information, issues like the spread of false information and the digital divide must be addressed.

The sources people choose to consult for cancer information can be influenced by cultural norms, religious beliefs, and societal factors. In certain cultures, asking family members for guidance, especially the older generations, is highly prized and seen as a reliable source of knowledge. Swihart (2022) asserted that for advice on health issues, including cancer, community or spiritual leaders or personalities may also have an impact. The kinds of information people look for, and the sources they trust may also be influenced by cultural practices and beliefs towards health and sickness, such as traditional cures or alternative medicines. Designing successful cancer awareness campaigns and interventions that respect

and adhere to people's cultural beliefs and practices requires understanding these cultural and social aspects.

2.3 Cancer infodemiology and informetric

Infodemiology and informetrics are fields of study that focus on diverse dimensions of information in the digital era. Infodemiology focuses on the multifaceted relationships in information use, diffusion, and societal influence. Tajedini et al. (2023) claimed that infodemiology offers a comprehensive knowledge of information-seeking behaviour, especially in cancer-related enquiries. Infodemiology reveals popular cancer topics, new trends, and the prevalence of specific search topics by analysing search engine queries and social media discussions (Faoury et al., 2019). This information enables researchers to create efficient public health campaigns, awareness programmes, and targeted communication strategies. Infodemiology empowers stakeholders by identifying the trends and preferences that underlie people's searches for health-related information, enabling them to ensure that accurate, dependable, and pertinent health information reaches various audiences, encouraging healthier behaviours, well-informed decisions, and better cancer outcomes.

On the other hand, in the realm of cancer research, informetric is essential for evaluating scientific output and collaboration networks (Parker et al., 2023). Stakeholders can identify areas of research concentration, investigate prospective interdisciplinary partnerships, and assess the effect of diverse research endeavours by looking at the academic output, publishing patterns, and collaborative links (Borges-do-Nascimento et al., 2022). Informetric supports monitoring the impact and reach of research findings, assisting in assessing the effectiveness of cancer-related initiatives such as public health campaigns and awareness programmes. Stakeholders can enhance their strategies, communicate better, and ensure that critical health information is accessible to the target audiences by examining how well these activities are being received and disseminated.

2.3.1 Infodemiology and Cancer

Tana (2019) defined infodemiology as the study of how information spreads and the factors influencing its distribution through electronic media, particularly the Internet. Its goal is to inform public health and governmental policies. Originally, infodemiology was the field of study that dealt with determinants and distribution of information and misinformation on health (Eysenbach et al., 2002). Infodemiology's initial focus was to evaluate what was being published online since there were many conversations about the quality of health information on the World Wide Web and its impact on public health at the turn of the millennium (Eysenbach, 2009). Eysenbach (2011) asserted that infodemiology was useful in pin-pointing consumers, patients, and healthcare professionals toward evidence-based, high-quality health information while spotting misconceptions and knowledge gaps regarding various health behaviours and supporting data. According to Zeraatkar and Ahmadi (2018), this brought about research on infodemiology that examined Websites for inaccurate, false, or misleading health information. In 2006, the definition of infodemiology evolved to include new techniques that investigate the factors that influence the distribution of health information for public health purposes (Eysenbach, 2006). This brought about infodemiological metrics of the supply and demand of health information in a population, which can provide pointers for public health policies and practices.

The first infodemiology study was about a “model for predicting influenza outbreak during the flu season 2004-2005 in Canada using Internet searches” (Eysenbach, 2006). The Internet made searching and using health information quantifiable. Zeraatkar and Ahmadi (2018) noted that infodemiology studies have risen in number since 2002 and are still growing in different aspects of health. Some recent infodemiology studies cover coronavirus disease (COVID-19) (Rovetta & Bhagavathula, 2020; Springer et al., 2021); HIV/AIDS (Ling & Lee, 2016); influenza (Dalum-Hansen et al., 2017; Woo et al., 2016); intake of antibiotics (Dalum-Hansen

et al., 2018); uptake of vaccinations (Boucher et al., 2021; Perez et al., 2021) and alcohol consumption trends (Chan et al., 2013), among others. These studies use data from the Internet and social media platforms like Twitter and Facebook.

Based on these studies, infodemiology has evolved into two concepts: demand and supply-based infodemiology (Mackey et al., 2022; Zeraatkar & Ahmadi, 2018). Demand-based infodemiology concentrates on understanding the information-seeking behaviour and wants of people or populations. In contrast, supply-based infodemiology looks at the information's sources and features (Mackey et al., 2022). Cancer-related demand and supply-based infodemiology offer essential insights into people's information-seeking behaviour and the characteristics of the distributed materials. These insights are in areas like cancer information needs assessment, topical analysis and tailoring information delivery based on the demand of the users. Similarly, it can help identify cancer information sources, assess their credibility, and conduct a cancer information diffusion analysis (SeyyedHosseini et al., 2018).

Infodemiology studies have been conducted about cancer worldwide. The earliest was a study in 2004 that screened Websites for information about breast cancer (Eysenbach, 2004). A study by SeyyedHosseini et al. (2018) researched breast cancer information supply and demand. The study found that search interest in breast cancer increased with time. Also, the data indicated a positive relationship between Internet information-seeking behaviour searches and scientific publication behaviours. Another study by Xu et al. (2020) was on lung cancer detection using Web data and found that the monthly patterns of online searches for lung cancer were in line with the nationwide reported rates of lung cancer. Other cancer infodemiology studies were: social media context (Lee et al., 2023; Renner et al., 2023), types of cancer (Renner et al., 2022; Sajjadi et al., 2021) and COVID and cancer (Eala & Tantengco, 2022; Olszewski et al., 2022).

Xu et al. (2019) asserted that people's search for information on cancer reveals a different aspect of the public understanding of cancer. They further indicate that tracking people's search interests in cancer can be used to estimate cancer incidences and mortality. Their study found a positive correlation between the Baidu index and cancer incidence rates. The Baidu index enables people to track and examine the popularity and search patterns of particular keywords and subjects in China's search ecosystem. Similarly, a study by Xu et al. (2020) found that lung cancer incidence rates were highly associated with relative search volume. Eysenbach (2006) found a strong association ($r=.91$) between the number of clicks on a keyword-triggered link in Google and epidemiological data from the 2004–2005 Canadian flu season. According to research by Cooper et al. (2015), searches for cancer information are linked to estimates of the disease's impact on three different metrics: incidence, death, and news coverage. Zhang et al. (2015) showed the seasonality and moderately strong cross-correlations of searches for tobacco and lung cancer in the United States, Canada, the United Kingdom, Australia, and China.

Modelling cancer incidence and understanding cancer dynamics have been made possible through the unique perspective provided by infodemiology. Infodemiology entails analysing online data from sources, including Internet searches and social media interactions. This helps to learn more about how people interact with cancer information. This makes it possible to gauge public interest, monitor information-seeking tendencies, and even spot early indications of impending cancer epidemics or changing illness patterns, thus acting as an early warning system. Demand-based infodemiology provides insights that help shape targeted public health campaigns that address particular cancer information gaps. In contrast, supply-based infodemiology analysis aids in determining the reliability of information sources. Infodemiology has evolved from observing trends to modelling complicated phenomena, enabling the creation of prediction models for more effective cancer prevention and management.

2.3.2 Informetric and cancer

Informetric is the study and application of quantitative methods to quantify, examine, and comprehend information and its flow within diverse systems (Yang et al., 2020). It tracks various scientific communication elements, including publication trends, citation analysis, collaboration networks, and impact evaluations. In cancer research, informetric substantially influences comprehending the scientific environment, recognising research trends, assessing the impact of research, and guiding policy and financing choices. The critical aspects of informetric about cancer are:

- a) **Publication Trends:** Informetric studies reveal the quantity, growth, and geographic distribution of publications about cancer (Lin et al., 2020). It gives information on the scientific output of oncology researchers, organisations, and nations. The progression of cancer research is tracked over time by informetric by examining publication trends.
- b) **Collaborations:** Informetric can identify networks and collaboration partnerships in cancer research (Fagan et al., 2018). Researchers can identify influential people, organisations, or nations supporting international collaborative cancer research efforts by examining co-authorship patterns and citation networks. Collaboration networks make sharing information, resources, and skills easier, enhancing research quality.
- c) **Impact assessment:** Informetrics is essential to evaluating the effect of cancer research. To assess the impact and exposure of specific articles, researchers, or institutions, bibliometric analysis entails counting the number of citations, h-index, and other bibliometric indicators (Hanna et al., 2021). Impact analyses assist in locating significant research discoveries, high-impact publications, and developing trends in the study of cancer.
- d) **Knowledge mapping and trend analysis:** According to Wang et al. (2019), informetrics makes it possible to map out different knowledge areas and identify

emerging patterns in cancer research. Informetric approaches can identify new study areas, hotspots, and knowledge gaps by analysing the literature. Such data helps scientists and decision-makers to prioritise their research, find fresh areas of inquiry, and fill in significant knowledge gaps.

A bibliometrics analysis of how cancer is portrayed in the medical literature by Glynn et al. (2010) found that the most reputable medical journals in PubMed and Web of Science have a high number of articles about oncology with most of the articles being on breast, prostate, lung, and intestinal cancer, and leukaemia. A bibliometrics study on clinical cancer research in China by Lin et al. (2020) found that clinical cancer research using the SEER database of China has recently experienced continuous and fast expansion. Sarangapani (2021) found that most cancer research is published in high-impact factor journals. Additionally, only three of the articles published were single-authored. This resulted in a high degree of collaboration.

However, Eysenbach (2009) did not find any significant relationship between occurrences and information availability on cancer. A study by SeyyedHosseini et al. (2018) between 2011 and 2015 showed a strong and favourable correlation between the Iranian users Internet search behaviour in Google Trends and the supply publication behaviour of Iranian researchers on breast cancer in PubMed ($p < 0.05$). At the same time, a study by Tajedini et al. (2023) found a negative correlation between information-seeking behaviour and publications in Iran.

2.4 Modelling cancer occurrence using infodemiology

The ability to inform policymakers and support the policymaking process depends on accurately predicting cancer incidence and death rates. Tudor (2022) used machine learning and R programming to predict the cancer incidences and mortality rate in Romania by the year 2026 using Web data. The model indicated that cancer occurrences and death rates will increase by 3% by 2026. Therefore, accurate cancer incidence predictions are essential for the early

identification and development of more inclusive and effective public health strategies. Kent (2019) reported that Microsoft was partnering with researchers from the Jackson Laboratory in Bar Harbor, Maine, to develop a model for analysing voluminous research papers and help cancer specialists predict cancer mutation and patients' responses to drugs.

In another project, the National Health Service of the United Kingdom signed an agreement with the AI business to analyse medical records for its people and identify the risks they may face in future (Collins, 2016). Artificial Intelligence models have been on the rise to help detect cancer in the early stages, an output that radiologists cannot attain. A study by Stark et al. (2019) used personal health information and machine learning models to predict the risk of breast cancer. The study developed non-invasive models that facilitate affordable early detection of breast cancer. Many cancer risk prediction models have been published in the last decade. In the USA, very few projects have advanced from the development and preliminary validation phases to anticipated real-time validation (Alfayez et al., 2021). In the EAC, no literature shows models or algorithms that have been developed to help predict cancer occurrences or any cancer issues concerning infodemiology.

2.5 Theoretical framework

Research on infodemiology seeks to understand and examine how information is disseminated, used, and impacted in digital spaces. Researchers use a variety of theories and models that offer frameworks for analysing phenomena connected to information when exploring the patterns, behaviour and dynamics relating to information demand and supply. This study was guided by the Monitoring and Blunting Theory, Wilson's (1996) Model of Information Behaviour and the Health Belief Model. The theory and models are discussed hereunder:

2.5.1 Millers' monitoring and blunting theory

Miller's monitoring and blunting theory was developed by Miller and Mangan in 1983 through their article titled "Interacting Effects of Information and Coping Style in Adapting to Gynaecologic Stress: Should the Doctor Tell All?" (Miller & Mangan, 1983). It is a theory of information-seeking behaviour regarding coping with stress. This psychological paradigm explains how people react differently to stressful or frightening events, such as learning about their health status, using different coping mechanisms and information-seeking behaviours (Muris et al., 1994). It claims that to control their emotional and cognitive reactions to stimuli, individuals differ in their tendency to seek out and analyse information (monitoring) or to avoid and restrict information (blunting).

Monitoring indicates that when people are confronted with a stressful circumstance, those with high monitoring capacity tend to seek and acquire information actively. They engage in intensive information-seeking behaviours and prefer detailed and explicit knowledge. To obtain as much information as possible, monitoring people may actively look for health-related material, speak with medical experts, and join support organisations (White, 2009). On the other hand, those who have a strong blunting style tend to withhold or limit information when under stress or threat. They could divert themselves, avoid eye contact, or restrict their exposure to information sources. Blunting people may rely on medical experts to provide the necessary information while avoiding unnecessary details (White, 2009). Additionally, they could employ detachment strategies or participate in pastimes or social interactions that divert their attention from the stressor.

According to the theory, depending on the individual and setting, coping mechanisms can be adaptive in various circumstances (Carlson et al., 2019). For instance, People with a high monitoring style could benefit from actively seeking information to feel in control and make informed choices. On the other hand, those with a high blunting style feel more at ease if they

restrict the amount of information they have access to, easing their anxiety and overload. In the context of health and cancer, an individual's information-seeking behaviour, adherence to screening or treatment regimens, and general coping mechanisms can all be affected by monitoring and blunting preferences (Addison, 2017). Healthcare practitioners and researchers can customise their communication strategies and information delivery and supply to the patient's requirements and preferences by being aware of the patient's monitoring and blunting inclinations. For instance, healthcare professionals and academicians may give resources and thorough information to those with high monitoring styles while giving people with high blunting styles concise and targeted information.

The monitoring and blunting theory contributed to the informetric elements of this study by helping to understand information demand and supply. It was used to analyse how people process and manage information overload. It sheds light on how people modify their information-processing actions in the face of overabundant information. The theory aided the study in understanding the cancer information search trends and informetric patterns of cancer information (Objective i and ii). According to the theory, people use different cognitive coping mechanisms in stressful or dangerous situations. Some people could use a "monitoring" technique, which comprises actively looking for cancer-related information in response to perceived dangers or worries, such as a family history of cancer or exposure to risk factors. Contrarily, "blunters" may avoid cancer-related material to lessen any associated tension or anxiety. The variables adopted are the monitoring and blunting behaviour, cancer information search intensity, and cancer occurrence rate and information sources.

2.5.2 Health Belief Model

The Health Belief Model (HBM) is a psychological framework that analyses and forecasts people's health-related actions based on their attitudes, perceptions, and beliefs. Developed by Irwin Rosenstock and further refined by social scientists from the U.S. Public Health Service

in the early 1950s, the model aims to understand why individuals do not utilize screening tests for early illness diagnosis or disease prevention techniques (Rosenstock, 1974; U.S. Public Health Service, 1952). HBM proposes that a person's belief in the personal danger of illness or disease and the effectiveness of the suggested health behaviour or action can forecast the likelihood that the individual would adopt the behaviour. It further indicates that communications that effectively address perceived obstacles, benefits, self-efficacy, and risk result in the best behaviour change (Jones et al., 2015). The constructs of the model are:

- a) ***Perceived susceptibility***: A person's perception of their likelihood of getting a specific health condition. The model suggests that people engage in behaviours that lower their chance of having a particular health concern if they believe they are vulnerable. Those who regard their susceptibility to disease as being low may reject this notion (Latunji & Akinyemi, 2018).
- b) ***Perceived severity***: This refers to a person's perspective of the gravity and effects of a health condition. According to the HBM, people are more likely to take action to prevent a health issue from arising if they consider it significant (Glanz & Bishop, 2010). Perceived seriousness includes attitudes about the illness as well as broader effects on performing in social and professional responsibilities.
- c) ***Perceived benefits***: According to Kim and Kim (2020), perceived benefits entail an individual's perception of the worth or effectiveness of participating in a behaviour that promotes health to lower their risk of disease. A person is likely to engage in any conduct if they feel that doing so would lessen their vulnerability to a health problem or its severity.
- d) ***Perceived barriers***: Kim and Kim (2020) define perceived barriers as how people perceive the challenges to behaviour change. Barriers may limit participation in health-promoting behaviour even if a person considers a health condition serious and feels that

a particular activity will successfully lessen the threat. In other words, for behaviour change to occur, the perceived advantages must outweigh the perceived disadvantages (Glanz et al., 2008).

- e) **Cues to action:** According to Tadesse et al. (2020), a signal or trigger is required to motivate people to participate in behaviours that promote their health. Action cues may come from the inside or the outside. For example, an internal stimulus to action is a physiological cue, such as pain or symptoms. The media, health care providers ‘events or information from close friends are examples of external signals that encourage engaging in health-related behaviours.
- f) **Modifying variables:** Individual traits, such as demographic, psychological, and structural factors, might impact how health-related behaviours are regarded (Short & Mollborn, 2015). Demographical factors include age, sex, race, ethnicity, and education, while psychosocial factors include personality, socioeconomic status, and peer and reference group pressure (Glanz et al., 2008). Structural variables include information on a particular health condition and past exposure. Figure 2 represents the HBM.

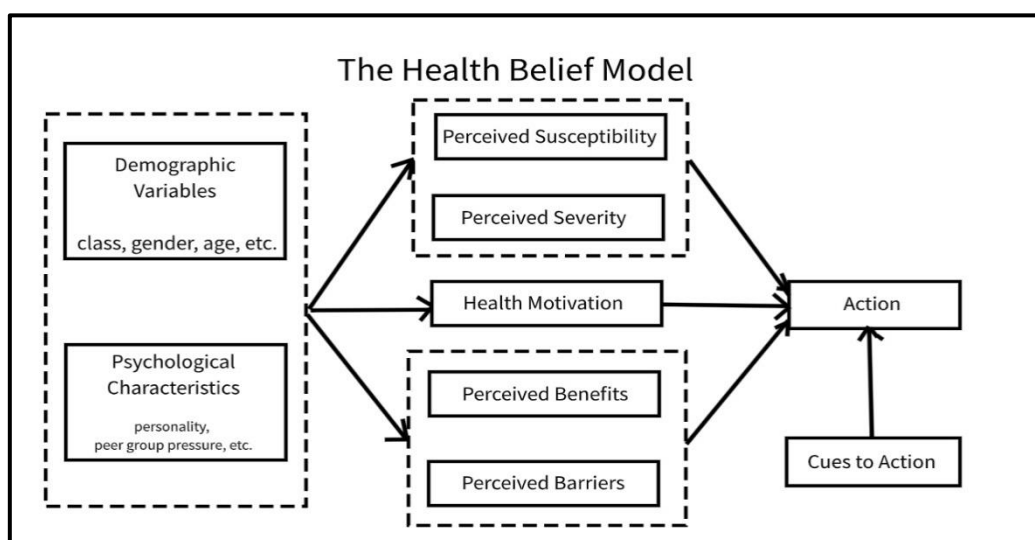


Figure 2: The Health Belief Model

Source Rosenstock et al., (1988)

The Health Belief Model was used to understand how people relate to information regarding health issues. For example, people with a high risk of getting cancer could take more proactive precautions and seek information about it. The Health Belief Model offers insightful analysis for investigating the correlation between cancer incidence and changes in information search (objective iii). This helps evaluate how people's views about cancer risks affect their information-seeking behaviour and their impact on cancer occurrence by using key concepts, including perceived susceptibility, perceived severity, and perceived benefits of information-seeking. The model also helped infer the relationship between information search trends for cancer and informetric patterns (objective iv). The motivation for obtaining cancer information and people's self-confidence is factors illuminated by variables like signals to action and self-efficacy, which aid in drawing connections with informetric patterns. Additionally, the model may be used to predict the demand for and supply of cancer information (objective v), with factors including perceived advantages and constraints influencing the information ecosystem and informing models that reflect information.

2.5.3 Wilson 1996 model of information behaviour

Wilson developed the 1996 model of information behaviour as a revision of his 1981 and 1994 models. The model addresses how people use the information they seek and the triggers that influence their information-seeking (Wilson & Walsh, 1996). The model's constructs are:

- a) ***Context of the information need:*** Wilson bases his claims on two ideas. First, information needs are secondary needs that result from primary needs, which are classified as physiological, cognitive or emotional in psychology (Niedzwiedzka, 2003; Vansteenkiste et al., 2020). The context, which might be the person, their role in work and life, or the settings (social, political, economic, technical), all impact the emergence of a specific demand.

- b) **Activating mechanisms:** Wilson introduces the idea of an activation mechanism between what he refers to as “person-in-context” and the choice to seek out knowledge (Niedzwiedzka, 2003). He points out that not every requirement motivates one to engage in actions that lead to understanding-seeking. Wilson turns to psychology to answer what spurs and drives information seeking, but he also emphasises the need to include other sciences. A stress and coping theory can explain one of the activation processes. Wilson contends that not all information needs to prompt someone to seek information. For instance, if a person believes that the information, they already have is adequate to comprehend the issue and make a choice, they will not participate in searching activities. Another motivating element is the need to deal with a situation or solve a problem. Even if the reward is just the comfort that removes the sense of uncertainty, wanting anything can cause this feeling of necessity. The risk and reward hypothesis explains why certain circumstances need the search for knowledge while others do not and why some information sources are more frequently used.
- c) **Intervening variables:** Wilson emphasises personal traits affecting information-seeking behaviour. These traits may include demographic factors like age, gender, educational level, psychological factors (beliefs, attitudes, and emotions), and past knowledge or experiences (Ajzen, 2020).
- d) **Information-seeking behaviour:** According to Broekhuis et al. (2022), information-seeking entails passive attention, passive search, active search and ongoing searching. Passive attention refers to passively absorbing information from the environment, such as when the TV or radio is on and no one actively listens to it. Although it is a significant method of information assimilation, it is not intentional information-seeking behaviour. Passive search is applicable when a particular behaviour leads to gathering information that just so happens to be pertinent to the individual. A person engages in an active

search while they are looking for information. The fourth definition, “ongoing search”, refers to ongoing research to expand or refresh a body of knowledge.

- e) **Information processing and use:** The information a user obtains is digested, developed into a piece of personal knowledge, and is utilised, either directly or indirectly, to affect the environment and, as a result, produce new information demands. Figure 3 depicts the model.

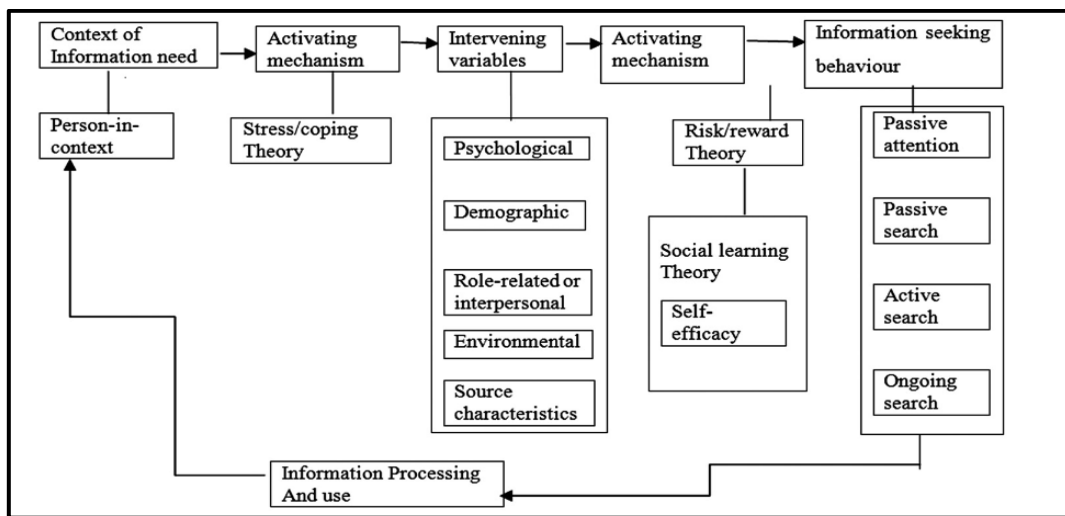


Figure 3: Wilson's 1996 model of information behaviour (Wilson & Walsh, 1996)

Wilson's model of information behaviour gave the study a theoretical framework for exploring the intricate relationships between information demand, information-seeking behaviour, and information usage across settings. It assisted in understanding the cognitive processes, social relationships, and environmental variables that affect people's information behaviour. First, the model emphasises the significance of information demands and the underlying causes behind people's information-seeking and usage. In cancer research or public health, for example, this aids in comprehending the precise knowledge gaps, preferences, and priorities within the field. Second, the model highlights the variety of sources of information that people consult, allowing researchers to investigate the media and platforms used for information access and dissemination. Understanding the sources of information is essential for informetric since it facilitates the investigation of citation networks and publishing trends. The variables adapted

from Wilson's 1996 model are information need, information-seeking behaviour, information use and sources, information production and data characteristics.

2.6 Conceptual framework

This study's conceptual framework is derived from the literature review, the health belief model, Wilson's 1996 model of information behaviour and the monitoring and blunting theory. This choice is substantiated by the study's focus on understanding how the accessibility and availability of cancer-related information affect cancer incidence. The independent variable, infodemiology (demand and supply), encompasses several elements which entail *Information need*, which helped delve into the diverse information requirements within the population, shaped by demographic factors, education levels, and health concerns. *Information-seeking behaviour* entails perceived susceptibility, severity, benefits, barriers, and the tendencies of monitoring and blunting. This set of variables investigates the extent and manner in which individuals seek cancer information. *Sources of information* which examine the channels used to access cancer-related information, thereby exploring their effectiveness in reaching the population. *Information production* helped evaluate the creation and distribution of cancer-related information, considering its accuracy, reliability, and comprehensiveness. The *characteristics of information* will assess quality, format, and relevance, while *information overload* and *information filtering* probe into how individuals manage the volume of cancer-related information.

The dependent variable, cancer occurrences, measures cancer incidence, including overall rates and cancer types. This variable is intrinsically linked to awareness, information-seeking behaviour, and access to accurate information. Additionally, the study acknowledges "technologies" as intervening variables mediating the independent and dependent variables. Technologies encompass digital tools, platforms, and channels that mediate the dissemination

and acquisition of information. This selection is rationalised by the profound role of digital media in shaping how cancer-related information is accessed and disseminated. This conceptual framework facilitates a thorough analysis of the intricate dynamics between information, technology, and cancer occurrences within the study's population. Figure 4 shows the conceptual framework.

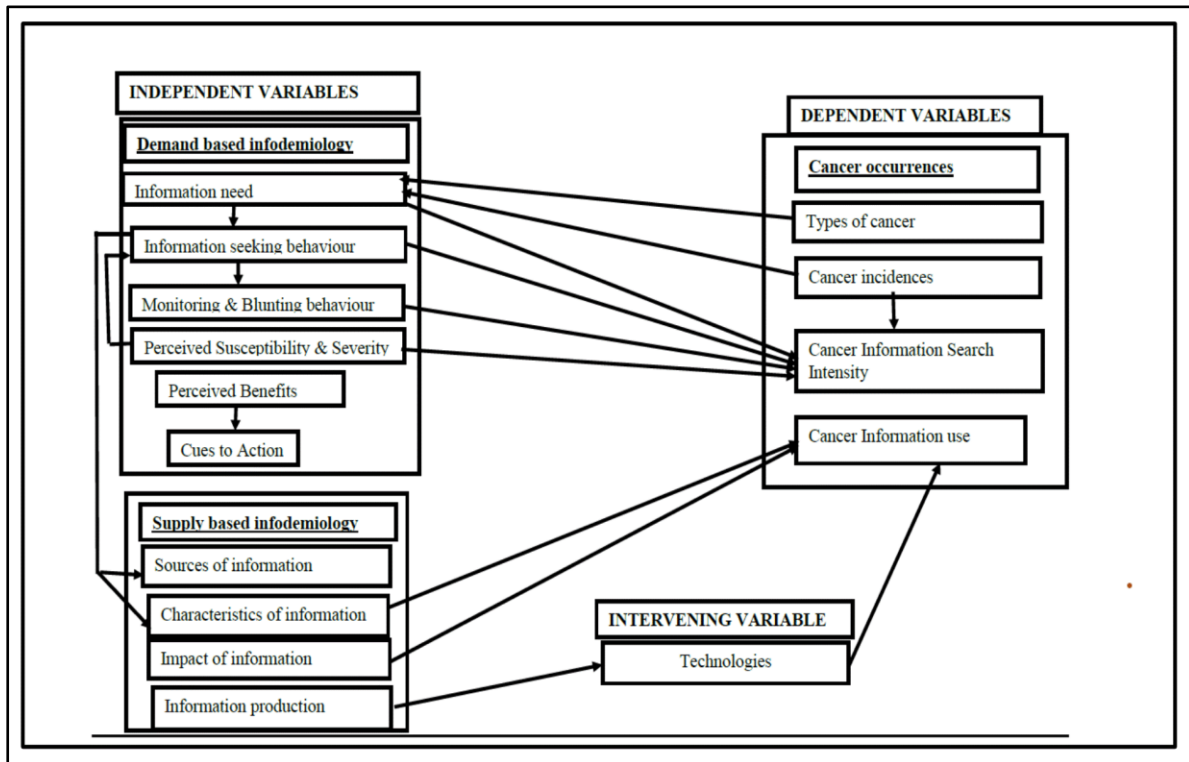


Figure 4: Conceptual framework

(Source, Researcher 2023)

2.7 Related studies and research gaps

Table 1: Literature gaps in related studies

	Authors	Research focus	Findings	Research gap	The focus of current research
1	Foroughi et al. (2016)	The study focused on how people Google cancer information in Australia, Canada, New Zealand, the United States and the United Kingdom.	Comparatively, more persons in the United States, Canada, and Australia searched for cancer than in New Zealand or the United Kingdom. The rise in cancer-related keyword searches demonstrated the potential efficacy of awareness campaigns in raising public demand for online health information.	The study only focused on the demand aspect of cancer information but did not check the supply of the cancer information.	The current research focuses on cancer information seeking (demand) and supply.
2	Xu et al. (2019)	The research focused on the relationship between cancer occurrence and death rates based on Web data in China.	There was a strong correlation between the Baidu index and cancer death rates. Women's search for cancer information has risen. The searchers for cancer information were more for people in their 30s and 40s.	The study used the Baidu index, which the Chinese use more. Hence, generalisation of the findings may still need to be achieved.	The current study focused on a search engine that is globally used to enable the generalisation of the findings for countries with similar characteristics to EAC.
3	SeyyedHosseini et al. (2018)	The research's main focus was an infodemiology study on breast cancer in Iran, comparing the supply and demand for health information using PubMed and Google Trends data.	According to the study, interest in breast cancer searches grew with time. The data also showed a favourable correlation between online information-seeking behaviour and behaviours related to scientific publishing.	This study solely looked at the supply and demand for health information in PubMed and Google Trends; it ignores other databases often utilised for medical research and care.	The current study looked for data in the PubMed database and investigate data in Google Scholar and social media platforms. Similarly, the study is not limited to one type of cancer.

4	Lee et al. (2023)	The study focused on leveraging social media data and Web search queries as a digital pulse on cancer communication: Towards an Extended Infodemiology Framework.	The study found that relying solely on public tweets may miss opportunities to spot dangerous cancer disinformation discovered through individualised Web searches. Secondly, tweets about lung cancer were much gloomier after Cancer Awareness Month. Finally, the cancer communication landscape was democratised, with no notable conduits dominating Twitter conversations.	The study only relied on tweets for the data set.	The current study considered a wide range of databases that users search and publish health information.
5	Zhang et al. (2015)	The research focused on the effects of seasonality on information-seeking regarding tobacco and lung cancer.	There were seasonal solid connections between search patterns for cigarettes and lung cancer, with cross-correlations exceeding 0.700.	The study only focused on information-seeking behaviour on tobacco and lung cancer.	The research had a holistic view of cancer search interests and correlate them with cancer incidences.
6	Lin et al. (2020)	The study focused on analysis of the Surveillance, Epidemiology, and End Results (SEER) Database Trends in Clinical Cancer Research Publications in Mainland China: Bibliometric Study.	There was a steady increment of cancer publications in the SEER database. Most of the articles were on breast cancer, colorectal cancer, lung cancer, gastrointestinal cancer and genital system cancer.	The focus was only on the SEER database	The current study considered a wide range of databases.
7	Tajedini et al. (2023)	The study focused on infodemiological analysis of users' online information-seeking behaviour and the scientific output of	The Shapiro-Wilk test findings showed that Iranian researchers' scientific output and users' Google Trends behaviour were normal (P -value > 0.05). However, the two variables had a negative and significant association ($r = -0.81$).	The study was limited to multiple sclerosis cancer.	The current study investigated a holistic view of cancer information-seeking and scientific publication without being

		multiple sclerosis researchers in Iran.			constrained to one type of cancer.
8	Tudor (2022)	The research focused on using Web Queries and Automated Forecasting Algorithms, a Novel Method for Modelling and Predicting Cancer Incidence and Mortality Rates: Evidence from Romania.	The findings showed that cancer incidence and mortality in Romania will continue to rise by 2% to 3% over the next decade.	The study used automated statistical and machine learning forecasting techniques; hence, it was limited to the available algorithms to predict cancer incidences.	The current study anticipates developing a model that can be used to predict cancer incidences in EAC.
9	Kent (2019)	The project focused on developing an Artificial Intelligence model for predicting cancer mutation and patients' treatment responses using scientific papers.	The project is anchored on the fact that voluminous research papers about cancer offer insights into the current cancer issues and help predict the future.	The project relied only on published scientific papers.	The current study developed a model based on scientific papers published, Google search trends, and social media.
10	Collins (2016)	The project focused on analysing patient clinical records and predicting a better way of changing their lifestyles.	The project faced challenges getting the electronic health records as the respondents feared privacy and confidentiality issues.	The project used electronic health records only.	The current research relied on Web-based data for information seekers and providers.
11	Stark et al. (2019)	The research was based on using personal health information and machine learning models to predict the risk of breast cancer.	The study found that the Breast Cancer Risk Prediction Tool (BCRAT) was not considerably more potent than any machine learning models that used solely BCRAT inputs. However, the BCRAT was dramatically outperformed by the broader collection of input neural network models, logistic regression, and linear discriminant	The study did not conduct extensive statistical comparisons between the sensitivity, specificity, and accuracy values of the BCRAT metrics	The current study conducted an extensive analysis of both qualitative and statistical data.

			analysis. According to these findings, adding more personal health inputs might enhance the BCRAT's ability to predict five-year breast cancer risk.	and the machine learning models.	
12	Alfayez et al. (2021)	Using supervised machine learning to predict adult cancer risk: a scoping review	The study showed that ten articles employed machine learning to forecast future cancer risk in asymptomatic people. No research published metrics for model calibration, although all studies reported values for the area under the receiver operating characteristic curve as measurements of model performance.	The study only reviewed other analyses to identify the models they used.	The current research modelled cancer occurrence using infodemiology.

2.8 Chapter summary

This chapter synthesised current literature and established a theoretical framework for analysing EAC cancer information search trends and supply. It began with a comprehensive review aligned with the study's objectives to analyse cancer information search trends, informetric patterns, and their relationship with cancer occurrence. The literature encompassed infodemiology and informetrics, crucial for understanding and managing cancer-related information in the digital age. The chapter explored health informatics' role in cancer management, leveraging data analytics and AI for personalised medicine and population health. Challenges such as data quality and ethical considerations are highlighted, emphasising opportunities for improving cancer diagnosis, treatment, and public health interventions in the EAC through robust information systems and technology-driven approaches. It delved into the intricate relationship between infodemiology and cancer information dynamics, synthesising pertinent literature and theoretical frameworks. It introduced infodemiology as crucial for analysing digital information behaviours in cancer contexts, incorporating Miller's monitoring and blunting theory, the Health Belief Model (HBM), and Wilson's 1996 model of information behaviour. Theoretical insights culminated in a conceptual framework integrating information need, seeking behaviour, sources, production, characteristics, and technologies, identifying critical gaps in understanding both the demand and supply aspects of cancer information across digital platforms and databases, underscoring the need for empirical investigations to bridge theoretical insights with practical applications in public health and cancer communication strategies.

CHAPTER THREE

RESEARCH METHODOLOGY

Research methodology is a logical systematic plan or strategy used in conducting research within a particular field of study (Kumar, 2018). According to Dawadi et al. (2021), research methodology entails laying out in detail the procedures that researchers use to gather information and data, as well as explaining the underlying assumptions and justifications for the methodologies and approaches that have been selected. In essence, it serves as the framework for a research study, providing a systematic methodology to guarantee accurate and trustworthy results. This chapter explains procedures carried out to examine the study and the basis for the use of different methods. It presents the research's philosophical assumptions, research approach, design, target population, sampling procedure, data collection and analysis and ethical considerations.

3.1 Research philosophical assumptions

Philosophical worldviews are fundamental principles that guide the research process, influencing the formulation of research questions and the gathering, analysis, and interpretation of evidence (Singh, 2019). The four critical facets of these presumptions are ontological, epistemological, axiological and methodological. Lawani (2021) asserts that ontological assumptions are based on the nature of reality. Realists emphasise the discovery of universal truths and maintain that an objective, external world exists apart from the human perspective. Contrarily, constructivism asserts that reality is socially and subjectively created, differing among people and civilisations. Nominalism asserts that generic concepts are only labels and rejects the existence of universals. Idealism maintains that awareness is the source of the physical universe and that reality is essentially mental. Pragmatism stresses usefulness above reality's inherent qualities and places a higher priority on practical implications. Existentialism emphasises the role that each person has in shaping their existence. The concept of a static,

objective reality is contested by postmodernism, which emphasises the subjectivity and fragmentation of reality. Khatri (2020) contends that epistemological assumptions guide knowledge acquisition, whereas pragmatists stress flexibility and practical utility, interpretivists emphasise social construction and subjective context, and positivists prioritise empirical evidence and objectivity. These perspectives represent distinct philosophical orientations shaping diverse approaches to understanding knowledge. When applied to real-world problem solving and goal attainment, positivism and interpretivism can be combined pragmatically to provide flexibility in approach. Marej (2020) discussed axiological presumptions, indicating that they are core moral precepts and beliefs that guide judgements and choices. They include utilitarianism, cultural relativism, universalism, pragmatism, tolerance, objectivity, subjectivity, and ethical principles. These presumptions direct moral and ethical reasoning in various settings and disciplines, such as the social sciences, philosophy, and ethics. Methodological assumptions guide research techniques (Al-Ababneh, 2020). Positivists employ quantitative methods while interpretivists favour qualitative approaches. Pragmatists prioritize practicality, blending methods as needed for specific research objectives. These methodological stances shape the research process and data collection in various ways. This study's philosophical worldviews are discussed here:

3.1.1 Ontological assumptions

Ontological assumptions serve as foundational pillars that shape the researcher's perspective on the nature of reality and the role of data (Mauthner, 2020). These assumptions can be explained through two principal lenses: objectivism and subjectivism, each offering distinct viewpoints on how to comprehend and model cancer incidence (Al-Ababneh, 2020). Objectivist presumptions explain that cancer incidence is subject to an objective reality. Objectivists view cancer as not only a question of subjective interpretation but rather a quantitative and quantifiable entity with innate patterns and causes apart from human views

(Salter et al., 2020). From this perspective, empirical facts are of utmost importance. Accurate and unbiased data collection that reflects the actual incidence of cancer is a top priority for objectivists. Objectivists contend that researchers need to acknowledge these objective facts to manage cancer incidences (Wyllie, 2019).

On the other hand, subjectivist ontological assumptions contend that environmental variables and subjective interpretations significantly influence explanations of cancer incidences (Rabetino et al., 2021). Subjectivists contend that a wide range of human experiences and perspectives profoundly impact reality rather than reality being a static, objective substance. Subjectivists recognise that individual viewpoints, cultural circumstances, and socioeconomic variables all substantially impact how cancer is seen (Kassaman, 2023). Subjectivist presumptions highlight the relative nature of cancer incidence and imply that it can be a subjective concept that varies from person to person. Subjectivists argue that cancer data are interpretable and represent a broad range of social, cultural, and political factors rather than objective truths.

This study combined subjectivist and objectivist ontological assumptions to provide a comprehensive knowledge of cancer incidences. To define basic patterns in cancer incidence, objectivist viewpoints provided a strong basis of factual evidence and objective truths that reveal universal trends and causal links. Subjectivist perspectives, which consider variables influencing data interpretation, simultaneously provide depth to the research by delving into how human interpretation, context, and cultural influences change the impression of cancer occurrence. This comprehensive approach incorporates subjective factors, objective patterns, and causes of cancer incidence. The incorporation of contextual subtleties and empirical facts that impact the understanding and transmission of cancer statistics facilitates the creation of more efficacious tactics in cancer prevention, treatment, and public health initiatives.

3.1.2 Epistemological assumptions

Epistemological assumptions are foundational beliefs about how knowledge is acquired and what constitutes valid knowledge. In this research, these assumptions are crucial in shaping the research methods, data collection, and interpretation of findings. There are three primary epistemological perspectives: positivism, interpretivism, and pragmatism.

Positivism places a strong emphasis on the value of objective, factual data in the process of learning (Zyphur & Pierides, 2020). When employing infodemiology to estimate cancer incidence, researchers who adhere to positivist principles concentrate on gathering observable and quantifiable data from various sources. Their focus is on objective patterns and causal linkages in cancer incidence, particularly on statistical analysis. Positivist scientific methodologies and data collection provide valid information. To learn more about cancer patterns, positivists emphasise using large-scale databases, surveys, and statistical modelling approaches (Brown, 2022). Conversely, interpretivism emphasises understanding people's meanings and interpretations of phenomena and prioritises the subjective context of learning (Darby et al., 2019). When modelling cancer incidence, interpretivism assumptions consider the qualitative features of the data. Interpretivists understand that the occurrence of cancer is influenced by a variety of factors, including how people interpret their symptoms, how they seek medical attention, and how society views the disease. Interpretivists frequently employ techniques including content analysis, interviews, and qualitative research. Pragmatism emphasises knowledge's usefulness and practical uses and adopts a more pragmatic approach (Kelly & Cordeiro, 2020). Researchers who use pragmatic assumptions concentrate on strategies and models that successfully anticipate and address cancer trends. They may be more motivated by the usefulness of their study than by the philosophical argument about the nature of knowing. Pragmatism creates easily implemented models for better cancer prevention, early

diagnosis, and treatment. In order to attain valuable results, pragmatics employs a combination of quantitative and qualitative data.

This study combined the epistemological stances to provide a comprehensive and well-rounded method. Positivism offered the methodical examination of empirical data to identify objective patterns. Interpretivism offers a human-centric view by exploring the individualised experiences and interpretations associated with cancer. Pragmatics offered real-world applications and practical value. Combining these epistemologies gave a more complete understanding of the dynamics of cancer. A multidisciplinary method enhances the study, increasing its relevance and effectiveness in tackling the intricate aspects of cancer occurrence.

3.1.3 Axiological assumptions

Axiological assumptions are essential in modelling cancer incidence within the EAC using infodemiology. These assumptions revolve around ethics and values, emphasizing the importance of moral considerations in research (Goldstein et al., 2018). Favaretto (2023) states that ethical considerations, particularly regarding privacy and informed consent, are crucial. Researchers must navigate the ethical landscape when working with sensitive health data, ensuring the responsible conduct of research and protecting individual rights and privacy.

Privacy and confidentiality are pivotal in ethical research, especially when handling sensitive health data (Thapa & Camtepe, 2021). This axiological assumption underscores the ethical duty to safeguard the privacy and confidentiality of individuals whose data contributes to the research (Stewart, 2021). Researchers are ethically bound to implement rigorous measures that ensure an individual's identity and health-related information remains secure and undisclosed. Beneficence and non-maleficence represent core ethical values in research, particularly within cancer incidence modelling (John & Wu, 2021). Beneficence emphasises the ethical responsibility to generate knowledge that can enhance individual well-being and advance

public health. Researchers aim to provide valuable insights that can improve society and individuals. Concurrently, the principle of non-maleficence highlights the importance of minimising harm (Shea, 2020). Researchers must meticulously safeguard the well-being and rights of those whose data contributes to the research, ensuring that data collection and usage do not result in harm or breaches of privacy.

Transparency and honesty are fundamental values in research ethics. Researchers must provide clear, honest information about their data sources and collection methods (Thompson et al., 2021). Accurate reporting of research findings is crucial, as it upholds the integrity of research outcomes and builds trust with participants and the broader public.

The value of evidence-based decision-making is an axiological assumption of immense significance in healthcare and policy (Sayer, 2020). This value emphasises the ethical obligation to base decisions on well-founded and validated data. It underscores the importance of using credible and reliable data to inform decisions that affect individuals and communities. These axiological assumptions are indispensable in modelling cancer incidence in the EAC using infodemiology. They provide an ethical framework for conducting research responsibly, safeguarding the rights and privacy of individuals providing data for the study, and upholding the credibility and trustworthiness of research outcomes.

3.1.4 Methodological assumptions

Methodological assumptions are crucial in modelling cancer incidence using infodemiology within the East African Community (EAC). These assumptions significantly influence the selection of research methodologies, guiding whether researchers opt for quantitative or qualitative techniques when collecting and analysing data from Internet sources (Alharahsheh & Pius, 2020). It is important to note that underlying ontological and epistemological presumptions often influence these methodological decisions.

This study's methodological assumptions encompass a combination of positivist and interpretivist approaches to understanding cancer incidence through infodemiology. The adoption of a mixed-methods approach recognises the multifaceted nature of cancer incidence in EAC. By combining quantitative and qualitative methods, the study aims to capture objective patterns and causal links underlying cancer incidence, as well as subjective experiences and contextual factors shaping data interpretation. This dual-method approach enriches the study's understanding, exploring the issue's "what" and the "why". Quantitative techniques, such as data mining and statistical analysis were used to uncover objective patterns and relationships within the data while qualitative methods provided a means to delve deeper into the themes in scientific research on cancer. These enabled the study to explore the subjective aspects of information, such as the sentiments and context surrounding discussions of cancer incidence. Furthermore, the study's commitment to interdisciplinary research is vital for addressing the complexity of cancer. Cancer incidence is influenced by diverse medical, social, cultural, and environmental factors. This interdisciplinary perspective recognises that cancer cannot be understood in isolation but requires a comprehensive view. The study's pragmatic orientation emphasises producing actionable knowledge, bridging the gap between theory and practical solutions, and benefiting individuals and communities.

From the discussed philosophical assumption, it is evident that the ontological assumptions underpinning the study on cancer incidence within the EAC through infodemiology reveal a blend of objectivist and subjectivist perspectives. Recognising cancer as an objectively quantifiable entity and a subjectively interpreted phenomenon, the study aims to amalgamate empirical facts with diverse human experiences and cultural influences. This comprehensive approach acknowledges the intricate nature of cancer incidence, incorporating objective patterns and the contextual subtleties that impact data interpretation. The epistemological assumptions further contribute to the richness of the study, combining positivism,

interpretivism, and pragmatism. The study seeks a holistic understanding of cancer dynamics by valuing objective, factual data and subjective interpretations. The study's axiological assumptions emphasise the need to guarantee privacy, beneficence, transparency, and evidence-based decision-making. These values underscore the ethical responsibility of researchers in handling sensitive health data, ensuring individual well-being, and contributing trustworthy insights to inform decisions. Lastly, the study's methodological assumptions encompass a mixed-methods approach. The study combined quantitative and qualitative methods which allowed exploring objective patterns and subjective experiences, addressing the complexity of cancer incidence within a multidisciplinary and pragmatic framework.

3.2 Research paradigms

According to Creswell and Creswell (2017), research paradigms are basic philosophical frameworks that drive the creation, execution, and interpretation of scientific investigation. Mertens (2019) asserts that the research paradigms include positivism, interpretivism and pragmatism. These paradigms influence how the researcher perceives reality and how information is produced, affecting a study's validity and generalisability (Davies & Fisher, 2018). The research paradigm must align with a study's objectives to provide a cogent and successful strategy for examining and interpreting events within the selected paradigmatic bounds (Akotia et al., 2023).

3.2.1 Positivism paradigm

Positivism strongly focuses on empirical observation and the scientific method to comprehend the tangible, objective features of the universe. As noted by Creswell and Creswell (2017), this paradigm is predicated on the notion that a single, objective reality can be investigated by methodical data gathering and analysis. Positivist researchers frequently use quantitative techniques like experiments, multi-site case studies and surveys to collect data (Cook et al.,

2019). They also aim for objectivity, generally reaching their conclusions via statistical analysis.

According to Savin-Baden and Major (2023), positivism emphasises factual, quantitative, and objective reality features to uncover causality and underlying principles. However, Guetterman et al. (2019) suggest that this method may be less effective for examining the complex social processes that characterise the social sciences. Simple cause-and-effect linkages frequently fall short when dealing with complex human behaviours, cultural differences, and environmental factors handled by the social sciences.

3.2.2 Interpretivism paradigm

Interpretivism is a research paradigm focusing on understanding individualised or collective subjective experiences, meanings, and interpretations (Denzin et al., 2023). It contends that reality is a socially created idea impacted by various elements, including culture, environment, and individual viewpoints, rather than a constant, objective substance. In-depth interviews, participant observation, and content analysis are the researchers' most common qualitative research techniques used in interpretative paradigms. These techniques allow exploring the complexity of human behaviour and culture to comprehend the various nuances and contexts that influence people's actions and views. In the social sciences and humanities, interpretivism is commonly used because it works well for examining phenomena peculiar to a particular setting, cultural norms, and the various views of individuals. Creswell and Creswell (2017), posit that this paradigm enables researchers to delve deeply into the breadth and depth of human experience, which helps to provide a more nuanced explanation of intricate social processes.

3.2.3 Pragmatism paradigm

Pragmatism is a flexible research paradigm that prioritises practicality and the utilisation of the most suitable methods to address specific research questions (Kaushik & Walsh, 2019). It is a

combination of positivism and interpretivism. Pragmatists contend that selecting research methodologies should be based on the particulars of the research problem. This strategy acknowledges that a research issue may be best addressed using quantitative and qualitative methods (Creswell & Creswell, 2017). The pragmatic paradigm is flexible and may be used in various academic fields and research settings. It is invaluable when tackling intricate, real-world issues that do not cleanly fit inside the constraints of other paradigms (Gray, 2021). Pragmatic researchers strive to conciliate between the requirement of being rigorous and objective and the need to successfully address practical, applicable challenges. Pragmatism is a valuable strategy for researchers who want to tackle complex, real-world problems because of its focus on problem-solving and combining many research approaches.

3.2.4 Choice and rationale for research paradigm

This study adopted a pragmatism research paradigm. This paradigm fits the study for several reasons. First, cancer research poses inherent challenges across diverse countries, such as the EAC, characterised by variations in cancer types, healthcare systems, and sociocultural influences (Tashakkori & Teddlie, 2021). Pragmatism is an ideal framework for navigating these complexities, given its inherent capacity to swiftly adjust to real-world problems. For instance, in the dynamic landscape of health-related research within the EAC, where diverse healthcare systems and cultural norms prevail, pragmatism's emphasis on practical solutions tailored to specific regional requirements becomes paramount.

Second, pragmatism's methodological flexibility aligns with infodemiology, which draws data from various sources, including social media, databases and health records (Yardley & Bishop, 2017). This flexibility allowed the researcher to use diverse methods to gather and analyse the data as needed. Furthermore, cancer modelling in EAC demands an interdisciplinary approach. Pragmatism encourages researchers to draw on various techniques and theories from different

disciplines, often required to comprehensively tackle complex health issues (Creswell & Creswell, 2017).

In addition, pragmatism prioritises the research problem itself, advocating that the choice of methods and data sources should be driven by specific research questions and the need to address pressing health concerns (Morgan, 2022). This problem-centred focus is crucial when dealing with complex health issues necessitating tailored solutions. Moreover, pragmatism excels in balancing research rigour with practicality. In infodemiology, where the timely assessment of health information is critical for early detection and intervention, this balance is essential for providing actionable insights to benefit the EAC. Lastly, pragmatism's emphasis on community engagement and stakeholder involvement aligns well with the goals of infodemiology, which seeks to provide timely, relevant information to the local community, healthcare providers, and policymakers for effective decision-making in cancer management (Kilgallon et al., 2022).

3.3 Research approach

A research approach is a fundamental lens through which researchers perceive and investigate the world (Mulisa, 2022). It offers a framework that directs the methodologies used and captures the underlying assumptions, worldviews, and philosophies that shape the researcher's point of view. The research approach significantly shapes the research process, from the initial formulation of research questions to the gathering and interpretation of data. The main research approaches are qualitative, quantitative, and mixed methods. Each approach is discussed below:

3.3.1 Qualitative research approach

Qualitative research is a systematic and exploratory approach that seeks to understand the multifaceted dimensions of human behaviour, experiences, and social phenomena (Kyngäs,

2020). Qualitative research's rigorous and exploratory methodology is usually used to understand human behaviour, experiences, and social events. This strategy is used by researchers who want to use non-quantitative data to capture these qualities' richness, depth, and complexity. Qualitative research uses various techniques, such as interviews, observations, content analysis, questionnaires and case studies (Ricci et al., 2019). Qualitative research is interested in the "whys" and "hows" of human behaviour, as opposed to quantitative research, which primarily focuses on measuring and quantifying factors (Hamilton & Finley, 2019). According to Merriam and Tisdell (2016), this method is beneficial when researchers are investigating subjective viewpoints, cultural influences, and social circumstances that impact human behaviours and emotions.

The qualitative approach enables researchers to explore the complexities of social phenomena in great detail because of its flexibility. Researchers can thoroughly grasp the topic using open-ended questions and techniques like in-depth interviews or participant observation. Accordingly, Charmaz and Thornberg (2021), explained that the rich material that qualitative research offers frequently results in creating ideas or hypotheses. Numerous academic fields have adopted qualitative research because they highly value the complexity of human behaviour and social interactions (Mohajan, 2018).

Overall, qualitative research is a potent and adaptable method that sheds light on the complexities of social processes and human behaviour. Because of its comprehensive and inquisitive character, researchers can learn more about the meanings and settings underpinning behaviours and experiences.

3.3.2 Quantitative research approach

Quantitative research uses numerical data and statistical methods to investigate and analyse phenomena (Apuke, 2017). It strongly emphasises empirical measurement, quantification, and

the dispassionate analysis of patterns, correlations, and causal linkages. It entails the gathering of observable, quantifiable data. It prioritises data that can be measured, quantified and objectively analysed. Bloomfield and Fisher (2019) underscore that the scientific rigour of quantitative investigations centres on a robust empirical base. This reliance on concrete, observable data ensures reliability, objectivity, and replicability in drawing meaningful conclusions. It uses variables, scales, and numerical measures to describe and analyse phenomena. This focus on numerical data offers precision and clarity in conveying study findings. Generalisability is a crucial tenet of quantitative research (Yarkoni, 2022). The quantitative approach allows the use of inductive conclusions sought through careful sampling techniques and statistical analysis. Another distinctive feature of quantitative research is the search for causal links (Mohajan, 2020). This entails using statistical methods to determine how one variable affects another.

Quantitative research encompasses a range of methods, each tailored to the research questions and objectives. One of the most popular quantitative approaches is using surveys, which involves getting research data from a sample of individuals using well-structured questionnaires (Queirós et al., 2017). In surveys, data may be gathered on various foci, including attitudes, opinions, behaviours, and demographics. A vital component of quantitative research is experimental research (Mohajan, 2020) which enables researchers to change one or more independent variables to see how they affect the dependent variables. According to Bruce et al. (2018), statistical analysis is a crucial quantitative research component. Some quantitative data analysis and interpretation techniques researchers use include regression analysis, t-tests, Analysis of Variance (ANOVA), and chi-square testing (Almquist et al., 2020). These methods allow researchers to find connections between variables, test hypotheses, and make decisions based on statistical data. Another strategy used in quantitative research is secondary data analysis (Bergin, 2018). Researchers may use pre-existing datasets and secondary data sources.

This method is prevalent in epidemiology, economics, and social policy research. Numerous fields have utilised quantitative research in various ways, advancing knowledge and guiding decision-making in multiple sectors. Epidemiology in the health sciences frequently uses quantitative analysis. Epidemiologists employ quantitative approaches to investigate the incidence and origins of illnesses, assess the efficacy of therapies, and influence public health policy (Babbie, 2020). Similarly, social sciences fields like sociology and political science also heavily rely on quantitative research. Sociologists use quantitative approaches to analyse societal phenomena, such as social norms, attitudes, and inequality (Clark et al., 2021).

Despite its advantages, quantitative research has its challenges and limitations. Researchers must pay close attention to details like sample size and selection (Lakens, 2022). A limited or unrepresentative sample might induce the results' external validity. Another critical factor is data quality. To generate reliable findings, the accuracy and reliability of the data obtained must be guaranteed (Fox et al., 2022). Researchers also need to be keen about potential data collection and interpretation biases which might skew the findings and provide false conclusions. Additionally, the statistical analysis might be challenging and may need sophisticated techniques (Hariri et al., 2019).

3.3.3 Mixed Methods Research Approach

The mixed methods research approach is robust and versatile, combining qualitative and quantitative research methods within a single study (Timans et al., 2019). This approach allows researchers to draw upon the strengths of qualitative and quantitative, offering a comprehensive and nuanced understanding of research questions. According to Mulisa (2022), through quantitative research, the mixed methods gather observable, numerical data to prioritise evidence that can be measured, quantified, and objectively analysed. On the other hand, the qualitative approach allows examination of the diversity of human experiences,

comprehending context, and documenting subjective meanings. Despite their differences, these qualitative and quantitative work well together in mixed-methods research because they provide a more comprehensive viewpoint. Dawadi et al. (2021) assert that mixed methods allow the integration of qualitative and quantitative data to create a deeper and more thorough understanding of research topics. This integration can occur at different stages of the research process, including data collection, analysis, and interpretation. The mixture of qualitative and quantitative approaches in mixed methods research depends on the study's questions and goals.

There are several domains and research areas where mixed methods research is used. For instance, researchers may employ various techniques while studying patient experiences in healthcare. While quantitative surveys can evaluate the overall impact of a therapy, qualitative interviews can shed light on the patient's perspective on a medical condition (O'Cathain, 2020). Mixed methods research helps analyse complicated social processes in the social sciences. For instance, qualitative interviews can capture the unique motives and tales of migrants. However, quantitative data can reveal more general trends and patterns across many locations in a study of migration patterns (Gazzola et al., 2020). The versatility and adaptability of mixed methods research make it suited for tackling research problems that might not be wholly explored using a single methodology. Researchers from various disciplines might use integration for a more comprehensive and in-depth knowledge of challenging research challenges.

3.3.4 Choice and rationale for research approach

The study adopted a mixed-methods research approach. This approach combines quantitative and qualitative data and analysis to offer a more comprehensive picture of how information seekers use, share, and engage with cancer information. The complex and multidimensional nature of cancer occurrences was efficiently addressed by combining these two methodologies to get insights that are impossible through a single study strategy.

The quantitative aspect entailed analysis of cancer trends and information search patterns. The study employed a quantitative approach to examine temporal patterns and bibliometric indicators. The quantitative approach provided a thorough understanding of the evolution of cancer-related material in academic circles and Internet search trends. The study's qualitative aspect investigated themes from abstracts acquired via bibliometric analysis. This qualitative element deepens the analysis by revealing recurring themes and important ideas and developing patterns in research on cancer in the EAC (Xu & Zammit, 2020).

The combination of quantitative metrics with qualitative subtleties creates a holistic view of the study. In addition to offering a more precise grasp of the underlying themes and dynamics, this provided light on the changing environment of cancer knowledge. This mixed-methods approach allowed the study of the issues surrounding cancer infodemiology in the EAC by bridging the gap between scientific discourse and community participation.

3.4 Research design

Research design is a crucial and systematic blueprint that outlines the structure and methodology of a research study (Dannels, 2018). It serves as the framework for organising, carrying out, and evaluating research investigations. It helps researchers make wise judgements on how to respond to their research questions or hypotheses, define the scope of their study, and choose acceptable data-gathering techniques. The choice of research design depends on the study's unique environment and research aims. The validity, reliability, and generalisability of a study's conclusions depend on the research project's design, which must be well-structured. It also offers rigour and transparency, allowing other researchers to assess and expand upon the study's findings.

The study used a mixed method approach which has several research designs that govern it. These designs are discussed here under.

3.4.1 Exploratory sequential design

Exploratory sequential design is distinguished by a two-phase procedure (Alkhourayyif & Weir, 2018). This design starts by gathering and analysing qualitative data, followed by collecting and analysing quantitative data. This design's primary goal is to conduct qualitative research first to get a thorough grasp of a subject before conducting quantitative research to reinforce or broaden the preliminary qualitative findings (Creswell & Creswell, 2017). Researchers begin gathering and analysing qualitative data in the first stage of this approach. The methods used to collect this qualitative data frequently include interviews, focus group discussions, and content analysis. The main concerns are understanding the study issue's intricacies, experiences, and context. Themes, patterns, and insights that may take time to be evident through a quantitative method are frequently discovered through qualitative research.

The prioritisation of qualitative data is one of the main aspects of this design (Guest et al., 2011). Researchers understand the need to examine the study issue, and qualitative data offers the depth and context required. The rich story and detail in qualitative data frequently contributes to developing a solid knowledge base regarding the subject of the study.

The exploratory sequential design acknowledges the need to integrate qualitative and quantitative techniques. The experimental nature of the qualitative phase enables researchers to identify essential themes, create hypotheses, and thoroughly comprehend the study subject. By providing statistical support and more generalisability, the succeeding quantitative phase strengthens and broadens the qualitative findings (Onwuegbuzie & Johnson, 2016). Additionally, it enables a thorough and all-encompassing investigation of complex research problems. This research design is frequently used in real-world settings to investigate and evaluate complex topics in the social sciences, healthcare, and education sectors. The exploratory sequential design is a potent mixed methods research strategy that begins with

gathering and analysing qualitative data to investigate a topic thoroughly and is then followed by gathering quantitative data to confirm and generalise the original qualitative results. This strategy offers a thorough and well-rounded approach to research by combining both qualitative and quantitative methodologies.

3.4.2 Embedded design

Embedded design is characterised by the dominance of one data-gathering technique - either quantitative or qualitative - while the second method is embedded to offer supplemental context (Zoellner & Harris, 2017). The embedded dataset helps to supplement and enhance the study findings in this design, which prioritises one dataset and assigns it a significant function. According to Almeida (2018), embedded design is instrumental when the parts of the two data-gathering techniques are distinct. The embedded method is frequently used to provide additional insights, context, or validation, while one approach is considered the primary source of data that addresses the main research issue (Creswell & Creswell, 2017).

For instance, the embedded design may include a central quantitative survey to evaluate the efficacy of a health intervention in a study environment (Dopp et al., 2019). In this instance, the qualitative component may be formed by gathering patient narratives or qualitative feedback to give a deeper insight into how the intervention affected people's lives. When one approach cannot fully meet the research objectives, the embedded design is a wise strategic move. According to Tashakkori and Teddlie (2021), using the supplemental dataset improves the research's overall quality by adding qualitative depth or quantitative validation.

The embedded design has real-world applications in many sectors, including education, public health, and programme assessment. When qualitative data can provide in-depth explanations and context regarding the execution and impact of a programme, quantitative data may offer statistical insights into the programme's results, this is very advantageous (Palinkas et al.,

2015). This design demonstrates that quantitative and qualitative approaches have particular strengths and may be successfully integrated to offer a more thorough knowledge of challenging research problems. It also emphasises the importance of thoughtfully integrating and prioritising data sources while doing mixed methods research (Reilly & Jones, 2017).

The embedded design is helpful in mixed methods research where one data-gathering technique is prioritised, and the other is incorporated to increase the breadth and context of the investigation. It gives researchers a practical means to make the most of both the strengths of quantitative and qualitative data, providing a more thorough view of research problems across various fields.

3.4.3 Explanatory sequential design

The explanatory sequential design is characterised by a two-phase process that starts with gathering and analysing quantitative data and continues with collecting and analysing qualitative data. This design's primary goal is to use qualitative data to explain, contextualise, or elaborate the initial quantitative findings, primarily when unexpected results are found (Creswell & Creswell, 2017). Researchers begin the first stage of this approach by gathering and analysing quantitative data. The quantitative data is frequently collected through data mining techniques, tests, or structured questionnaires. Researchers measure variables, evaluate statistical correlations, and provide numerical results illuminating the study subject. Preliminary results or hypotheses are frequently generated from this early step (Spiers et al., 2018).

Explanatory sequential design's emphasis on using quantitative data as the basis for research is one of its distinguishing characteristics. Quantitative data provide the foundation for the study. After the quantitative phase, the second step comprises gathering and analysing qualitative data. Qualitative data is collected using procedures like interviews, focus group discussions, or

content analysis, by revealing the study issue's contextual and subtle features. The main goal is to employ qualitative information to develop further or explain the quantitative results. According to Creswell and Creswell (2017), qualitative data may explain the "why" and "how" underlying quantitative findings. The explanatory sequential design is instrumental when researchers encounter unexpected or complex quantitative data requiring more investigation and comprehension. Insights into the experiences, viewpoints, or contextual elements that underpin the observed quantitative findings can be gained from the qualitative data gathered in the second phase. This method acknowledges that combining quantitative and qualitative data can provide a comprehensive view of research issues by ensuring that quantitative data is supported by the depth and context offered by qualitative insights (Spiers et al., 2018).

3.4.4 Convergent parallel research design

Convergent parallel design concurrently gathers and analyses both quantitative and qualitative data, providing a complete view of research problems (Pardede, 2019). This method emphasises collecting complementary data, giving both datasets equal weight and then independently analysing them. After that, the datasets are compared and combined to present a comprehensive analysis of the research issue from both quantitative and qualitative perspectives (Bergin, 2018). Convergent parallel design allows the simultaneous collection of both types of data, one distinctive aspect. Researchers concurrently collect quantitative and qualitative data to prevent one data type from dominating the study process. This emphasises how crucial both data sources are in understanding the study issue. The qualitative and quantitative datasets are separately analysed after data collection. According to Demir and Pismek (2018), convergent parallel design allows different analytic methods to be used by researchers depending on the type of data. It acknowledges the distinctive qualities of each dataset and prevents data merging during the analysis phase; this separation enables a focused examination of each dataset's specific advantages and disadvantages.

Convergent parallel design has several real-world applications, including social sciences, education, healthcare research, and programme assessment (Zoellner & Harris, 2017). For instance, in healthcare research, qualitative data may comprise patient interviews to delve into their thoughts and experiences, whereas quantitative data might relate to clinical metrics. Converging these datasets enables healthcare professionals to understand patient outcomes and experiences, thereby enabling well-informed decision-making. While the convergent parallel design has many benefits, such as thorough insights and increased validity, it also has drawbacks. The method might be resource-intensive and calls for adequately blending data from many sources (Sharma et al., 2023). Additionally, both data formats might have complicated results that require a high level of researcher knowledge to analyse. To successfully traverse the subtleties of each dataset, researchers need to be skilled in both quantitative and qualitative methodologies or to work with experts.

3.4.5 Choice and rationale for research design

The convergent parallel design is the most appropriate research design for modelling cancer occurrences using infodemiology, where demand-based and supply-based infodemiological data was gathered. This design enables the simultaneous gathering of quantitative and qualitative data thereby comprehensively exploring the research subject from several perspectives. Data collection is critical in obtaining valuable insights into cancer occurrences, information-seeking behaviours, and online information searching and use trends. The convergent parallel design enables the simultaneous and complementary quantitative and qualitative data group.

Quantitative data was collected through bibliometric analysis, delving into scholarly publications to uncover trends in author collaborations, identify influential articles, and gauge research productivity. Simultaneously, Google Trends data was collected to quantitatively

assess public search behaviour trends over the specified timeframe, offering insights into evolving patterns of interest and awareness regarding cancer occurrences. A content analysis of sources derived from bibliometric research was conducted on the qualitative front, seeking to unravel the underlying themes, patterns, and user sentiments embedded within the scholarly literature. The thematic analysis further delves into recurrent themes, patterns, and user sentiments, providing a nuanced understanding of public perceptions, concerns, and viewpoints on cancer incidences. The convergent parallel design facilitates the seamless integration of these quantitative and qualitative datasets during the analysis phase, allowing for a synergistic comparison and contrast to derive a more comprehensive understanding. Combining the capabilities of quantitative and qualitative data sources enabled the researcher to get a comprehensive picture of how information is created, shared, and sought in the context of cancer incidences and infodemiology. The researcher acquired essential insights into the multiple facets of this critical public health issue by gathering, analysing, and combining data from bibliometrics sources and Google Trends.

3.5 Location of the study

The actual context in which a research study is carried out is known as the research location or setting (Feger & Wo, 2022). It covers the precise background, circumstances, or environments under which information is gathered, tests are run, or observations are made. Several research sites may be used depending on the sort of study and the precise subject of investigation. The study's context is shaped by the research site, which serves as its background. The study context is crucial in deciding on participants, access to critical resources, and data-collecting techniques (Wang & Li, 2022).

The study focused on the East Africa Community (EAC) nations: Burundi, the Democratic Republic of the Congo, Kenya, Rwanda, South Sudan, Tanzania, and Uganda. Numerous efforts and programmes focusing on tackling cancer management and monitoring have been

established in this region. The East African Cancer Registry Network (EACRN) significantly influenced the research setting. EACRN, founded in 2010, is essential to enhancing cancer surveillance and control among EAC member nations (Dangou et al., 2011). Standardising cancer registration procedures, improving the accuracy and comprehensiveness of data connected to cancer, and supporting cancer research and policy formulation are some of the goals of this programme. The EACRN guarantees that data from various member states are harmonised, and cross-border comparisons become more practical by promoting a collaborative environment for cancer-related data collecting and analysis. Additionally, it improves the accuracy and comprehensiveness of data connected to cancer, resulting in a study environment with more trustworthy data. The East African Cancer Consortium (EACC), which was launched in 2013 as a result of cooperation between the African Union Commission and the EAC, is another crucial initiative that guided this study. The EACC focuses on enhancing regional cancer control initiatives via research, capacity development, and the creation of regional cancer control strategies. This consortium's activities directly influence the research environment by offering a framework for cooperation and the development of research capability (East African Cancer Consortium, 2015).

3.6 Population of the study

The population of study refers to the group, components, or things that are the subject of a survey (Willie, 2022). It is a crucial component of research design since it establishes the study's parameters and decides where the data will be gathered. The population can include a variety of categories, such as people undergoing treatment for a medical problem, students at a school, or people who work for an organisation (Poscia et al., 2018). Researchers carefully select the population depending on the study's goals, the resources at their disposal, and the practicality of gathering data since this decision affects how generalisable the results are to the

intended context (Majid & Zafar, 2018). The population of this study entailed bibliometrics and Google trends populations.

The population for the bibliometrics phase of the study primarily consist of academic publications, research papers, and scholarly literature directly on Cancer in the EAC. Academic databases, journals, and repositories contain these materials and make them accessible to the public. The main goal of this population is to collect pertinent material from various academic sources that have advanced the intellectual conversation on the subject at hand. On the other hand, the population for Google Trends data was more dynamic and consisted of Internet users who have searched for information on cancer on Google. The research uses Google Trends data to provide a dynamic viewpoint by using the always-evolving online user landscape for cancer information searches. In contrast to conventional polls, Google Trends data captures the interests of a wide range of users by reflecting the varied and real-time patterns of online information-seeking activity.

Inclusion and exclusion criteria were established to ensure better representation and outcomes. For the bibliometric data, only peer-reviewed articles accessible and written in English from repositories and journals were included. This approach aimed to capture relevant scholarly literature on cancer in the EAC countries. It also did not include grey literature, which could have allowed access to government reports and policy documents providing context-specific insights into local cancer matters (Poscia et al., 2018). Moreover, delays in indexing scholarly databases may restrict the availability of very recent studies; hence, an emerging trend may not be captured (Majid & Zafar, 2018). Google Trends data were only based on public searches using cancer-related search terms in the EAC. In addition, this analysis had to rely on Internet users in Google Trends analysis by necessity, a factor that inherently excludes populations with limited internet access, especially in rural areas (Willie, 2022).

3.7 Sampling techniques

Sampling procedures are essential to research because they enable researchers to pick a subset of people or groups that correctly reflect the larger population. These steps are necessary to ensure the acquisition of representative samples that accurately reflect the traits and features of the target population. Various sampling methods are used depending on the research goals and the type of data being gathered. According to Mweshi and Sakyi (2020), a sample is a smaller, more manageable group selected to represent the wider population. Sampling entails randomly selecting a representative subset of the people to collect information and draw conclusions about the total population. Probability and non-probability sampling are the two primary subcategories of sampling procedures (Pace, 2021). Oribhabor and Anyanwu (2019), posited that probability sampling includes stratified, systematic, cluster, and simple random sampling. These methods allow the population to be randomly picked, guaranteeing that each person has an equal chance of being chosen. On the other hand, non-probability sampling includes strategies like purposive, snowball, quota, and convenience sampling that do not rely on random selection.

First, this study sampled the EAC countries. The study adopted information-oriented purposive sampling to sample the countries. From the seven (7) EAC nations, the study anticipates covering four (4) of them: Kenya, Tanzania, Uganda and Rwanda. These nations have cancer registries set up at various times with variable levels of assistance from groups like the International Agency for Research on Cancer (IARC). One of the early adopters in the area was Uganda, which created a cancer registry in 1968 (Okongo et al., 2019). Kenya, Tanzania, and Rwanda followed in 2001, 2016, and 2018, respectively (Joko-Fru et al., 2020). A cancer registry was established in Burundi in 2016; however, problems eventually led to its dissolution hence it won't be part of the study (Bagorane et al., 2023).

Secondly, the study sampled demand-based infodemiology (cancer information seeking). The study adopted a convenience sampling technique to delve into demand-based infodemiology focused on cancer information seeking within the East African Community (EAC). Specifically, the study relies on the analysis of Google Trends data, recognised as a valuable resource for scrutinizing Internet search activity, even though it may only represent a portion of the total population (Rovetta, 2021). Convenience sampling is deemed appropriate in this context as it facilitates the utilisation of readily available data sources, such as Google Trends, which provides a comprehensive dataset for tracking search trends over time. The emphasis on convenience sampling aligns with the study's goal of efficiently understanding cancer-related information-seeking habits in the EAC. In demand-based infodemiology, convenience sampling extends beyond participant recruitment and underscores digital data's uncomplicated access and utilisation. This method underscores the simplicity of acquiring Internet-based data sources like Google Trends, eliminating the need for laborious participant recruitment. It emphasises the practicality of selecting data sets rather than specific individuals in the digital realm, diverging from traditional convenience sampling practices. Convenience sampling enables the study to tap into real-time or near-real-time data streams, providing continuous insights into the dynamic landscape of information demand. Ultimately, convenience sampling underscores the ease and effectiveness of accessing online information without the logistical challenges associated with traditional participant-based sampling techniques.

Finally, for supply-based infodemiology, the study adopted purposive sampling for the population. The study used Google Scholar and PubMed databases for the study. According to Gusenbauer and Haddaway (2020), Google Scholar and PubMed are recognised for covering academic literature in various fields. This thorough coverage guarantees that the study accessed a wide range of educational resources, supporting the research objective of analysing the intellectual discourse and knowledge base related to the study problem. The fact that these

databases include a substantial selection of peer-reviewed scientific publications, research papers, and articles is another reason people value them (Sayers et al., 2019). The use of Google Scholar and PubMed databases satisfies the demand for intellectual rigour and relevance in the supplied materials, given the study's emphasis on an in-depth understanding and expertise of the research issue (Kwanya, 2020). Additionally, the accessibility, structure, and user-friendliness of these databases promote data gathering and analysis, making the sample selection feasible and resource-efficient.

3.8 Data collection techniques

Data collection techniques are key research steps used to collect data (Wiechetek & Pastuszak, 2022). Data collection techniques include questionnaire, interviews, observation, and online scraping. The research's goals, nature, and quantity of data dictate which techniques to use. Effective data collection ensures the validity and dependability of study findings (Creswell & Creswell, 2017). Researchers should carefully choose and implement data collection techniques that support the study's objectives to ensure that the data obtained is pertinent and appropriate for analysis. This study adopted the following data collection techniques:

3.8.1 Web scraping

Web scraping is a valuable method for gathering data, and it is especially pertinent when using academic databases like Google Scholar and PubMed. Web scraping enables researchers to collect data from websites. This includes publication metadata, abstracts, and other important information. Compared to labour-intensive manual data input, this technology dramatically speeds up data collection (Saaya, 2021). According to Khder (2021), efficiency is one of the main benefits of Web scraping when working with academic databases. Web scraping also makes it easier to gather complete data, giving researchers access to various scholarly publications - including those that might not be easily accessible in other ways. This extensive

coverage enables researchers to conduct more thorough analyses and tackle challenging research problems that need more data. According to Rennie et al. (2020), it is essential to emphasise the ethical issues when online scraping. Researchers must adhere to any applicable legislative restrictions regulating data collecting and the terms of service and conditions established by the websites they are scraping.

The intricate process of Web scraping involves a structured approach, commencing with crawling through the website's structure and systematically accessing search results and individual publication pages(Luscombe et al., 2022). Once on a Webpage, the scraper employs HTML parsing to dissect the Hypertext Markup Language code, extracting desired data elements such as text, images, links, or other HTML tags (Ahmed &Salam, 2023). This method is exemplified in Google Scholar, where details such as publication titles, authors, abstracts, and publication dates are gathered. Predefined rules or patterns guide extracting relevant data by identifying specific HTML tags, classes, or identifiers associated with the target information. Subsequently, the extracted data is stored in a structured format, typically a database or spreadsheet, setting the stage for further analysis and organization based on specific criteria.

3.8.2 Search engine queries

In modern research, search engine queries are a fundamental and essential method of data collection (Eysenbach, 2009). It comprises entering terms or phrases into search engines like Google directly related to their study subject (Nutti et al., 2014). These search engines set out to search and index Web pages all over the Internet using sophisticated algorithms. This approach to data collection is flexible and effective since it yields a curated list of web sources, including academic papers, reports, websites, news stories, and blogs, all of which are relevant to the search keywords (Giustini, 2019). The main benefits of search engine queries are their

rapid and ease of execution. Researchers may comb through a large and varied pool of materials in a matter of seconds. In addition to helping researchers find pertinent sources quickly, this quick procedure also acts as a preliminary step of exploration, giving them a general understanding of their study topic. The value of search engine queries also includes encouraging interdisciplinary research. For scholars, it presents a rare chance to connect disparate disciplines of study (Parti & Szigeti, 2021). This multidisciplinary method is beneficial for tackling intricate, diverse research problems that gain from a broad viewpoint. Although using search engine queries has many benefits, it is essential to recognise that a cautious and critical approach is required. There may be difficulties due to the deluge of information, and not all sources are trustworthy. To ensure the quality and reliability of the data they collect, researchers must thus use evaluative skills to evaluate the authority and applicability of the material they come across (Eysenbach, 2011).

This study used the general Google and Google Scholar search engines. These search engines were chosen due to their global ubiquity and the wealth of information they provide. They are among the most extensively utilised search engines globally. They provide a wide variety of information from news stories, scholarly papers, general online material, and other publicly accessible sources. Their efficiency comes from their capacity to quickly and thoroughly index large amounts of data, which makes it a preferred platform for gaining access to a wide range of knowledge. The researcher used specific terms associated with cancer in EAC to get data on information-seeking behaviour in cancer. The crawling on Google was done by use of the Google Trend tool that provided reports on the popularity of specific searches in the Google while the crawling on Google Scholar was done using Harzings Publish or Perish.

3.9 Data collection tools

This study employed the following data-gathering tools:

3.9.1 Google Trends

Google Trends is a tool that provides reports on the popularity of certain searches in the Google search engine. Google Trends is an effective infodemiological research tool that provides insightful data on information-seeking behaviour. As a result, researchers may better understand when and where individuals are actively looking for information on topics like health-related issues like cancer prevalence in various regions (Nutti et al., 2014). It offers statistics on search volume for specific terms across time. Additionally, Google Trends offers geographic insights by providing information on the places where search queries originate. To determine which nations or areas have the most interest in themes relating to cancer, researchers can utilise this characteristic to analyse the dynamics of information-seeking in certain places (Ginsberg et al., 2009). Google Trends also allows for comparison analysis. To find patterns and trends in the information people seek, researchers might analyse the search interest for various keywords or phrases.

The researcher entered terms and expressions associated with cancer into Google Trends (*see Appendix 3 sample search*). The search yielded detailed information on search volume over time, offering a detailed picture of times when interest in particular cancer-related topics has grown or declined. The researcher may find patterns and trends which provide dynamic insights into how EAC seek cancer information. Furthermore, temporal analysis pinpointed certain times when there is a surge in interest in cancer-related subjects, enabling researchers to find patterns and oscillations throughout a range of periods, from days to months or years. By examining linked questions, researchers can obtain further knowledge about the particular parts

of cancer that pique users' interests. This allows for a thorough and dynamic investigation of infodemiological trends within the EAC.

3.9.2 Harzing's Publish or Perish software

Harzing's Publish or Perish software is a specialised tool that plays a pivotal role in infodemiology research by facilitating bibliometric analysis (Kwanya, 2020). It enables researchers to retrieve and analyse publication data from reliable sources, such as Google Scholar and Pubmed, to gain insight into academic publications about cancer incidences in the EAC. It automatically extracts publication data from academic databases like Google Scholar and PubMed, including crucial details like article titles, authors, publication dates, and citation counts. As it offers a thorough overview of academic contributions and their significance, this information might be helpful while researching cancer research within the East African Community. Additionally, one can perform keyword research using Publish or Perish.

For instance, once set up, Publish or Perish retrieves extensive publishing data from Google Scholar by automating the execution of search queries (*see Appendix 4 sample search*). Important information, including article names, authors, publication dates, and citation counts, is included in this data. The application makes it easier to analyse and analyse the obtained data by presenting it systematically. Publish or Perish also helps with keyword research, making it possible to find important terms and phrases linked to cancer cases in the EAC. The researcher exported the collected data in various formats for additional analysis or connection with additional research instruments. Publish or Perish, at its core, provides a smooth and effective process that enables researchers to precisely and thoroughly explore the extensive panorama of academic papers on cancer in the EAC.

3.10 Data collection procedure

The data collection began by formulating the search terms that were used for collecting data using Google Trends and Harzing's Publish or Perish. The search terms were formulated from the concept of information seeking and production guided by the literature review and theories of the study. The search phrases in Google Trends, Google Scholar, and PubMed differed somewhat from one another, a difference largely influenced by user behaviour and indexing techniques. The majority of the words were interchangeable, while Google Scholar and PubMed had a few extras. Google Trends, for instance, shows the popularity or interest in particular phrases over time by reflecting user search activity. For example, "*Cancer Research*" contrasted with other more particular cancer-related subjects such as "*Breast Cancer*" or "*Lung Cancer*." As such, it might not show up as much in Google Trends statistics. By contrast, while publishing scientific publications, researchers and academics often refer to their work as "*Cancer research*" or "*Oncology research*." These phrases cover a wide range of cancer-related studies and research endeavours, such as epidemiology, clinical trials, fundamental science, translational research, and public health studies. Furthermore, papers are indexed in scholarly databases according to the keywords submitted by authors, publishers, or database administrators, as well as the substance of the article. In academic publications, terms like "*Cancer research*" and "*Oncology research*" are frequently used to describe and categorise research within the larger subject of cancer studies. However, unlike academic databases, Google Trends indexes or classify search queries differently. Rather than using academic or scientific classification, it concentrates more on catching the trends in popular searches, reflecting the different search behaviours and needs of academic and non-academic users.

The words that were used for collecting data in Google Trends were: "*Cancer*", "*Breast Cancer*", "*Prostate Cancer*", "*Lung Cancer*", "*Colon Cancer*", "*Cervical Cancer*", "*Cancer symptoms*", "*Signs of Cancer*", "*Cancer risk factors*", "*Cancer treatment*", "*Chemotherapy*",

"Radiation", "Cancer prevention", "How to prevent cancer", "Cancer Screening and "Cancer awareness". These terms were searched with each EAC country (Kenya, Uganda, Tanzania, and Rwanda). This was concerning all categories of search and linked to Web search, Image search, News search and YouTube search.

The terms that were used to collect data in Harzing's Publish or Perish were: *"Cancer", "Breast Cancer", " Prostate Cancer ", " Lung Cancer ", "Colon Cancer", "Cervical Cancer", "Cancer symptoms", "Cancer risk factors", "Cancer treatment", "Chemotherapy", "Radiation", "Cancer prevention", "Cancer Screening", "Cancer awareness", "Cancer research", "Oncology research", "Cancer prevalence", Cancer Epidemiology", "Cancer burden", "Cancer surveillance" and "Cancer diagnosis".* These terms were searched in the title words of the tool in combination with the EAC countries (Kenya, Uganda, Tanzania and Rwanda).

Before data collection, the researcher presented the research proposal for clearance by the Technical University of Kenya. The Technical University of Kenya's School of Graduate and Advanced Studies (SGAS) provided a pertinent letter for the clearance procedure. The letter was used to apply for a research permit with the National Commission for Science, Technology, and Innovation (NACOSTI). Although the research wholly uses online data, the researcher processed an ethical clearance letter from an institutional review board. When these letters were ready, the researcher began data collection by conducting a pilot study.

3.11 Pilot study

A feasibility study or pilot study is a preliminary research inquiry that is an essential first step before starting a more extensive research effort. Its main goal is to test and improve different aspects of the data gathering and research process. This preliminary investigation helps researchers see and address any problems, difficulties, and constraints that could appear during the primary research endeavour, thereby improving the overall effectiveness and quality of the

study. According to Ismail et al. (2018), one of the primary goals of a pilot study is to evaluate the appropriateness and efficacy of the research instruments, such as questionnaires, surveys, or methods for data collection. This assessment aids in figuring out whether these tools can correctly capture the desired data. It helps to spot any misunderstandings or challenges respondents could experience when submitting information. According to Thabane et al. (2019), a pilot study allows researchers to learn more about their research design's viability and assess the usefulness of the sample size they have selected and any potential difficulties with data collection and analysis.

The researcher conducted a pilot study using the same data collection tools with one EAC country. The pilot country was Uganda. Despite being the early adopter of cancer registries Uganda is ranked 4th among the sample countries in terms of Internet penetration by January 2023 (Galal, 2023). The Internet penetration by the sampled EAC countries is Kenya (32.7%), Tanzania (31.6%), Rwanda (30.5%) and Uganda (24.6%). Additionally, Uganda was still used for final data collection but the data collected during piloting was not used instead new set of data was collected with updated search terms. The use of new search terms ensured the relevance and accuracy of the findings in line with other EAC countries. Appendix 5 shows the report of the data collected from the pilot study. The data gathered from Google Trends was used to improve the search terms by adding new terms and removing the terms that did not have value for the research in terms of getting to understand the cancer information seeking behaviour. The value of search terms for Google Trend was based on understanding cancer information-seeking behaviours. The terms had to align closely with the research objective, which was to understand how users seek cancer information. This led to the need for terms focusing on specific cancer types, symptoms, treatments, and awareness campaigns. The terms that were removed were: "*Types of Cancer*", "*Cancer information search trends*", "*Cancer statistics*", and "*Cancer Registry*". For example, the search term "types of cancer" was

removed and broken down to five types of cancers that are predominant in the East Africa region based on the literature review (De-Martel et al., 2020; Ferlay et al., 2021; Mery et al., 2020). This was done because using the search term limited recall of information about each of these types of cancers. The terms that were added were: "*Breast Cancer*", "*Prostate Cancer*", "*Lung Cancer*", "*Colon Cancer*", "*Cervical Cancer*", "*Cancer symptoms*", "*Signs of Cancer*", "*Cancer risk factors*", "*Cancer treatment*", "*Chemotherapy*", "*Radiation*", "*Cancer prevention*", "*How to prevent cancer*", "*Cancer Screening* and "*Cancer awareness*".

For Harzing's Publish or Perish, the search terms were also updated to fit issues around cancer information production. For example, the search term "cancer research" was added to assist in retrieving research output in the EAC on cancer from Google Scholar and PubMed. The updated search terms facilitated more clarity, relevance, and efficacy, which improved data gathering and study findings.

3.12 Data analysis and presentation

Data analysis is the methodical application of statistical and logical techniques to explain, condense, synthesise, and evaluate data. It includes a variety of procedures that make it easier to get inductive insights from data while identifying significant patterns (Maharana et al., 2022). According to Parish and Edmondson (2019), data presentation includes the rigorously analysed study data's visual, graphical, textual, and pictorial representation. To make the data more accessible to display and research later, the study's data was divided into quantitative and qualitative categories.

3.12.1 Quantitative data analysis and presentation

The research acquired quantitative data like search volume trends from Google, depicting how frequently users search for specific cancer-related keywords. Geographic insights pinpoint regions with the highest search volumes, while related queries provide additional context by

revealing associated terms and topics users explore alongside cancer-related searches. From Harzing's Publish or Perish, the researcher got publication data encompassing article titles, authors, publication dates, and citation counts.

After collection, the data was screened as a preliminary step in data cleaning and filtering. The dataset was carefully examined to identify any glaring errors or inconsistencies. The primary goal of screening is to detect and flag anomalies that could distort the analysis and conclusions drawn from the data. After the screening, the data was analysed statistically with the help of Statistical Package for the Social Sciences (SPSS) version 26 and STATA version 16. Statistical analyses included descriptive measures, and correlations to provide comprehensive insights. The utilisation of SPSS and STATA ensures methodological rigour and precision in data interpretation. Tables were used to present specific numerical data, and graphs—such as bar charts or line graphs—were used to show patterns and trends. This two-pronged strategy improves comprehension and makes communicating intricate infodemiological findings on cancer incidence in the EAC countries easier.

3.12.2 Qualitative data analysis and presentation

The qualitative data for this research was gathered from academic materials related to cancer. The main focus was on the titles and abstracts, which helped to capture essential themes and concepts within the literature. The material extracted consisted scholarly articles on cancers in EAC mainly journal articles, conference papers, and reports. In extracting this material, only the titles and abstracts were used to avoid redundancy from full-text analyses. Titles of selected academic publications were collected to identify common keywords and phrases that indicate the primary focus of the research. Meanwhile, the abstracts concisely summarised research objectives, methodologies, findings, and implications. The data was cleaned to remove irrelevant or redundant information, including stop words and duplicates.

The cleaned qualitative data underwent thematic analysis, a systematic approach to identifying patterns, themes, and recurring words within the dataset. This analysis involved familiarising with the data, initial coding of key terms and phrases, and the development of broader themes encapsulating major findings. The researcher utilised Atlas.ti Version 9 for coding and organising the qualitative data, while VOSviewer visualised the relationships between different themes and keywords.

The presentation of qualitative findings involved a variety of techniques, such as using quotes to exemplify particular sentiments or viewpoints, discovering and illustrating thematic patterns to provide a structured understanding of the data, and creating word clouds to represent the frequency and importance of particular terms visually. The qualitative data extraction and analysis provided valuable insights into cancer research in the EAC, revealing trends, gaps, and emerging themes that inform the broader understanding of the region's cancer information demand and supply.

3.13 Reliability and validity

Data quality and trustworthiness are influenced by reliability and validity (Mohajan, 2020). Data consistency and stability are the main reliability concerns, which ensure that measurements provide comparable findings when repeated in identical circumstances. Conversely, validity is concerned with the veracity and correctness of data, validating that the measuring tool accurately evaluates the intended notion. These concepts are crucial in research approaches like infodemiology, which collects and analyses data from various sources, including Google Trends and Harzing's Publish or Perish. For inferences to be relevant and trustworthy, the accuracy and validity of the data must be guaranteed (Rahman & Shiddike, 2020).

3.13.1 Reliability

In infodemiology research, ensuring the accuracy of data gathered from resources like Google Trends and Harzing's Publish or Perish is crucial. One method of determining data consistency is test-retest reliability (Park et al., 2018). Researchers can find out if the information consistently represents information-seeking habits related to cancer incidences by carrying out several searches using the exact search keywords at different times. For the study, the researcher first identified pertinent search terms that represent trends in academic publication and information-seeking behaviours. After that, a preliminary search on Google Trends and Harzing's Publish or Perish was done, noting the outcomes. The researcher reruns the searches using the precise terms after a specific time and the outcomes of the retest were noted. Statistical analysis like correlation coefficients to gauge further the consistency of the original and retest data from both sources were employed.

The researcher gathered data from sources like Harzing's Publish or Perish; hence, inter-rater reliability is crucial (McDonald et al., 2019). This entails establishing standardised data-gathering processes and procedures to reduce variances from various data collectors. When utilising Google Trends and Harzing's Publish or Perish consistency in terms of search criteria is critical for the accuracy of the data. Additionally, it is crucial to maintain methodological consistency in data-gathering techniques, including employing the same search criteria and phrases on both platforms. The accuracy of data gathered from Google Trends and Harzing's Publish or Perish can be impacted by even modest fluctuations in these factors. To ensure methodological consistency, the researcher set clear objectives and used standardised search phrases to ensure accuracy and relevance to academic publishing patterns and information-seeking behaviours while gathering data using Google patterns and Harzing's Publish or Perish. To further promote consistency, the researcher used comparable regional settings on Google Trends, record measurements methodically, and selects regular periods for data gathering.

Finally, the data's credibility and dependability are increased by cross-verifying. The researcher started by ensuring that the search terms appropriately reflect the subject of the study and are aligned between the two data collection tools. The researchers found patterns and inconsistencies and concurrently examine data trends from the two sources over periods. They further used statistical measurements to determine how much information-seeking behaviour and academic publishing trends are correlated. Furthermore, the researcher verified consistency by cross-referencing individual data points, such as particular search ranks or publishing metrics.

3.13.2 Validity

To guarantee the authenticity and dependability of the data for infodemiology research, it is necessary to maintain the validity of data gathered from sources like Google Trends and Harzing's Publish or Perish. Content validity is crucial in Harzing's Publish or Perish, where scholarly articles and citations are retrieved. According to Almanasreh et al. (2019), content validity guarantees that the data-collecting tool, including search criteria and filters, accurately assesses the desired notion. As it directly pertains to cancer research within the East African Community, using well-defined search criteria and filters is crucial to guaranteeing the content validity of the data.

Criterion-related validity is another aspect to consider (Abdelkarim et al., 2021). In the study, the researcher used cross-referencing and fact-checking the retrieved academic papers against pre-established criteria or other reliable sources to establish criterion-related validity. This assisted in confirming the data's relevance and correctness.

According to Abdelkarim et al. (2021), construct validity evaluates how well a measuring tool corresponds to the theoretical construct it is meant to assess. The research used search phrases and queries consistent with the study - information-seeking behaviours related to cancer

incidences in the EAC - to ensure construct validity in data. Also, the study adopted concurrent validity. Concurrent validity assisted in measuring how well one assessment tool corresponds to the other (Keating et al., 2019). To determine the contemporaneous validity of the data, the researcher compared Google Trends search trends with information from academic databases like Harzing's Publish or Perish.

3.14 Ethical considerations

In infodemiology research, ethical issues are crucial, especially in the digital environment where health information is shared and accessible widely. Some of the ethical considerations for this study were:

3.14.1 Anonymisation and de-identification

An essential method for preserving people's privacy in research is anonymising and de-identifying data (Morley et al., 2020). Personally identifiable information (PII), such as names, addresses, or other identifying information, were removed or encrypted if they appeared in the data collected from Google. The goal is to make the data anonymous, making it difficult to link it to particular people. This protection guarantees adherence to data protection laws and respect for privacy. In the end, anonymisation balances the study's goals and the preservation of people's personal information by enabling researchers to work with valuable data while lowering the danger of privacy breaches.

3.14.2 Data minimisation

Data minimisation is crucial to balance gaining valuable insights and preserving people's privacy. This study collected the exact information needed to answer its inquiries on health information trends (Rizi & Seno, 2022). This strategy ensures that data collection is motivated by a specific goal and adheres to the ethical rule of only collecting data required to achieve the

intended research goals. In the digital era, it protects against overreach and aids in maintaining the delicate balance between public health research and private privacy rights.

3.14.3 Responsible data use

Responsible data use is a crucial ethical consideration when gathering data from Internet sources (Ienca & Vayena, 2020). Ensuring that data gathering supports the specified study aims is the fundamental tenet. To accurately target the necessary information, researchers must carefully choose search phrases. For instance, the search keyword for this study were strictly adhered to. Inappropriate or too wide search words may lead to the capture of irrelevant data and, more importantly, may mislead the investigation (Stahl & Wright, 2018).

3.14.4 Ethical clearance from Institutional Review Board

Ethical approval for the study is unnecessary because data was collected in aggregate form with no person-identifiable information (Calleja et al., 2021; Ciaffi et al., 2021). Even in this scenario, obtaining ethical clearance from an Institutional Review Board (IRB) is crucial for upholding ethical standards; hence, the study applied for ethical clearance from IRB. The IRB ensures privacy protection and ethical conduct by enforcing stringent requirements for informed consent and transparent communication about the study's purpose and data usage (Bauman et al., 2020). Emphasising the commitment to fair and respectful data use, the IRB's oversight extends to data security, obligating researchers to implement robust measures to safeguard against unauthorised access and anonymise sensitive information (Smith et al., 2020). Continuous monitoring by the IRB is vital to address ethical considerations in the dynamic nature of online research responsibly (Carniel et al., 2023). Transparent reporting, facilitated by the IRB, fosters trust in the research process, and the external accountability it provides guarantees the maintenance of ethical standards, reinforcing the ethical integrity of the study (Haasian, 2023).

3.15 Chapter summary

The chapter extensively viewed the study's research methodology and philosophical foundations. It emphasised the role of research methodology, encompassing study design, data collection techniques, and ethical considerations, in shaping the research process. The chapter introduced philosophical assumptions, including epistemological, ontological, axiological, and methodological perspectives, highlighting their profound influence on data interpretation and research techniques. It explored three primary research paradigms: positivism, interpretivism, and pragmatism, with pragmatism deemed the most suitable for the dynamic, multidisciplinary, and pragmatic nature of health-related research. The chapter introduced qualitative, quantitative, and mixed methods research approaches, each serving distinct purposes. For this study, a convergent parallel design was adopted, enabling the simultaneous collection of quantitative and qualitative data to understand information-seeking behaviours and online trends related to cancer. The study population comprised academic publications, research papers, online content related to cancer (bibliometric population) and Internet users seeking cancer-related information (Google search population). Various sampling techniques were applied, including purposive and convenience sampling. Data collection involved Web scraping from sources like Google Scholar and PubMed, alongside search engine queries using tools like Google Trends. Data analysis combined quantitative and qualitative methods, employing software such as SPSS, Atlas.ti, and VOSviewer. Data presentation included tables, graphs, quotes, thematic patterns, and word clouds. Reliability and validity were ensured through consistency testing and various validity assessments. Ethical considerations encompassed data anonymisation, minimisation, and responsible data use.

CHAPTER FOUR

DATA ANALYSIS AND PRESENTATION

This chapter presents the researcher's data analysis, presentation, and interpretations. The data was analysed according to the study's objectives and research questions. This entailed exploring the intricate landscape of cancer-related information-seeking behaviours and information production across the EAC countries. The study used Google Trends to show digital footprints of cancer information-seeking alongside Harzing's Publish or Perish, which sheds light on the scholarly output. The search was performed between 1st to 12th April 2024 using the pre-formulated search terms for information seeking behavior and documents produced between 2004 and 2023.

Google Trends tool, the data was collected to show information interest through Web, news, image and YouTube searches. In terms of category, the search terms were linked to the health category and the specific country since this study is interested in health-related information-seeking behaviour. Google Trends has provided data for Web searches since 2004, while data for image, news, and YouTube searches was only available from 2008. The data was divided into four sets namely: interest over time, interest by city, related topic, and related queries.

The interest over time dataset shows how the popularity of a search term has changed over a period. It reveals trends, seasonal variations, event-driven spikes, and long-term shifts. The interest by city dataset highlights the geographic distribution of searches, indicating which cities or towns have the highest relative search activity. This helps to identify regional variations and localized concerns. It is important to note that "interest by city" does not necessarily mean these areas have the typical characteristics of cities. Instead, it simply indicates higher relative search activity within those geographic boundaries, which can be towns. The related topics dataset provides insights into other topics of interest related to the

primary term, helping to understand the broader context of search behaviour. The related queries dataset shows other search queries commonly searched alongside the primary term, identifying specific questions or concerns related to the main topic. All these datasets were in the form of relative search volume (RSV), which measures the proportion of searches for a term relative to the total number of searches on Google over time and across locations. It is usually scaled from 0 to 100, where 100 represents the peak popularity of the term.

Harzing's Publish or Perish software was used to mine the informetric data from Google Scholar and PubMed databases. The search terms were entered in the "Title words" tab to retrieve all scholarly work published using all the search terms. The retrieved data was analysed using descriptive statistics, inferential statistics and thematic analysis techniques.

4.1 Cancer information search trends in the East African Community countries

The first objective of the study was to investigate how people seek cancer-related information. The data from the search terms are presented hereunder.

4.1.1 Cancer search term

The first term was to obtain the digital footprints of people searching for the term "*cancer*" on the Web, news, images, and YouTube.

4.1.1.1 Cancer search interest over time

For the cancer search interest over time, for the Web search, Figure 5 shows the search interest over time. For Kenya, the highest searches were in June 2005 (100), November 2004 (98), July 2019 (74), May 2005 (72) and August 2019 (71). For Tanzania, the highest Web searches were in March 2010 (100), September 2010 (75), October 2011 (69), August 2020 (68) and December 2010 (66). For Uganda, most of the Web searches were from November 2011 (100), July 2008(37), March 2009 (34), September 2009 (34) and October 2009 (32). For Rwanda,

the highest searches were from August 2022 (100), June 2011(82), May 2011(72), August 2020 (53) and February 2019 (40).

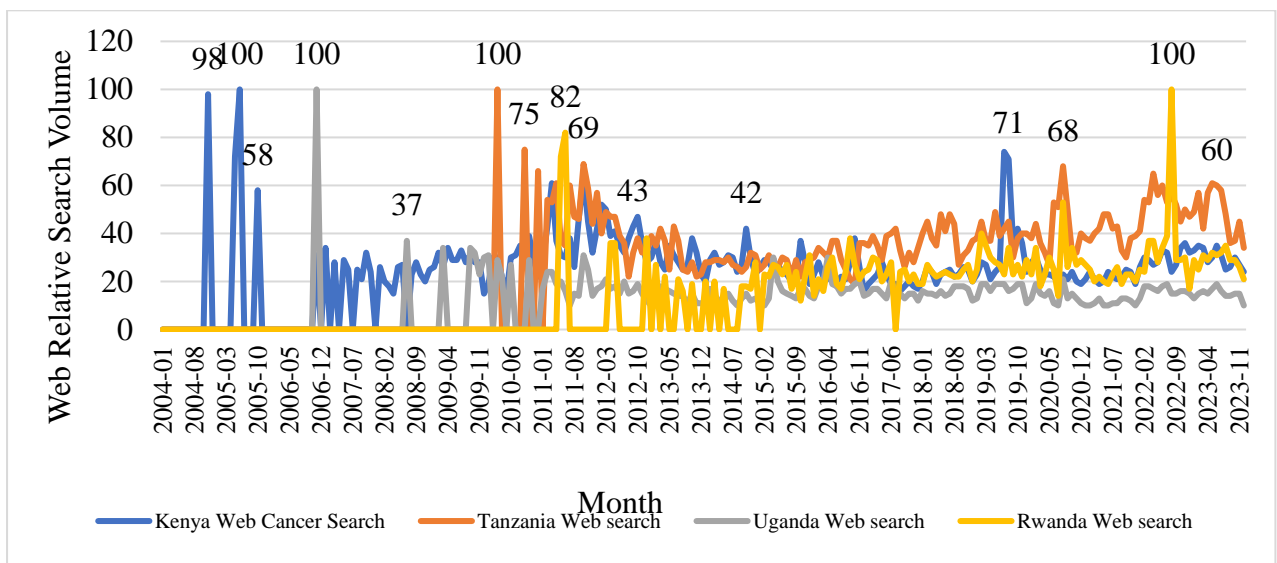


Figure 5: Cancer Web search over time for Kenya, Uganda, Tanzania and Rwanda

From this data, the year that appeared to have the highest search interest was 2011(4). This was followed by thrice in 2009, 2010, and 2019. Years 2004 and 2020 appeared twice, while 2008 and 2022 appeared one time. The months that appeared most were August (4), followed by March, May, June, July, September, October, and November, which appeared twice each. The months of February and December appeared only once, while January and April did not appear in the highest interest Web searches for all four countries.

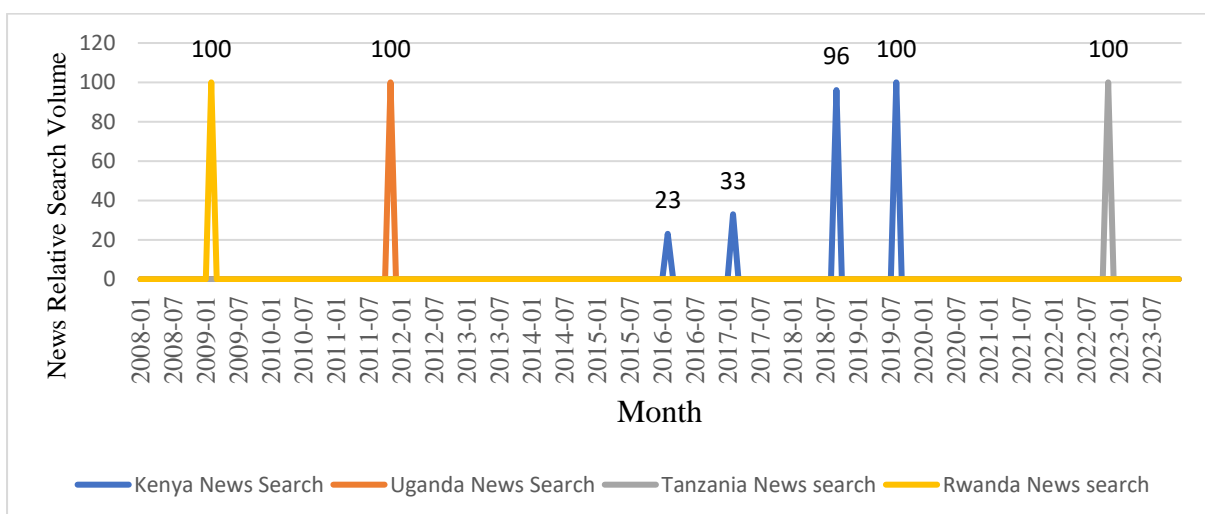


Figure 6: Cancer news search over time

Figure 6 shows cancer information seeking in terms of news. Kenya only had four peaks. The highest month was August 2019 (100), followed by September 2018 (96), February 2017 (33) and February 2016 (23). The rest of the months and years did not attain any news searches. For Uganda, the only month that had the search was November 2011 (100). The rest still need to attain a search. For Tanzania, the month of November 2022 (100) was the only one that had a search, while for Rwanda, only the month of February 2009 (100).

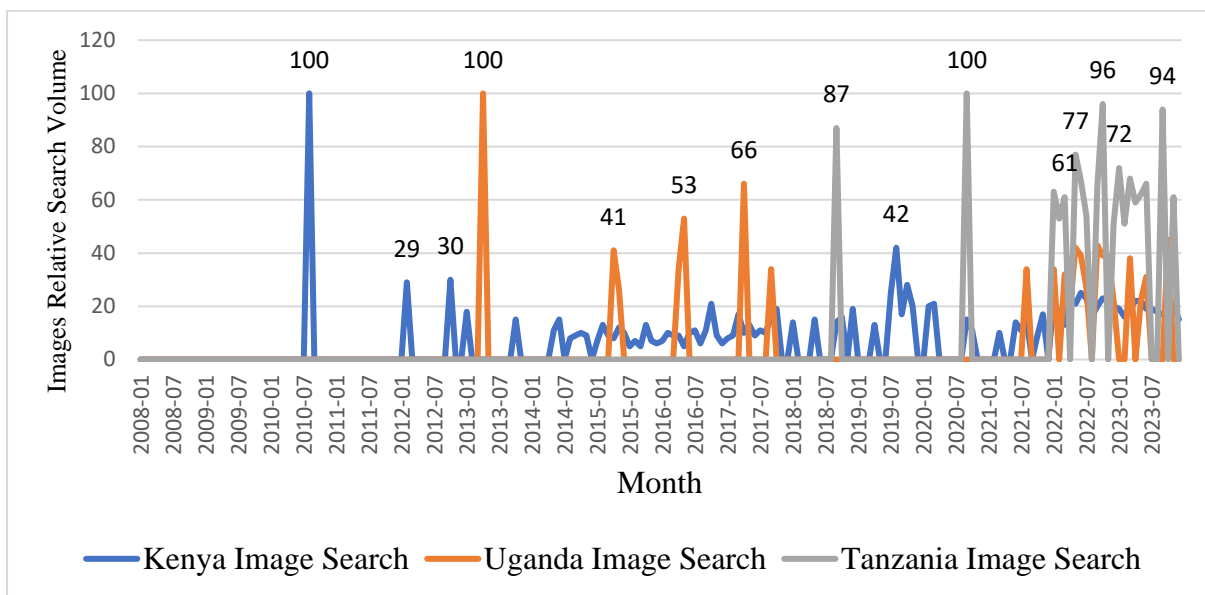


Figure 7: Cancer image search over time

From Figure 7, the month that has the highest cancer image search in Kenya was August 2010 (100). This was followed by August 2019 (42), October 2012 (30), February 2012 (29) and October 2019 (28). For Uganda, the month that had the highest cancer image search was April 2013 (100). This was followed by April 2017 (66). The other high searches were recorded in May 2016 (53), October 2023 (45) and September 2022 (43). For Tanzania, those who searched more about cancer in terms of images came from September 2020 (100). This was followed by October 2022 (96), September 2023 (94), September 2018 (87) and May 2022 (77). Rwanda did not have any searches for images in terms of cancer.

The collected data reveals that October and September had the highest frequency of mentions, each appearing four (4) times. April, May and August were mentioned twice, suggesting a

moderate level of search activity. February had the lowest frequency, with one mention. Overall, October and September emerged as the months with the highest number of mentions within the dataset. In terms of the years, the year the year 2022 had the highest frequency of mentions, with three (3) appearances. Following closely, the years 2012, 2019 and 2023 each had two mentions. The year 2010 was mentioned once, along with the years 2013, 2016, 2017, 2018 and 2020, each with a single mention.

The dataset for the people who searched YouTube about cancer was only available from 2008.

Figure 8 shows the search interest.

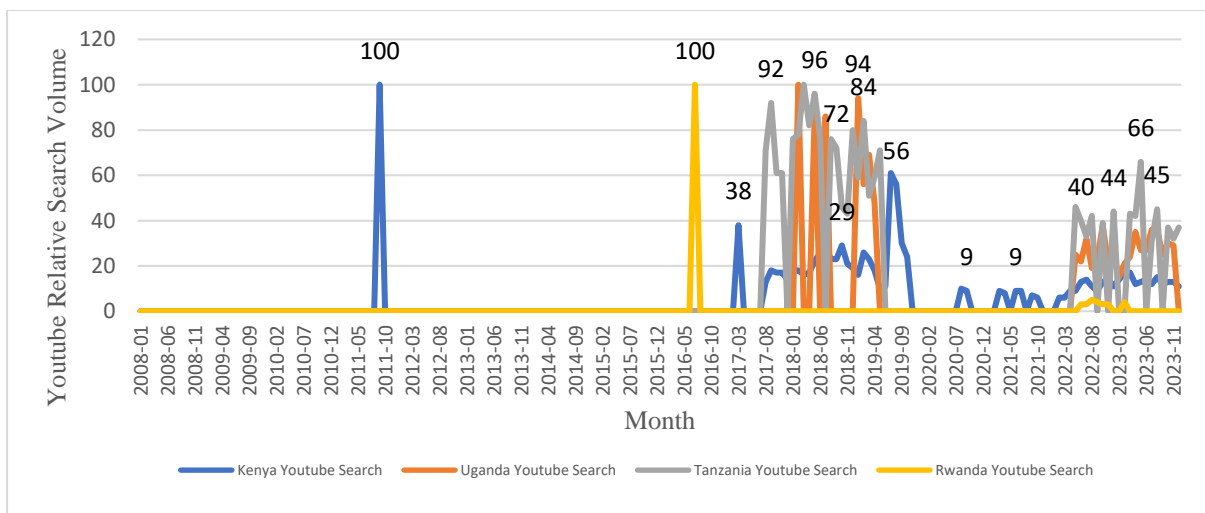


Figure 8: Cancer search on YouTube over time

From Figure 8, the month with the highest YouTube search volume for Kenya was September 2011, with a search volume of 100. July 2019 followed with a search volume of 61, and August 2019 had a search volume of 56. March 2017 had a search volume of 38, while September 2019 had a search volume of 30. For Uganda, February 2018 had the highest search volume of 100, followed by January 2019 with a search volume of 94. May 2018 had a search volume of 87, while July 2018 had a search volume of 86. March 2019 showed a search volume of 69. For Tanzania, the month with the highest search volume was March 2018, with a search volume of 100, followed by May 2018, with a search volume of 96. September 2017 had a search volume of 92, and February 2019 showed a search volume of 84. In April 2018, the search

volume was 82. Lastly, for Rwanda, the month with the highest search volume was July 2016, with a search volume of 100. In comparison, other months showed significantly lower search volumes, with August 2022 having a search volume of 5, September 2022 showing a search volume of 4, and February 2023 also having a search volume of 4. Additionally, June 2022 had a search volume of 3.

From the data, the months with the highest frequency were September, which appeared four times, followed by February, March, and July, each thrice, in the YouTube cancer search. May and August appeared twice, while January, April, and June each appeared once. In terms of year, the years that appeared most often were 2018 and 2019, with six (6) appearances. The year 2022 appeared three times, while 2017 appeared twice. The years 2011, 2016, and 2023 each had one mention.

4.1.1.2 Cancer search interest by city

The data on the Web, news, images and YouTube searches for cancer-related topics across several cities in Kenya provide valuable insights into the varying levels of interest in seeking information about this health issue. Table 2 shows the data for Kenya's cancer search by city.

Table 2: Kenya cancer search interest by city

City	Web RSV	City	Image RSV	City	YouTube RSV	City	News RSV
Kijabe	100	Migori	100	Majengo	100	Nanyuki	100
Litein	70	Chogoria	79	Migori	45	Nairobi	7
Kerugoya	56	Nguluni	46	Kajiado	29		
Ngenda	53	Kitui	43	Ruaka Town	21		
Nyeri	51	Maua	36	Diani Beach	17		
Meru	50	Ruaka Town	34	Meru	17		
Machakos	50	Karatina	31	Kericho	15		
Kitui	50	Bomet	29	Njoro	14		
Karatina	50	Ndenderu	24	Rongai	14		
Eldoret	48	Garissa	21	Eldoret	13		

From Table 2, in terms of Web search, Kijabe emerged as the city with the highest search volume of 100. Litein followed with a search volume of 70, and Kerugoya ranked next with a search volume of 56. Ngenda and Nyeri scored 53 and 51. Meru had a search volume of 50. In

the data on image searches, Migori (100) stands out with a high score, indicating significant interest. Chogoria (79) follows with substantial interest, indicating notable engagement with visual content. Nguluni (46), Kitui (43), and Maua (36) also exhibit interest, suggesting varying levels of visual exploration regarding cancer. The YouTube search data illustrates Majengo's (100) predominant interest in cancer-related content. Migori (45) follows, indicating a notable engagement. Kajiado (29), Ruaka Town (21), Diani Beach (17) and Meru (17) also demonstrate some interest. In news searches, Nanyuki leads significantly with a score of 100, indicating a keen interest in staying updated with cancer-related news. Nairobi follows with a score of 7, suggesting relatively less engagement with news on this topic compared to Nanyuki.

For Uganda, the interest by the city is as indicated in Table 3.

Table 3: Uganda cancer search interest by city

City	Web RSV	City	Image RSV	City	YouTube RSV	City	News RSV
Ishaka	100	Arua	100	Gulu	100	Entebbe	100
Mbarara	48	Entebbe	72	Mbarara	56	Kampala	7
Mbale	48	Mukono	70	Jinja	49		
Kabale	43	Gulu	36	Kampala	39		
Hoima	42	Kasangati	35				
Soroti	41	Kampala	17				

From Table 3 the city with the highest Web search was Ishaka (100), followed by Mbarara (48) and Mbale (48). Kabale and Hoima recorded search volumes of 43 and 42, respectively, demonstrating considerable interest in cancer topics. Soroti rounds out the list with a search volume of 41. In terms of image search, Arua emerged with the highest search volume of 100, indicating a significant interest in visually exploring cancer content. Entebbe and Mukono had a search volume of 72 and 70, respectively. Gulu town had a search volume of 36, while Kasangati had 35. Kampala also emerged as a city where people search for visual cancer content, with a search volume of 17. In terms of YouTube searches by city in Uganda, Gulu emerged as the city with the highest search volume of 100, reflecting significant interest in watching videos related to cancer. Mbarara follows with a search volume of 56. Jinja recorded a search volume of 49, while Kampala had a search volume of 39. For news, only Entebbe

(100) and Kampala (7) had people interested in accessing news articles and updates about cancer.

For Tanzania, the interest by the city is indicated in Table 4.

Table 4: Tanzania cancer search interest by city

City	Web RSV	City	Image RSV	City	YouTube RSV	City	News RSV
Kibaha	100	Kigoma	100	Arusha	100	Dar es Salaam	100
Ihumwa	94	Ihumwa	59	Mbeya	88		
Dodoma	90	Mbeya	29	Dar es Salaam	56		
Iringa	89	Tanga	18	Dodoma	42		
Mbeya	86	Zanzibar Town	5	Zanzibar Town	41		
Mafinga	84	Arusha	5	Mwanza	40		
Makete	70	Dar es Salaam	5				
Usagara	65	Mwanza	3				
Kigwe	63						
Tanga	63						

From Table 4, in terms of city Web search, Kibaha had the highest search volume (100). This was followed by Ihumwa (94), Dodoma (90), Iringa (89) and Mbeya (86). For the image search by city, Kigoma had the highest search volume (100). This was followed by Ihumwa (59) and Mbeya (29). The city that had the highest YouTube search for cancer was Arusha (100). This was followed by Mbeya (88) and Dare es Salam (56). In terms of news, Dar es Salaam city was the only city with a search volume of 100.

For Rwanda, the cancer search interest by the city is indicated in Table 5.

Table 5: Rwanda cancer search interest by city

City	Web RSV	City	YouTube RSV	City	Image RSV	City	News RSV
Ruhondo	100	Kinazi	100	Kigali	100	Kigali	100
Huye	40	Kigali	56				
Nyakabanda	22						
Kinazi	19						
Kigali	16						
Kinigi	15						
Nyamyumba	14						
Kabuga	14						

Table 5 shows that the city that had the highest Web search was Ruhondo (100). This was followed by Huye (40), Nyakabanda (22) and Kinanzi (19). For YouTube, Only Kinanzi (100)

and Kigali (56) had searches. Additionally, for Image and News searches, only Kigali (100) had searched.

4.1.1.3 Cancer searches related topics

Google Trends also provided data on related topics and queries related to "cancer." These were data on other keywords that were often used concerning "cancer" to seek cancer-related information. Figure 9 gives the keywords of the related topic for all the countries.

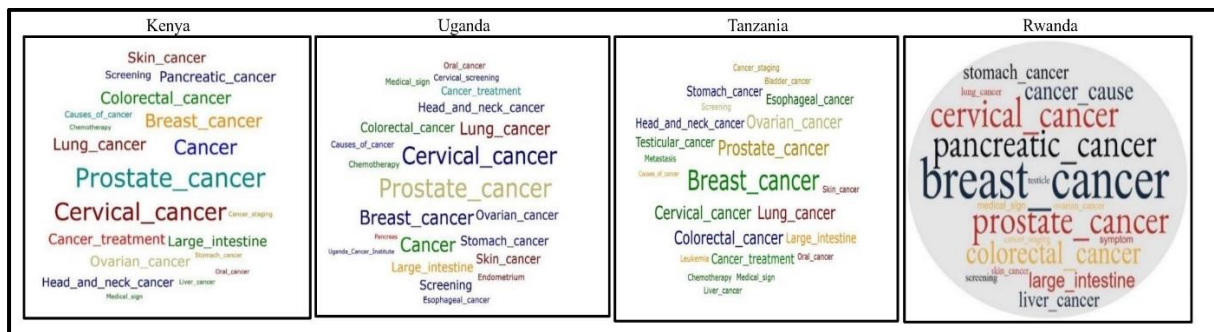


Figure 9: Related topics keywords for cancer search

Figure 9 shows other keywords that information seekers use to search for information. For Kenyan information seekers, these terms include prostate cancer (12), cervical cancer (11), breast cancer (8) and colorectal cancer (7). For Ugandan information seekers, the keywords that had the highest occurrences were prostate cancer (10), cervical cancer (9), breast cancer (7), cancer (7) and lung cancer (6). For Tanzania, the terms were breast cancer which had the highest occurrence, (10), prostate cancer, (7), cervical cancer, colorectal cancer, lung cancer, and ovarian cancer, 6. For Rwandan information seekers, breast cancer had the highest occurrence, (10), cervical cancer, pancreatic cancer, and prostate cancer, 8.

An analysis of cancer-related search keywords across Kenya, Uganda, Tanzania, and Rwanda revealed common interests and differences in information searching. Breast, cervical, and prostate cancer were among the top searched terms in all four countries, indicating shared concerns. Colorectal cancer is unique to Kenya and Tanzania. Lung cancer is notably searched

in Uganda and Tanzania, while ovarian cancer is specific to Tanzania, and pancreatic cancer is specific to Rwanda.

4.1.1.4 Cancer searches related queries

For the related queries, these were other questions information seekers asked to get cancer information. Table 6 shows the top ten queries for each country. For Kenya, the most popular queries were cancer symptoms and signs (23), breast cancer symptoms (15), cervical cancer (12) and cause of cancer (11). For Uganda, the queries that had the most occurrences were breast cancer signs (9), breast cancer (8), cancer symptoms and signs (8) and cervical cancer (8). For Tanzania, the highest queries were cancer symptoms (9), breast cancer (8), cervical cancer (6) and oesophageal cancer (6). For Rwanda, the queries that had the highest searches were breast cancer, cause of cancer, pancreatic cancer, prostate cancer, sign of cancer and stomach cancer all with 4 occurrences.

Table 6: Cancer related queries for information seekers in EAC countries

Kenya Related queries	N	Uganda Related queries	N	Tanzania Related queries	N	Rwanda Related queries	N
Cancer symptoms&signs	23	Breast cancer signs	9	Cancer symptoms	9	Breast cancer	4
Breast cancer symptoms	15	Breast cancer	8	Breast cancer	8	Cause of cancer	4
Cervical cancer	12	Cancer symptoms&signs	8	Cervical cancer	6	Pancreatic cancer	4
Cause of cancer	11	Cervical cancer	8	Oesophageal cancer	6	Prostate cancer	4
Cervical cancer symptoms&sign	8	Cancer causes	6	Breast cancer symptoms	5	Signs of cancer	4
Prostate cancer	8	Lung cancer	6	Lung cancer	5	Stomach cancer	4
Breast cancer	7	Prostate cancer	6	Prostate cancer	5	Blood cancer	2
Cancer treatment	6	Cervical cancer signs	5	Throat cancer	5	Cancer de prostate	2
Colon cancer	5	Causes of prostate cancer	4	Cancer causes	4	Cancer du col	2
Ovarian cancer	5	Penile cancer	4	Cancer treatment	4	Cancer du sein	2

(N=occurrences)

An analysis of top cancer-related queries in Kenya, Uganda, Tanzania, and Rwanda reveals common interests in understanding symptoms and causes of cancer, particularly for breast, cervical, and prostate cancer. General queries on cancer symptoms, causes, and treatment were common across all four countries. Additionally, queries on specific cancer types, such as

oesophageal, lung, ovarian, and colon cancer, varied in prominence, highlighting unique areas of concern and awareness in each country.

4.1.2 Breast cancer search term

The information seekers searched for information about “breast cancer” as explained hereunder.

4.1.2.1 Breast cancer search interest over time

Figure 10 shows the data on the frequency of Web searches on breast cancer.

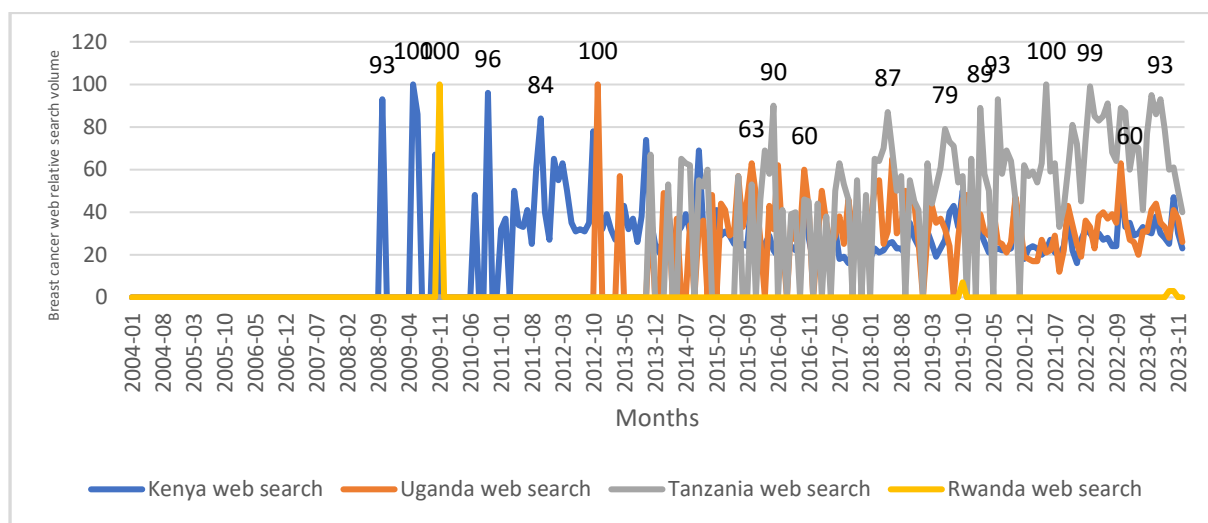


Figure 10: Breast cancer Web search over time

Figure 10 shows that search strikes began in October 2008. For Kenya, the highest search was from May 2009 (100), October 2010 (96), October 2008 (93), June 2009 (86) and October 2011(84). For Uganda, the highest Web searches came from November 2012(100), June 2018(65), October 2015 (63), October 2022 (63) and April 2016(62). For Tanzania, the highest searches came from May 2021 (100), March 2022 (99), May 2023(95), June 2020 (93) and July 2023(93). Lastly, for Rwanda, the searches only came from November 2009 (100), October 2019(7), September 2023(3) and October 2023 (3). Overall, the data reveals diverse patterns of interest in breast cancer-related searches across the years and months. Notably,

October emerged as a prominent month across multiple years, indicating heightened interest in breast cancer-related information during that month.

For news searches for breast cancer, Kenya had March 2011(100) and December 2020(22), while Tanzania and Rwanda had peak searches in December 2023 (100) and April 2020(100), respectively.

For image searches, in Kenya, breast cancer image searches were in August 2008(100), October 2023(4), November 2023(4), October 2016(3), October 2022(3), November 2022(3), January 2023(3), June 2023(3), October 201 (2), November 2016,(2) and May 2022(5). For Tanzania, the searches only came from April 2011(100) and May 2013(18). Uganda and Rwanda did not have data for image search.

Only Kenya and Uganda demonstrated interest over time in YouTube searches. For Kenya, the searches were in September 2018 (100), October 2018 (100), November 2018 (86), October 2022 (35), and October 2023 (33). Uganda only had searches in December 2018(100), while Rwanda had searches in October 2008(100).

4.1.2.2 Breast cancer search interest by city

The data also revealed the cities from which the searches were conducted for each country. In Kenya, the Web searches were mostly conducted in Machakos (100), Eldoret (92), Thika (80), Juja (78) and Kisumu (76). The YouTube searches were done in Machakos (100), Meru (94), Juja (48) and Kisumu (47). The image searches were in Kisumu (100), Nakuru (80) and Athi River (67), while news searches only came from Nairobi (100). Table 7 presents the data.

Table 7: Breast cancer interest by city in Kenya

City	Web RSV	City	YouTube RSV	City	Image RSV	City	News RSV
Machakos	100	Machakos	100	Kisumu	100	Nairobi	100
Eldoret	92	Meru	94	Nakuru	80		
Thika	80	Juja	48	Athi River	67		
Juja	78	Kisumu	47	Mombasa	26		
Kisumu	76	Eldoret	31	Thika	25		
Kiambu	69	Kiambu	22	Nairobi	22		
Ruiru	67	Nairobi	14				
Nakuru	62	Mombasa	12				

In Uganda, breast cancer Web searches were conducted in Mbarara (100), Kampala (56), and Kasangati (54). The YouTube, news and image searches were all in Kampala (100). Table 8 shows the data.

Table 8: Breast cancer interest by city in Uganda

City	Web RSV	City	YouTube RSV	City	News RSV	City	Image RSV
Mbarara	100	Kampala	100	Kampala	100	Kampala	100
Kampala	56						
Kasangati	54						

In Tanzania, the breast cancer Web searches were in Mwanza (100) and Dar es Salaam (73). The YouTube searches were from Dar es Salaam (100). The image and news searches did not have enough data to show the count in Google Trends. In Rwanda, all the searches for Web, news, images, and YouTube came from Kigali, which had a relative search volume of 100.

4.1.2.3 Breast cancer search related topics

The related topics that information seekers used when seeking information about breast cancer are as in Figure 11. The figure shows that for Kenya, breast cancer (11) was the main keyword used to get information about breast cancer. This was followed by breast cancer screening (7), cancer (6), breast cancer management, male breast cancer, signs and symptoms all had 4 occurrences. For Uganda, breast cancer (12) was the main keyword used to get information about breast cancer. This was followed by cancer (4), breast cancer screening (3), breast cancer awareness (2) and breast cancer management (2). For Tanzania, breast cancer (4) and breast cancer screening (4) were the main keyword used to get information about breast cancer. This was followed by cancer (3). In Rwanda, breast cancer (8) was the main keyword used to get

information about breast cancer. This was followed by breast cancer screening (4), cancer (4) and metastatic breast cancer (4).

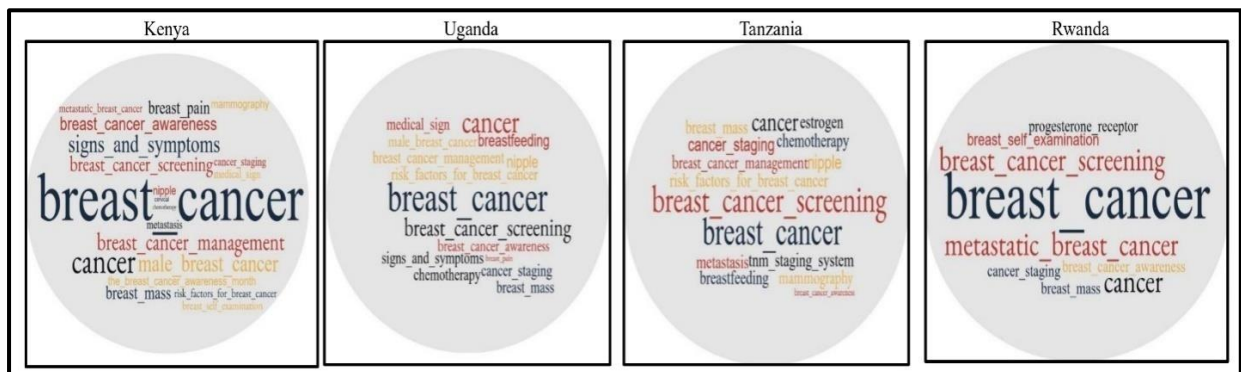


Figure 11: Keywords used in relation to breast cancer

The related topics concerning breast cancer in Kenya, Uganda, Tanzania, and Rwanda reveal that "breast cancer" was the primary search term in all four countries. Additionally, related topics such as "breast cancer screening," "cancer," and "breast cancer management" were common across the region. However, variations in keyword usage were also observed, such as "male breast cancer" in Kenya and "metastatic breast cancer" in Rwanda, highlighting specific areas of concern in each country.

4.1.2.4 Breast cancer search related queries

For Kenya, the query with the highest occurrence was breast cancer signs and symptoms (27), causes of breast cancer (7), and breast cancer awareness and signs and symptoms of cancer (4). For Uganda, the query with the most occurrence was breast cancer signs and symptoms (19), followed by the cause of breast cancer (5) and breast cancer staging (3). For Tanzania, the query with the most occurrence was breast cancer signs and symptoms (13), followed by the cause of breast cancer stages (7) and breast cancer (6). For Rwanda, the query that had the most occurrence was breast cancer signs and symptoms (6), followed by risk factors of breast cancer (2) and breast cancer awareness (1). Table 9 shows the queries.

Table 9: Breast cancer searches related queries

Kenya Related queries	N	Uganda Related queries	N	Tanzania Related queries	N	Rwanda Related queries	N
Breast cancer signs & symptoms	27	Breast cancer signs & symptoms	19	Breast cancer signs & symptoms	13	Breast cancer signs & symptoms	6
Causes of breast cancer	7	Cause of breast cancer	5	Breast cancer stages	7	Risk factors of breast cancer	2
Breast cancer awareness	4	Breast cancer staging	3	Breast cancer	6	Breast cancer awareness	1
Signs & symptoms of cancer	4	Breast cancer causes	2	Breast cancer causes	5		
Cancer of breast	3	Breast cancer in men	2	Breast cancer treatment	4		
Breast cancer causes	2	Breast cancer screening	2	Breast cancer awareness	2		
Breast cancer lump	2	Breast pain	2	Breast cancer pictures	2		
Breast cancer pictures	2	Causes of cancer	2	Breast cancer risk factors	2		
Breast cancer ribbon	2	Treatment of breast cancer	2	Breast cancer screening	2		
Breast cancer treatment	2	What is breast cancer	2	Breast cancer test	2		

(N=occurrences)

A comparative analysis of breast cancer-related queries across Kenya, Uganda, Tanzania, and Rwanda revealed that "breast cancer signs and symptoms" was the most frequently searched query in all four countries. This consistent interest in understanding the identification of breast cancer indicates a shared concern and priority in public awareness across the EAC region. Although each country displayed variations in additional queries, such as Kenya and Uganda searching for "causes of breast cancer," Tanzania focusing on "breast cancer stages," and Rwanda examining "risk factors of breast cancer," the common emphasis on signs and symptoms highlights the need to address this aspect of breast cancer information to improve public understanding in all four countries.

4.1.3 Prostate cancer search term

The researcher mined data on how information seekers searched for information about "prostate cancer".

4.1.3.1 Prostate cancer search interest over time

For the prostate search interest over time, for the Web search, Figure 12 shows the data.

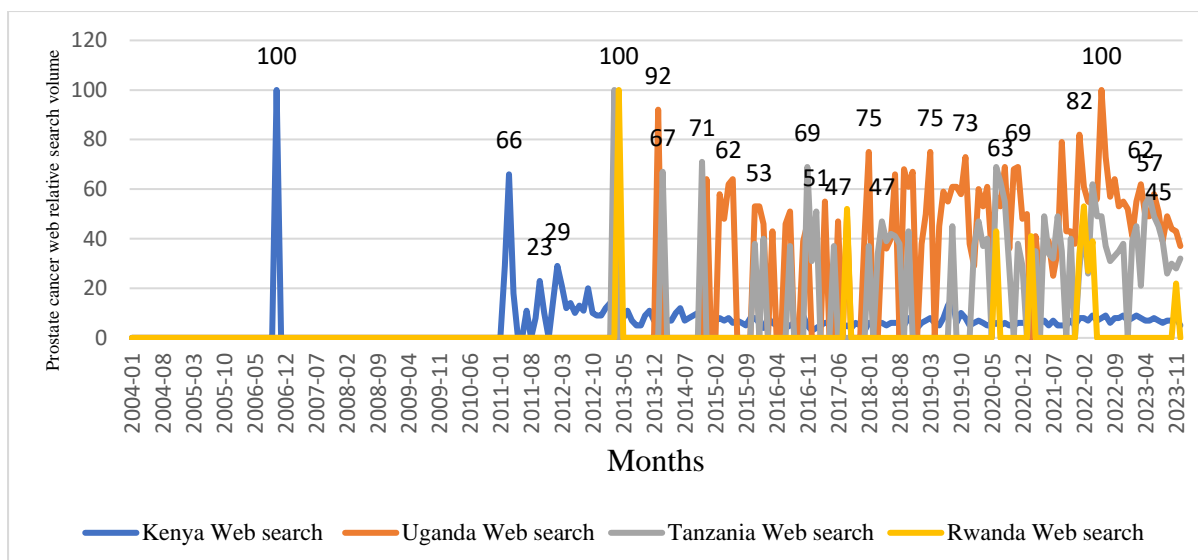


Figure 12: Prostate cancer Web search over time

Figure 12 indicates that Kenya's prostate cancer search was high in October 2006(100), March 2006 (66), February 2011(29), February 2012(29) and October 2011(23). For Uganda, the highest searches came from June 2022(100), January 2014(92), January 2022(82), September 2021(79) and January 2018(75). For Tanzania, the highest searches were in March 2013(100), November 2014(71), November 2016(69), June 2020(69) and February 2014(67). For Rwanda, the highest searches come from April 2013(100), February 2022(53), August 2017(52), June 2020(43) and February 2021(41).

For news about prostate cancer searches over time, only Tanzania had searches in January 2009(100) and April 2021(17). For image prostate cancer searches over time, only Kenya had searches in December 2017(100) and March 2023(59). For YouTube prostate cancer searches over time, Kenya, Uganda, and Tanzania had searches, whereas Rwanda did not have any. For Kenya, the searches only happened in November 2018(100). Uganda had the search in July 2010(100), while Tanzania was in June 2015(100).

4.1.3.2 Prostate cancer search interest by city

The data also revealed the cities from which the prostate cancer searches were conducted in each country. In Kenya, the Web searches mostly came from Kisumu (100), Thika (85), Eldoret

(83) and Kisii (83). For image searches, the highest search came from Kisumu (100). For YouTube, the highest search came from Eldoret (100), while the news searches only came from Nairobi (100). Table 10 presents the data.

Table 10: Prostate cancer interest by city in Kenya

City	Web RSV	City	Image RSV	City	YouTube RSV	City	News RSV
Kisumu	100	Kisumu	100	Eldoret	100	Nairobi	100
Thika	85	Nakuru	65	Nairobi	16		
Eldoret	83	Thika	58	Mombasa	9		
Kisii	83	Nairobi	14				
Ruiru	78						
Nakuru	73						
Athi River	60						

In Uganda, prostate cancer Web searches were conducted in Mbarara (100), Kasangati (42), and Kampala (41). The YouTube and image searches all came from Kampala (100). Uganda did not have city news search data. Table 11 shows the data.

Table 11: Prostate cancer interest by city in Uganda

City	Web RSV	City	Image RSV	City	YouTube RSV
Mbarara	100	Kampala	100	Kampala	100
Kasangati	42				
Kampala	41				

For Tanzania, the Web searches by city were limited to Mwanza (100) and Dar es Salaam (89). There was no data for the image, news and YouTube searches by city. For Rwanda, the searches for YouTube, images, and the Web were all from Kigali (100). The news did not have any city searches.

4.1.3.3 Prostate cancer searches related topics

The related keywords that information seekers used when seeking information about prostate cancer are highlighted in Figure 13.

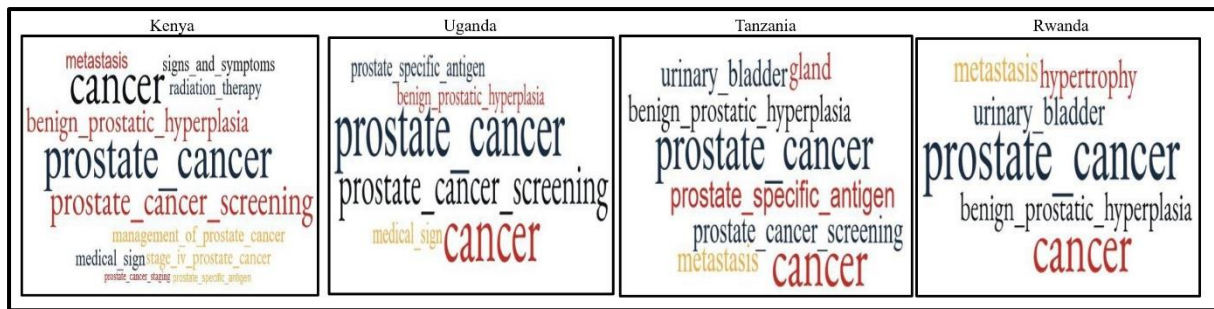


Figure 13: Keywords used in relation to prostate cancer

In Kenya, prostate cancer (11) was the primary keyword for seeking prostate cancer information, followed by prostate cancer screening (8), cancer (6), and benign prostatic hyperplasia (3). Similarly, in Uganda, prostate cancer (11) was the most frequent keyword, with cancer (6) and prostate cancer screening (4) as secondary search terms. In Tanzania, prostate cancer (7) led queries, followed by cancer (4) and benign prostatic hyperplasia (2). Lastly, Rwanda showed a similar pattern, with prostate cancer (8) being the most common keyword, along with cancer (4) and benign prostatic hyperplasia (2).

4.1.3.4 Prostate cancer searches related queries

For Kenya, the most related query was prostate cancer symptoms and signs (20), followed by prostate cancer (12), cause of prostate cancer (9) and prostate cancer treatment (6). For Uganda, the query that had the highest query was the causes of prostate cancer and signs and symptoms of prostate cancer (16), followed by prostate cancer treatment (6) and prostate cancer (4). For Tanzania, the query that had the highest occurrence was prostate cancer and prostate cancer symptoms (5). For Rwanda, that had the highest occurrence was the causes of prostate cancer and prostate cancer (8). The rest were prostate cancer symptoms and signs (6), prostate cancer treatment (4) and prostate cancer prevention (2). Table 12 shows the data.

Table 12: Prostate cancer search related queries

Kenya Related queries	N	Uganda Related queries	N	Tanzania Related queries	N	Rwanda Related queries	N
Prostate cancer symptoms & signs	20	Causes of prostate cancer	16	Prostate cancer	5	Causes of prostate cancer	8
Prostate cancer	12	Signs&symptoms of prostate cancer	16	Prostate cancer symptoms	5	Prostate cancer	8
Cause of prostate cancer	9	Prostate cancer treatment	6	Cause of prostate cancer	4	Prostate cancer symptoms & signs	6
Prostate cancer treatment	6	Prostate cancer	4	Cancer	2	Prostate cancer treatment	4
Breast cancer	2	Prostate cancer prevention	2	Prostate cancer treatment	2	Prostate cancer prevention	2
Cancer causes	2	Prostate cancer screening	2	Benign prostatic hyperplasia	1		
Prostate cancer test	2	Prostate cancer test	2	Complications of prostate cancer	1		
What is prostate cancer	2	Prostate enlargement	2	Diagnosis of prostate	1		
Prostate cancer prevention	1	Prostate gland	2	Metastatic	1		

(N=occurrences)

4.1.4 Lung cancer search term

The researcher mined data on how information seekers searched for information about “lung cancer”.

4.1.4.1 Lung cancer search interest over time

Figure 14 shows the data for the lung cancer search interest over time, for the Web search. For Kenya's lung cancer Web searches were high in April 2017(100), October 2015(87), November 2015(85), April 2013(72) and July 2019(65). For Uganda the highest searches were from March 2018(100), April 2017(84), February 2019(69), September 2019(52) and May2022(49). For Tanzania, the searches were from June 2005(100), while Rwanda had no data to show on Web searches.

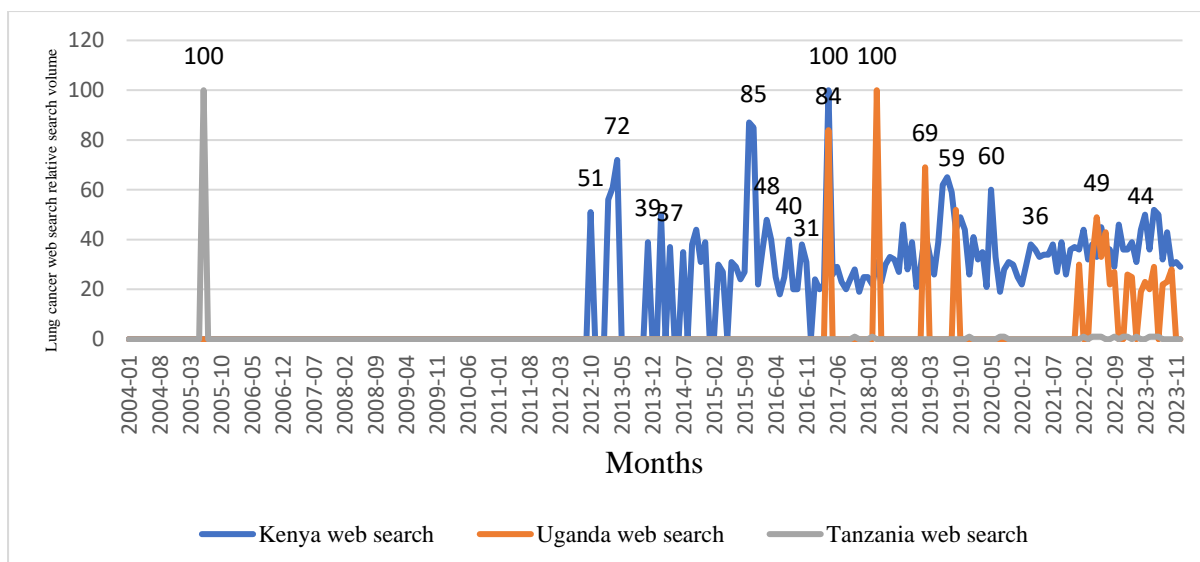


Figure 14: Lung cancer Web search interest over time

For YouTube searches, Kenya had a peak in April 2011(100). Uganda had a peak in October 2011(100), while Tanzania had peak in December 2022(100). Rwanda did not have any YouTube searches. Only Kenya and Rwanda had image searches, with Kenya in November 2015(100) and Rwanda in February 2022(100). For news searches, only Tanzania had searches in June 2011(100).

4.1.4.2 Lung cancer search interest by city

Kenya Web searches were from Eldoret (100). News and YouTube searches came from Nairobi (100) each, while image searches came from Mombasa (100) and Nairobi (40). For Uganda, the Web searches by city came from Kampala (100) and Kasangati (100). Images came from Kasangati (100) and Kampala (10), while YouTube came from Kampala (100). News searches in Uganda did not provide any data. For Tanzania, the Web searches came from Mwanza (100) and Dar es Salaam (66). The image searches came from Dar es Salaam (100). The YouTube and news searches did not have city-data. For Rwanda, the search by city data was only for Web search, with Kigali (100) being the only city. The news, YouTube and image searches did not have any city data.

4.1.4.3 Lung cancer search related topics

The related keywords that information seekers used when seeking information about lung cancer were highlighted in Figure 15.



Figure 15: Keywords used in relation to lung cancer

Figure 15 shows that in Kenya, lung cancer (8) was the most prominent search term, with related queries such as cancer (6) and smoking (4). Similarly, in Uganda, lung cancer (8) was the primary search term, followed by smoking (6), cancer (4), and chemotherapy (2). In Tanzania, lung cancer (8) was also the primary search term, with cancer (4) and chronic obstructive pulmonary disease (2) as related queries. Finally, in Rwanda, lung cancer (4) was the main search term, with smoking (4) and breathing (2) as accompanying queries.

4.1.4.4 Lung cancer search related queries

For Kenya, the query that was frequently used was lung cancer signs and symptoms (14), followed by causes of lung cancer (6), causes of cancer, lung cancer treatment and signs and symptoms of cancer (4). For Uganda, the query that had the highest occurrences was signs and symptoms of lung cancer (14), followed by causes of lung cancer (6). For Tanzania, the query that had the highest occurrences was the signs and symptoms of lung cancer (8). Rwanda-related query was only on signs and symptoms of lung cancer. Table 13 shows the data.

Table 13: Lung cancer search related queries

Kenya Related queries	N	Uganda Related queries	N	Tanzania Related queries	N
Lung cancer signs&symptoms	14	Signs&symptoms of lung cancer	14	Signs&symptoms of lung cancer	8
Causes of lung cancer	6	Causes of lung cancer	6	Lung cancer	6
Causes of cancer	4	How to treat lung cancer	2	Causes of lung cancer	4
Lung cancer treatment	4	Non-small cell lung cancer	2	Asthma	2
Signs and symptoms of cancer	4	Stage 4 lung cancer	2	Lung abscess	2
Cancer symptoms	2			Paraneoplastic syndrome lung cancer	2
Lung cancer stage 4	2			Pathophysiology of lung cancer	2

(N=occurrences)

4.1.5 Colon cancer search term

The researcher mined data on how information seekers search for information about “colon cancer”.

4.1.5.1 Colon cancer search interest over time

For the colon cancer search interest over time, for the Web search, Figure 16 shows the data.

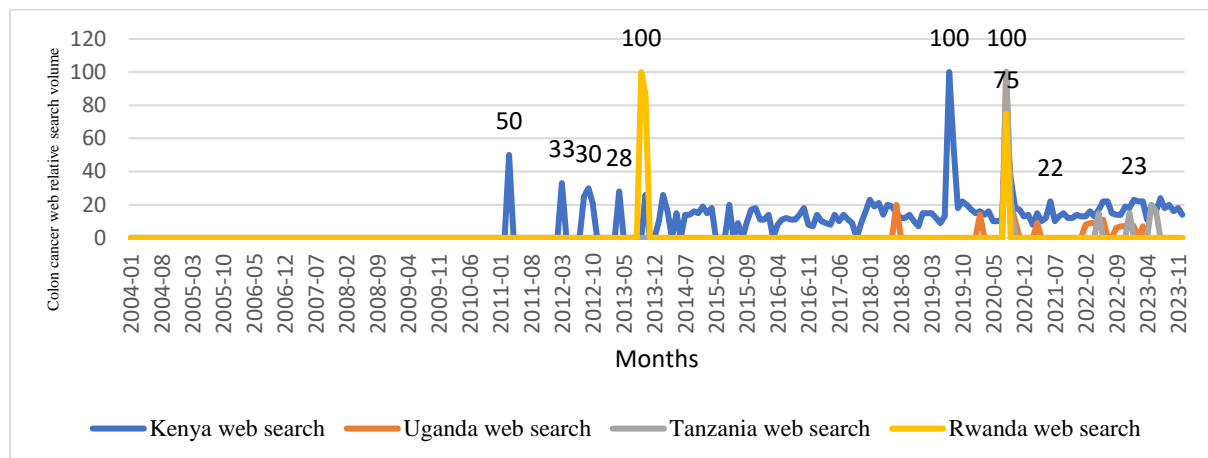


Figure 16: Colon cancer Web search interest over time

Figure 16 shows that Kenya colon cancer Web searches were high in July 2019(100), August 2020(68), August 2019(54), March 2011(50) and September 2020(36). For Uganda, the highest searches were from August 2020(100), September 2020(21), July 2018(20), February 2020(14) and June 2022(11). For Tanzania, the searches were only from August 2020(100), September 2020(23), May 2023(20), June 2023(16), May 2022(15) and December 2022(15). Rwanda only had searches on September 2013(100), October 2013(87) and August 2020(75).

For news, Tanzania did not have any search interest over time. Kenya’s colon cancer news searches were conducted in March 2013(100) and February 2015(40). Uganda’s searches were from July 2023(100) and October 2014(66) while Rwanda’s searches came from September 2013(100).

For image searches for colon cancer, Uganda and Tanzania did not have any. Kenya’s searches were from March 2018(100) and April 2021(46), while Rwanda came from October 2009(100). Over time, not all countries had enough search interest for YouTube colon searches.

4.1.5.2 Colon cancer search interest by city

For Kenya, colon cancer search interest by city, the Web searches were from Ruiru (100). News searches came from Nairobi (100), while image searches came from Mombasa (100) and Nairobi (49). For YouTube searches, the highest came from Ruiru (100) and the others from Nairobi (48) and Mombasa (38).Uganda's colon search by city for Web searches came from Kampala (100) and Kasangati (75). The image and YouTube searches came from Kampala (100). Tanzania’s search interest by city data was only enough for Web search with Dar es Salaam (100). Rwanda’s YouTube and Web searches came from Kigali (100).

4.1.5.3 Colon cancer search related topics

The related keywords that information seekers used when seeking information about colon cancer are highlighted in Figure 17.

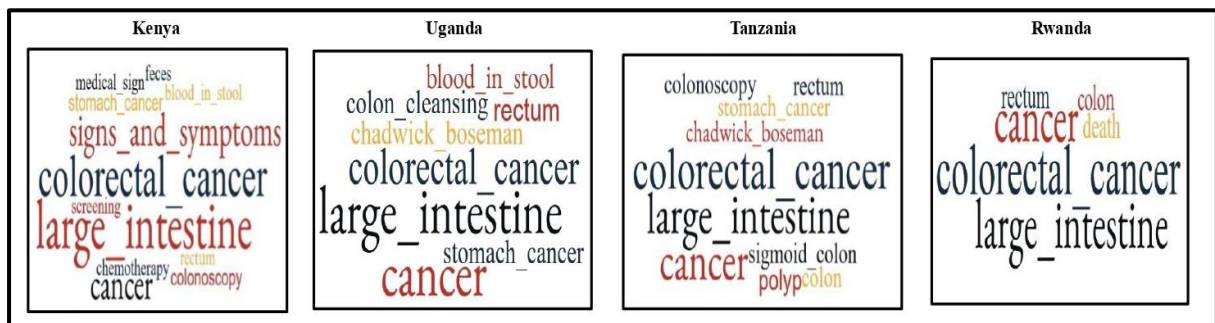


Figure 17: Keywords used in relation to colon cancer

From Figure 17, related topics in Kenya had colorectal cancer (10) with the highest frequency, followed by large intestine (6), cancer (4) and signs and symptoms (4). For Uganda, colorectal cancer (6) had the highest frequency, followed by large intestine (4), and cancer (4), For Tanzania, colorectal cancer (8) had the most occurrence, followed by cancer (4) and large intestine (4). For Rwanda, colorectal cancer (8) had the most occurrence, followed by cancer in the large intestine (4).

From the data, colorectal cancer consistently appeared as the most significant search term across all four countries, highlighting a shared interest in this cancer type. Additionally, related queries like large intestine, cancer, and signs and symptoms showcase a common interest in understanding the location of colorectal cancer and its associated signs and symptoms.

4.1.5.4 Colon cancer search related queries

For Kenya, the query that was frequently used was colon cancer signs and symptoms (16), followed by causes of colon cancer (8), cancer symptoms (6) and cancer of the colon (4). For Uganda, the query that was frequently used was colon cancer signs and symptoms (16), followed by causes of colon cancer (6). For Tanzania, colon cancer symptoms and signs had the highest occurrence (8), followed by causes of colon cancer (6). Rwanda did not have data on related queries. Table 14 shows the data.

Table 14: Colon cancer search related queries

Kenya related queries	N	Uganda related queries	N	Tanzania related queries	N
Colon cancer signs& symptoms	16	Colon cancer symptoms&signs	16	Colon cancer symptoms&signs	8
Cause of colon cancer	8	Causes of colon cancer	6	Causes of colon cancer	6
Cancer symptoms	6	Cancer of colon	4	Colon cancer treatment	2
Cancer of the colon	4	Colon cancer treatment	2	Colonoscopy	2
Bowel	2	Colonoscopy	2		
Bowel cancer	2	Haemorrhoids	2		
Cancer	2	How to prevent colon cancer	2		
Causes of cancer	2	Colon cancer pictures	1		
Colon cancer treatment	2				

(N=occurrences)

4.1.6 Cervical cancer search term

The researcher mined data on how information seekers search for information about “cervical cancer”.

4.1.6.1 Cervical cancer search interest over time

Figure 18 shows the data for the cervical cancer search interest over time, for the Web searches.

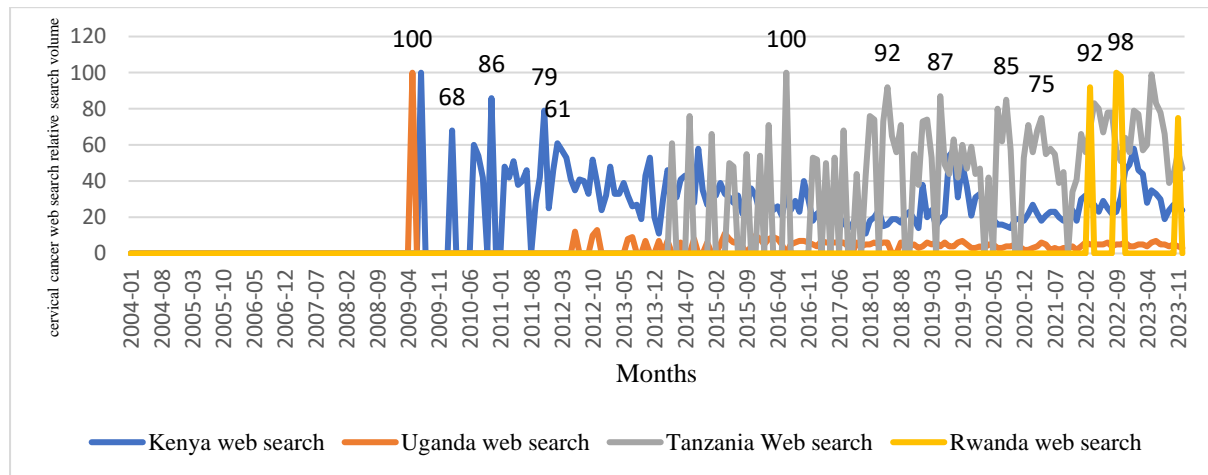


Figure 18: Cervical cancer Web search interest over time

Figure 18 shows that Kenya's cervical cancer Web searches were high in July 2009(100), November 2010(86), November 2011(79), February 2010(68) and February 2012(61). For Uganda, the highest searches were from May 2009(100), November 2012(13), June 2012(12), April 2015(11) and October 2012(10). For Tanzania, the searches were from June 2016(100), May 2023(99), May 2018(92), May 2019(87) and August 2020(85). Rwanda only had searches in September 2022(100), October 2022(98), March 2022(92) and November 2023(75).

For news, only Tanzania demonstrated search interest over time in July 2013(100) and June 2015(36). For image search on cervical cancer, Kenya and Rwanda did not have searches. Uganda’s searches were from August 2021(100) and June 2023(90) while Tanzania’s came from October 2022(100) and April 2016(4).

Tanzania and Rwanda did not have a search for YouTube search about cervical cancer, over time. Kenya’s searches came from June 2022(100), February 2023(98), December 2022(96),

August 2023(77) and November 2022 (72). Uganda’s searches were from December 2020(100).

4.1.6.2 Cervical cancer search interest by city

Table 15 shows the data for Kenya's cervical search interest by city. The data indicates that YouTube searches were high in Nakuru (100), while Web searches were high in Kisumu (100). For image searches, the high relative search volume came from Eldoret (100), while news was only in Nairobi (100).

Table 15: Cervical cancer search by city in Kenya

City	YouTube RSV	City	Web RSV	City	Image RSV	City	News RSV
Nakuru	100	Kisumu	100	Eldoret	100	Nairobi	100
Eldoret	44	Eldoret	95	Mombasa	17		
Thika	44	Thika	71	Nairobi	11		
Nairobi	41	Nakuru	60				
Mombasa	34						

In Uganda, the search by cities for the Web came from Mbarara (100), Kampala (28) and Kasangati (28). The searches by image and YouTube all came from Kampala (100). There were no news searches shown by the city in Uganda.

In Tanzania, the Web searches came from Mbeya (100), Dodoma (57), Mwanza (44), Dar es Salaam (25), Zanzibar town (21) and Arusha (16), while those on YouTube came from Dar es Salaam (100). There were no image and news searches categorised by cities in Tanzania. For Rwanda, both the Web and images came from Kigali (100). YouTube and news did not have searches by cities in Rwanda.

4.1.6.3 Cervical cancer searches related topics

For the cervical cancer search related topics, Figure 19 shows the related keywords. For Kenya, the terms that occurred most were cancer (6), cervical cancer staging (4) and cervical screening (4). For Uganda, the terms that occurred most were cancer (4), cervical cancer staging (4) and cervical screening (4). For Tanzania, the terms that occurred most were cancer (4) and cervical

screening (4). For Rwanda, the terms that occurred most were cancer screening (4) and cervical staging (2).

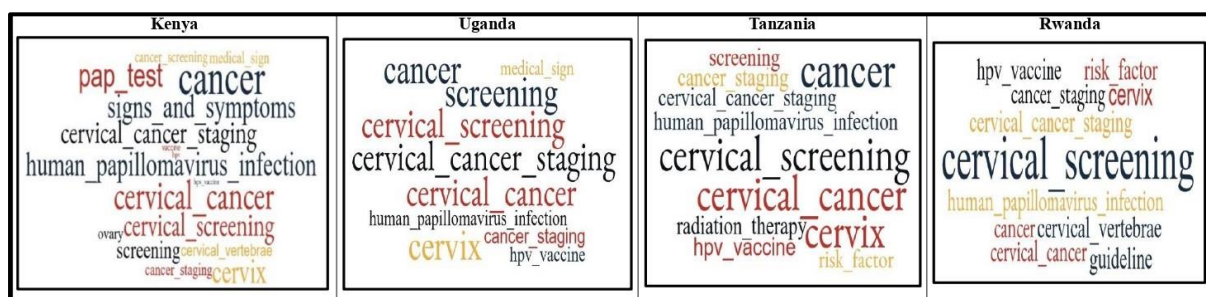


Figure 19: Keywords used in relation to cervical cancer

4.1.6.4 Cervical cancer searches related queries

Table 16 shows the data for cervical cancer search-related queries. For Kenya, the highly used related query for cervical cancer was cervical cancer signs and symptoms (31), followed by causes of cervical cancer (16) and cervical cancer screening (6). For Uganda, the highly used related query for cervical cancer was cervical cancer signs and symptoms (18) and causes of cervical cancer (10). For Tanzania, the highly used related query for cervical cancer was cervical cancer signs and symptoms (11) and cervical cancer staging (5). For Rwanda, they related queries were only cervical cancer screening (2), cervical cancer symptoms (2) and stages of cervical cancer (2).

Table 16: Cervical cancer related queries

Kenya related queries	N	Uganda related queries	N	Tanzania related queries	N
Cervical cancer signs&symptoms	31	Cervical cancer symptoms&signs	18	Cervical cancer symptoms&signs	11
Causes of cervical cancer	16	Causes of cervical cancer	10	Cervical cancer	7
Cervical cancer screening	6	Cervical cancer screening	4	Cervical cancer staging	5
Cervical cancer pictures	4	Cervical cancer treatment	4	Causes of cervical cancer	4
Cervical cancer treatment	4	Cancer of the cervix	2	Cervical cancer screening	4
Cancer screening	2	Cervical cancer staging	2	Cervical cancer treatment	4
Cancer symptoms	2	Cervical cancer test	2	Risk factors for cervical cancer	4
Cervical cancer staging	2	Cervical cancer vaccine	2	Cervical cancer stages	3
HPV	2	What is cervical cancer	2	Prevention of cervical cancer	2
Symptoms of cancer	2	Cervical cancer risk factors	1	What is cervical cancer	2

(N=occurrences)

4.1.7 Cancer symptoms and signs search term

The study analysed Google Trends data for cancer symptoms and signs in EAC countries. This data was intended to show how the public in these countries searches for cancer symptoms and the topics and queries they make to learn more about cancer symptoms.

4.1.7.1 Cancer symptoms and signs search over time

The cancer symptoms and signs search over time for the EAC countries revealed how the public searches for cancer symptoms and signs information. Figure 20 shows the Web searches over time. The Web search data for Kenya reveals intriguing patterns of public interest in cancer symptoms and signs over the years. In July 2019, there was a remarkable surge in online searches, with a peak relative search volume of 100. This heightened interest continued into August 2019 (98). October 2011 also stands out (95). Looking back further, March 2010 and February 2010 also show substantial interest, with relative search volumes of 84 and 81, respectively. Uganda's Web search trends reveal pronounced peaks in cancer symptoms inquiries. December 2011 saw the highest relative search volume at 100, followed by May 2012 with 62. April 2015 and April 2014 also showed significant interest, recording volumes of 43 and 38, respectively. Tanzania's search data reflects intense interest in cancer symptoms and signs, particularly in April 2022, with a peak relative search volume of 100. Subsequent notable peaks occurred in June 2023 (90), February 2023 (87), September 2018 (76), and February 2022 (73). Rwanda's search trends demonstrate a significant spike in cancer symptom inquiries in January 2014(100). In August 2022, interest persisted but at a lower volume of 51.

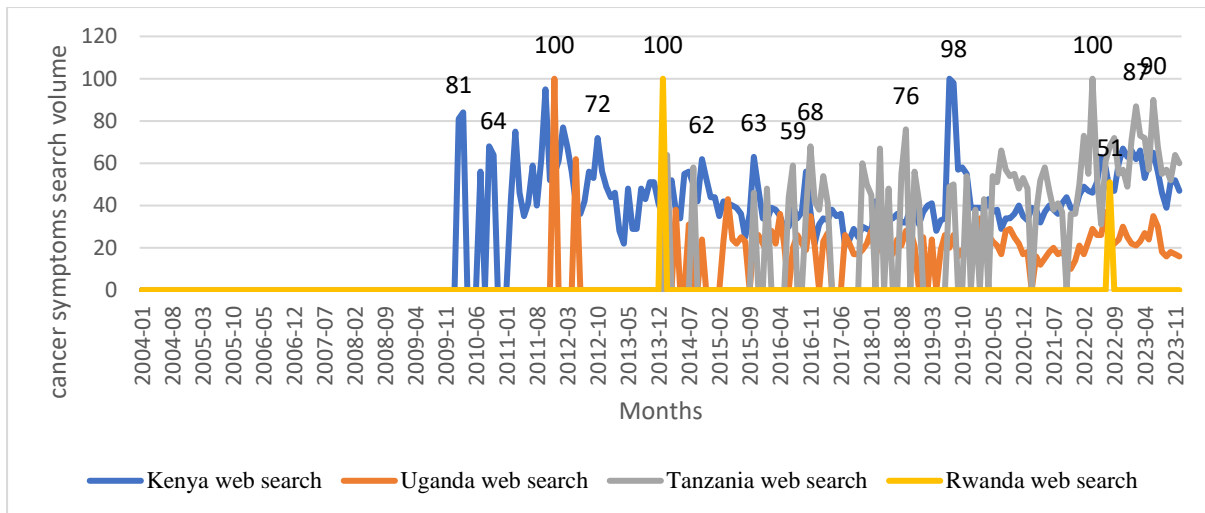


Figure 20: Cancer symptoms and signs Web search over time

For cancer symptoms and signs news search, for Kenya, news searches peaked at 100 in September 2008, and there was a moderate interest level of 53 in March 2011. In Tanzania, the highest news search volume was 100 in December 2010, with a low volume of 4 in October 2021. Rwanda had its highest news search volume of 100 in February 2023. Uganda did not have data on cancer symptoms and news.

For cancer symptoms and signs image searches, in Kenya, February 2008 witnessed a significant surge in image searches, reaching a volume of 100. Contrastingly, in May and June 2022 and March 2023, searches dropped to 2. Uganda peaked in January 2020 with a search volume of 100 while recording no activity thereafter. Tanzania and Rwanda did not have data on cancer symptoms and signs image search.

Only Kenya had YouTube searches. November 2021 and October 2018 saw significant peaks at 100 and 90, respectively. However, June 2022 and April 2023 maintained a search volume of 32. Conversely, December 2023 experienced a decline to 24.

4.1.7.2 Cancer symptoms and signs search by city

The provided data suggests varying levels of interest in searching for cancer symptoms and signs across different cities, as reflected in Web, news, image, and YouTube searches. Table 17 show the data for Kenya's search by city.

Table 17: Cancer symptoms and signs search by city in Kenya

City	Web RSV	City	Image RSV	City	YouTube RSV	City	News RSV
Meru	100	Nanyuki	100	Nyeri	100	Nairobi	100
Naivasha	96	Nyeri	52	Nakuru	40		
Eldoret	79	Athi River	45	Athi River	36		
Kiambu	79	Juja	44	Nairobi	17		
Thika	78	Eldoret	33	Eldoret	15		
Kikuyu	75	Thika	29	Mombasa	11		
Nakuru	74	Mombasa	16				
Ruiru	74	Nairobi	5				

Table 17 shows that Meru leads in Web searches with a search volume of 100, closely followed by Naivasha at 96, Eldoret at 79, and Kiambu at 79. Nanyuki takes the forefront in image searches with a volume of 100, trailed by Nyeri at 52, Athi River at 45, and Juja at 44. For YouTube searches, Nyeri takes precedence with a volume of 100, followed by Nakuru at 40, Athi River at 36, and Eldoret at 33. In news searches, it was only Nairobi with a volume of 100. In Uganda, Kampala stands out as the focal point for both image and YouTube searches related to cancer symptoms and signs, with a search volume of 100 for each category. Web and news did not have search by city.

In Tanzania, Dar es Salaam shows notable engagement with YouTube content related to cancer symptoms and signs, with a search volume of 100. However, there is no available data for Web searches, news articles, or image searches.

In Kigali, Rwanda, there is a significant interest in YouTube content related to cancer symptoms and signs, with a search volume of 100, suggesting a proactive approach to seeking health-related information through video platforms. However, there is no available data for news articles or image searches.

4.1.7.3 Cancer symptoms and signs search related topics

For the cancer symptoms and signs search related topics, Figure 21 shows the related keywords. In Kenya, colorectal cancer (8) and signs and symptoms (8) emerged as the most frequently searched topics, followed by breast cancer, cancer, cervical cancer, and medical signs, demonstrating a keen interest in understanding various types of cancer and their associated indicators.

In Uganda, signs and symptoms (10) dominated search queries, reflecting a strong emphasis on early cancer detection. Other significant themes included cancer (6), indicating a general interest in understanding the disease, and medical signs (6), showcasing a focus on identifying physical indicators of cancer.

Tanzania's search topics also centred around signs and symptoms (8), highlighting the shared interest in early detection across the EAC region. Additional important themes included breast (4), breast cancer (4), cancer (4), colorectal cancer (4), lung (4), and medical signs (4), indicating a diverse range of concerns surrounding cancer symptoms and signs.

In Rwanda, cancer (5) emerged as the most prominent theme, followed by signs and symptoms (4), colorectal cancer (2), and lung (2), demonstrating a common interest in understanding cancer as a broader subject and specific concerns regarding colorectal and lung cancer.

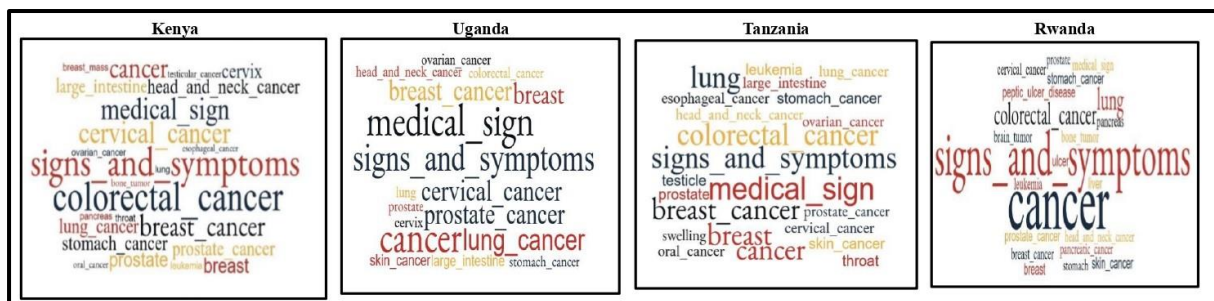


Figure 21: Keyword used in relation to cancer signs and symptoms

4.1.7.4 Cancer symptoms and signs search related queries

For cancer symptoms and signs search related queries. Table 18 shows the data. In Kenya, breast cancer symptoms and signs (16) emerged as the most frequent query, followed by cancer signs and symptoms (14), throat cancer symptoms and signs (12), and cervical cancer symptoms and signs (11). This indicates a strong interest in understanding the indicators of various cancer types, particularly breast, throat, and cervical cancers.

In Uganda, cervical cancer symptoms and signs (10) dominated search queries, with breast cancer symptoms and signs, prostate cancer symptoms and signs, and symptoms of cancer each occurring 6 times. This highlights a primary concern for cervical cancer and a shared interest in understanding breast and prostate cancer signs.

For Tanzania, breast cancer symptoms and signs (8) and signs and symptoms of cancer (8) were the most frequent queries. Cervical cancer symptoms and signs and prostate cancer symptoms and signs are followed with 6 occurrences each, emphasising a focus on breast, cervical, and prostate cancer indicators.

In Rwanda, breast cancer symptoms and signs, colon cancer symptoms and signs, lung cancer symptoms and signs, prostate cancer symptoms and signs, and stomach cancer symptoms and signs each accounted for 4 occurrences. This showcases a broad interest in understanding various cancer types and their associated signs and symptoms.

Table 18: Cancer symptoms and signs search related queries

Kenya related queries	N	Uganda related queries	N	Tanzania related queries	N	Rwanda related queries	N
Breast cancer symptoms& signs	16	Cervical cancer symptoms& signs	10	Breast cancer symptoms& signs	8	Breast cancer symptoms & signs	4
Cancer signs and symptoms	14	Breast cancer symptoms & signs	6	Signs and symptoms of cancer	8	Colon cancer symptoms & signs	4
Throat cancer symptoms& signs	12	Prostate cancer symptoms&signs	6	Cervical cancer symptoms&signs	6	Lung cancer symptoms&signs	4
Cervical cancer symptoms& signs	11	Signs and symptoms of cancer	6	Prostate cancer symptoms and signs	6	Prostate cancer symptoms and signs	4
Colon cancer symptoms& signs	6	Throat cancer symptoms and signs	4	Colon cancer symptoms and signs	4	Stomach cancer symptoms and sign	4
Prostate cancer symptoms& signs	6	Breast cancer	2	Lung cancer symptoms and signs	4	Blood cancer symptoms and signs	2
Stomach cancer symptoms& signs	5	Causes of cancer	2	Blood cancer	2	Brain cancer symptoms and sign	2
Breast cancer	4	Cervical cancer	2	Blood cancer symptoms and signs	2	Breast cancer	2
Skin cancer symptoms&signs	4	Colon cancer symptoms&signs	2	Breast cancer	2	Cervical cancer	2
Cancer causes	3	Prostate cancer	2	Cervical cancer	2	Cervical cancer symptoms and signs	2

(N=occurrences)

4.1.8 Cancer treatment search term

The study examined Google Trends data regarding searches related to cancer treatment across East African Community (EAC) countries. This analysis aimed to illuminate how the public in these nations search for information on cancer treatment.

4.1.8.1 Cancer treatment search over time

Figure 22 shows the Web search over time for cancer treatment information searching behaviour. The Web search data for Kenya was only in November 2005(100), April 2011(10), November 2011 (5) and March 2012(4). For Uganda, the number of Web searches was high in September 2014(100). This was followed by February 2016(80), April 2016 (74), February 2017(60) and November 2022(58). Tanzania's Web search data reflects intense interest in cancer treatment, particularly in January 2017 and April 2022, both with 100 relative search volumes. Subsequent notable searches occurred in August 2023(98), July 2023(90) and July 2020(86). Rwanda's Web search trends occurred in June 2011(100), April 2013(34), February 2020(10), July 2021(9) and March 2023(5).

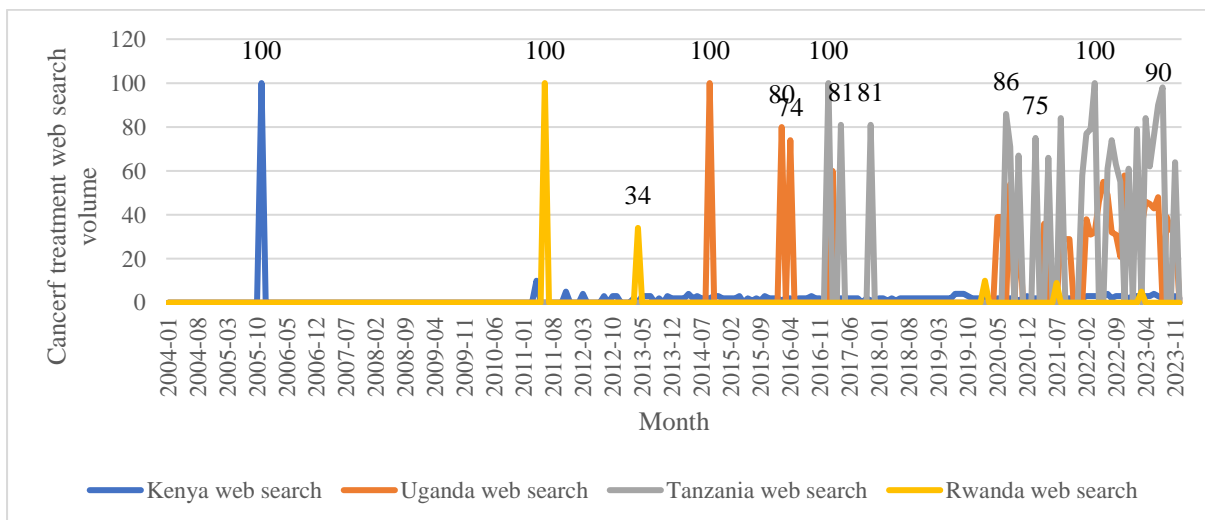


Figure 22: Cancer treatment Web search over time

For news searches, Kenya did not show any interest over time. Uganda’s search was only in March 2023(100), Tanzania’s was in March 2020(100) while Rwanda’s news searches were in March 2021(100) and October 2017(87).

Kenya and Uganda did not have cancer treatment image searches. Tanzania’s searches were from March 2022(100) and July 2015(77). Rwanda searches came in February 2014(100). Only Kenya had a search for YouTube searches in May 2023(100).

4.1.8.2 Cancer treatment search by city

The provided data suggests varying levels of interest in searching for cancer treatment across different cities, as reflected in Web, news, image, and YouTube searches. Table 19 shows the data for Kenya's search by city. For Web search, Eldoret had the highest (100). This was followed by Thika (80) and Ruiru (66). For image searches, Eldoret had the highest search (100). Mombasa had 67, while Nairobi had 8. For news searches, Mombasa had 100, while Nairobi had 8. Similarly, YouTube searches in Mombasa had 100 and in Nairobi 58.

Table 19: Cancer treatment search by city in Kenya

City	Web RSV	City	Image RSV	City	News RSV	City	YouTube RSV
Eldoret	100	Eldoret	100	Mombasa	100	Mombasa	100
Thika	80	Mombasa	67	Nairobi	8	Nairobi	58
Ruiru	66	Nairobi	8				

For Uganda, Kampala was the most popular city across different platforms, including YouTube, image searches, and Web searches, all with a score of 100. However, Kasangati is also popular, particularly in image searches, with a score of 84.

Tanzania did not have enough data for searches by city, while Rwanda only had searches by city on Web searches, with Kigali having a relative search volume of 100.

4.1.8.3 Cancer treatment search related topics

For the related topics regarding cancer treatment, Figure 23 shows the data. For Kenya, terms like chemotherapy (10) and radiation therapy (10) underscore the importance of conventional

treatments across different cancer types. The figure also mentions breast cancer chemotherapy (5) and breast cancer management (4) highlighting tailored approaches for particular cancers. For Uganda, the word cloud provides a broad spectrum of cancer treatment interventions and specific cancer types. Prominent themes are chemotherapy (9), radiation therapy (8) breast cancer (6), prostate cancer (6), and therapy (4). For Tanzania, the prominent topic was cancer (10), followed by chemotherapy (8) and therapy (6). For Rwanda, chemotherapy and radiation therapy (8) stood out as primary topics of interest. Several specific cancers are mentioned, including breast cancer (5), cervical cancer (4) and colorectal cancer (3).

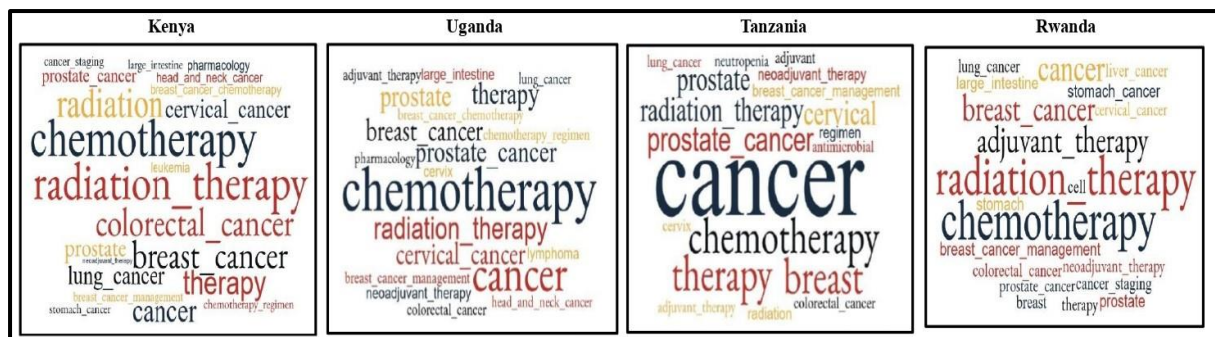


Figure 23: Keywords in relation to cancer treatment

4.1.8.4 Cancer treatment search related queries

Table 20 shows the data for cancer treatment search related queries. In Kenya, chemotherapy side effects and chemotherapy treatment for cancer emerged as the most prevalent search queries, each with 8 occurrences. Closely following was prostate cancer treatment, with 7 occurrences, and cervical cancer management treatment, with 6 occurrences. This demonstrates a primary interest in understanding chemotherapy's impact and the treatment options for prostate and cervical cancers.

For Uganda, a range of queries related to cancer treatment and specific types of cancer were observed. Notably, queries about cervical and prostate cancer treatments appeared most frequently, each with 6 occurrences. Additionally, breast cancer treatments and the side effects of chemotherapy emerged as essential areas of interest, both with 4 occurrences.

In Tanzania, the chemotherapy side effect was the most sought-after topic, with 8 occurrences. Prostate cancer treatment, with 6 occurrences, and breast cancer treatment, with 4 occurrences, followed closely, indicating a focus on understanding the side effects of chemotherapy and the treatment options for breast and prostate cancers.

In Rwanda, chemotherapy and prostate cancer treatments were the most prevalent queries, with 4 and 3 occurrences, respectively. This points to a shared interest in chemotherapy and the treatment of prostate cancer within the country.

Table 20: Cancer treatment search related queries

Kenya related queries	N	Uganda related queries	N	Tanzania related queries	N
Chemotherapy side effects	8	Cervical cancer treatment	6	Chemotherapy side effects	8
Chemotherapy treatment for cancer	8	Prostate cancer treatment	6	Prostate cancer treatment	6
Prostate cancer treatment	7	Breast cancer treatment	4	Breast cancer treatment	4
Cervical cancer treatment	6	Chemotherapy side effects	4	Cervical cancer treatment	3
Breast cancer treatment	5	Adjuvant chemotherapy	2	Adjuvant chemotherapy	2
Chemotherapy	4	Bone cancer treatment	2	Cervical cancer	2
Adjuvant chemotherapy	2	Breast cancer	2	Chemoprophylaxis	2
Breast cancer	2	Cancer	2	Chemotherapy	2
Breast cancer chemotherapy	2	Cervical cancer	2	Chemotherapy drugs	2
Cancer chemotherapy	2	Chemotherapy drugs	2	Colon cancer treatment	2

(N=occurrences)

4.1.9 Cancer risk factors search term

Cancer risk factors search terms lacked data on search interest over time and geographical data. Despite this, the related topics and query data were used to gain insights into people's information-seeking behaviour, aiding the understanding of cancer risk factor awareness.

For the related topics to cancer risks for EAC countries, the most frequently searched topics, with eight (8) occurrences each, include breast, breast cancer, cancer, cervical cancer, ovarian cancer, prostate, risk factors, and risk factors for breast cancer. This high frequency across multiple related topics suggests a significant public interest in understanding various aspects of cancer, including different types of cancer, risk factors, and preventive measures. Figure 24 shows the data.

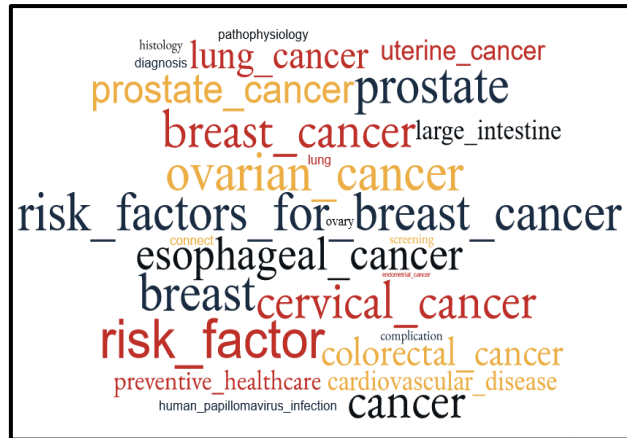


Figure 24: Keywords used in relation to cancer risks factors in the EAC countries

For the related queries with cancer risk factors, the EAC country's data showed that most people seek cancer information on risk factors with specific types of cancer. Table 21 shows the data.

Table 21: Cancer risks factors search related queries

Related queries	N	%	Related queries	N	%
Cervical cancer risk factors	14	20.59	Cervical cancer	2	2.94
Prostate cancer causes and risk factors	12	17.65	Colon cancer risk factors	2	2.94
Breast cancer risk factors	11	16.18	Colorectal cancer	2	2.94
Risk factors for cancer	5	7.35	Lung cancer	2	2.94
Lung cancer risk factors	4	5.88	Modifiable risk factors	2	2.94
Breast cancer	2	2.94	Ovarian cancer risk factors	2	2.94
Causes of cancer	2	2.94	Prostate cancer	2	2.94
Causes of cervical cancer	2	2.94	Types of cancer	2	2.94
Total				68	100

(N=occurrences)

Table 21 shows that cervical cancer risk factors emerged as the most prevalent, constituting 14(20.59%). Following closely behind, prostate cancer causes, and risk factors garnered significant attention, with 12(17.65%). Breast cancer risk factors also garnered substantial interest, receiving 11(16.18%). Exploring the broader spectrum of cancer, there were five queries dedicated to understanding general risk factors, representing 7.35% of the total. The data underscores a significant interest in understanding the risk factors associated with different types of cancer, with cervical, prostate, and breast cancers emerging as main focal points of inquiry.

4.1.10 Cancer prevention search term

Despite the lack of search interest and geographical data for cancer prevention terms, related topics and queries provide valuable insights into public awareness. The data was minimal for each country. Hence, they were combined to provide a general view of information seekers on how to prevent cancer. Figure 25 shows the word cloud for the data. The most prominent topic is cancer prevention. Types of cancers also appear dominant in the word cloud: prostate cancer, cervical cancer, lung cancer and colorectal cancer. Topics related to cancer treatment, screening, and secondary prevention also emerged.

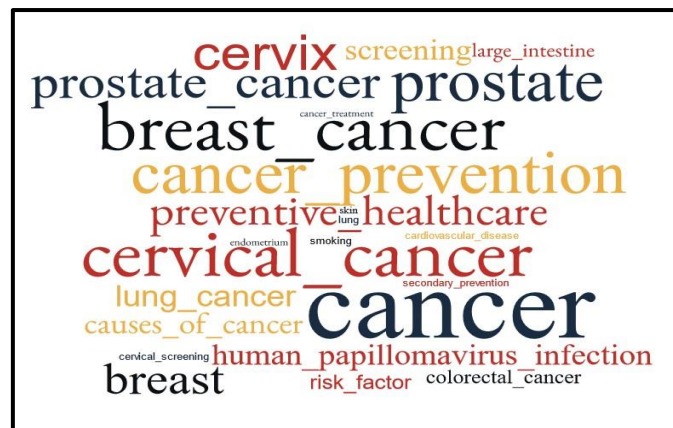


Figure 25: Keywords used in relation to cancer prevention in the EAC countries

For the related queries with cancer prevention, the EAC country's data showed that most people seek cancer prevention information with specific types of cancer. Table 22 shows the data. The majority of queries are centred around prevention measures for prostate cancer 18(26.47%), cervical cancer 12(17.65%), and breast cancer 11(16.18%). General queries on cancer prevention, such as cancer prevention foods, prevention and control of cancer, and cancer prevention diet, were also used. This indicates an interest in understanding lifestyle factors, diet, and other measures that can contribute to cancer risk reduction. The presence of queries like how to prevent cancer naturally suggests a desire for alternative or natural approaches to cancer prevention.

Table 22: Cancer prevention search related queries

Related queries	Frequency	%
Prostate cancer prevention	18	26.47%
Cervical cancer prevention	12	17.65%
Breast cancer prevention	11	16.18%
Cervical cancer	6	8.82%
Breast cancer	4	5.88%
Colon cancer prevention	4	5.88%
Prostate cancer	4	5.88%
Cancer prevention foods	3	4.41%
Prevention and control of cancer	2	2.94%
Throat cancer prevention	2	2.94%
Cancer prevention diet	1	1.47%
How to prevent cancer naturally	1	1.47%
Total	68	100.00%

4.1.11 Cancer screening search term

Despite the lack of search interest and geographical data for cancer screening terms, related topics and queries provide valuable insights into public awareness. The data was minimal for each country. Hence, they were combined to see a general view of how information seekers seek information on cancer screening across the nations. Figure 26 shows the word cloud for the data.

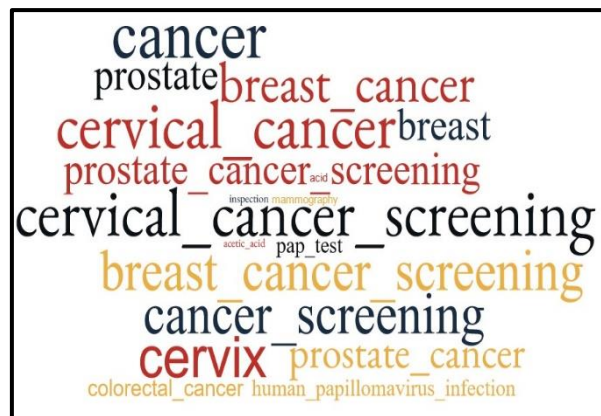


Figure 26: Keywords used in relation to cancer screening

The data presents a comprehensive interest in cancer screening across multiple cancer types. The major theme of the search topic is cancer screening for specific types of cancer. A significant portion of queries focus on screening for particular cancers, including breast, cervical, colorectal, and prostate cancers. Additionally, there is the theme of screening procedures with queries related to mammography, pap tests and inspection.

For the related queries regarding cancer screening, the data from the EAC countries showed that most people seek cancer screening information for specific types of cancer. Table 23 shows the data.

Table 23: Cancer screening search related queries

Related queries	N	%	Related queries	N	%
Cervical cancer screening	20	25.64	Cancer screening tests	2	2.56
Breast cancer screening	8	10.26	Cervical cancer screening guidelines	2	2.56
Cervical cancer	6	7.69	Cervical cancer symptoms	2	2.56
Prostate cancer screening	6	7.69	Cervical screening	2	2.56
Cancer screening in Kenya	4	5.13	Colon cancer screening	2	2.56
Cervical cancer screening methods	4	5.13	Free breast cancer screening	2	2.56
Prostate cancer	4	5.13	Free cancer screening	2	2.56
Breast cancer	2	2.56	Free cancer screening in Kenya	2	2.56
Cancer screening cost	2	2.56	Importance of cervical cancer screening	2	2.56
Cancer screening methods	2	2.56	Pap smear	2	2.56
Total			78	100	

(N=occurrences)

Table 23 data highlights a strong interest in cancer screening, particularly for cervical and breast cancers. The most frequently searched term is cervical cancer screening 20(25.64%). Breast cancer screening follows closely with 8(10.26%) and prostate cancer screening 6(7.69%). Additionally, users seek information on cancer screening in Kenya4(5.13%), indicating a desire to understand the local context, including costs and public health initiatives. The data also reveals an interest in the general aspects of cancer screening, such as costs, methods, and tests, which make up a smaller percentage of the searches.

4.1.12 Cancer awareness search term

This analysis delves into Google Trends data to examine public interest in cancer awareness. Figure 27 shows the word cloud for the data for topics that people used to search for information about cancer awareness.



Figure 27: Keywords used in relation to cancer awareness

The word cloud highlights several key themes about cancer awareness. The most prominent theme is breast cancer. Additionally, breast cancer awareness campaigns, events, and initiatives draw significant interest. Cancer screening emerges as another essential theme, reflecting users' interest in understanding the importance of early detection and prevention. Other themes include cancer awareness months, pink as a symbol for breast cancer awareness, and promotional materials like posters and ribbons which showcase the significance of campaigns and initiatives in raising awareness and support for cancer-related issues. Table 24 shows the data for the related queries to cancer awareness.

Table 24: Cancer awareness search related queries

Related queries	Occurrence	%
Breast Cancer Awareness Month	14	35.00%
Breast cancer awareness	10	25.00%
Breast cancer	4	10.00%
Breast cancer awareness poster	4	10.00%
Breast Cancer Awareness Day	2	5.00%
Breast cancer symptoms	2	5.00%
Cancer awareness month	2	5.00%
October breast cancer awareness	2	5.00%
Total	40	100.00%

The data provides valuable insights into the public's interest in breast cancer awareness, revealing a strong focus on Breast Cancer Awareness Month 14(35%). Promotional materials, such as breast cancer awareness posters and a broader understanding of cancer awareness initiatives, were also queries that users used to seek information about cancer awareness.

4.2 Informetric pattern of cancer information in the East African Community countries

The study collected data from both PubMed and Google Scholar to analyse their informetric patterns. PubMed offered bibliographic information, such as titles and abstracts, but did not include citation data for its entries. On the other hand, Google Scholar indexes scholarly literature across diverse disciplines and provides not only titles and abstracts but also citation data. The data for PubMed was used to compare themes and the evolution of themes in titles and abstracts with that of Google Scholar.

4.2.1 Quantity of research on cancer in East African Community countries

After the data was collected, a comprehensive data-cleaning procedure was carried out to guarantee the applicability of the study scope and remove redundancy. For Kenya Google Scholar, 698 articles were retrieved and after cleaning, 580 were found to be relevant. For PubMed, the first instances gave 480, and after cleaning, only 222 articles were deemed relevant. Figure 28 shows the data.

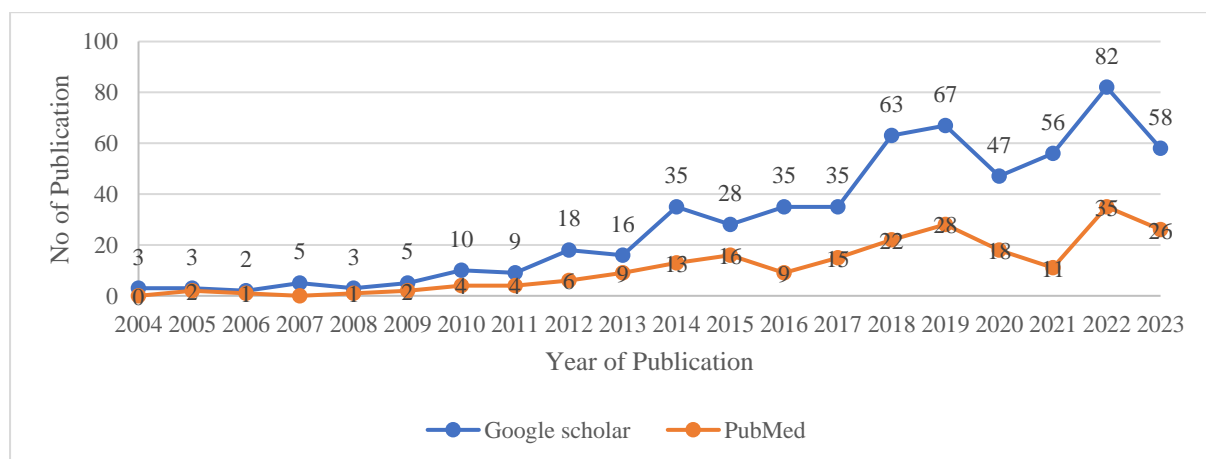


Figure 28: Trends of publications on Cancer in Kenya

Figure 28 data presents a comparison of the number of articles published annually from 2004 to 2023, as indexed by Google Scholar and PubMed. The data indicates that the number of publications has generally increased over the years, with Google Scholar consistently indexing more articles than PubMed. In the earlier years (2004-2011), both databases show relatively

low publication counts, with Google Scholar averaging around four articles per year, while PubMed averages less than one article per year. From 2012 onwards, the number of publications increased significantly in both databases, with Google Scholar reaching a peak of 82 articles in 2022 and PubMed reaching a peak of 35 articles in the same year.

For Uganda, Google Scholar had 469 articles and 434 after cleaning. In PubMed, 436 articles were retrieved, and after cleaning, 204 were deemed relevant. Figure 29 shows the article publication trends.

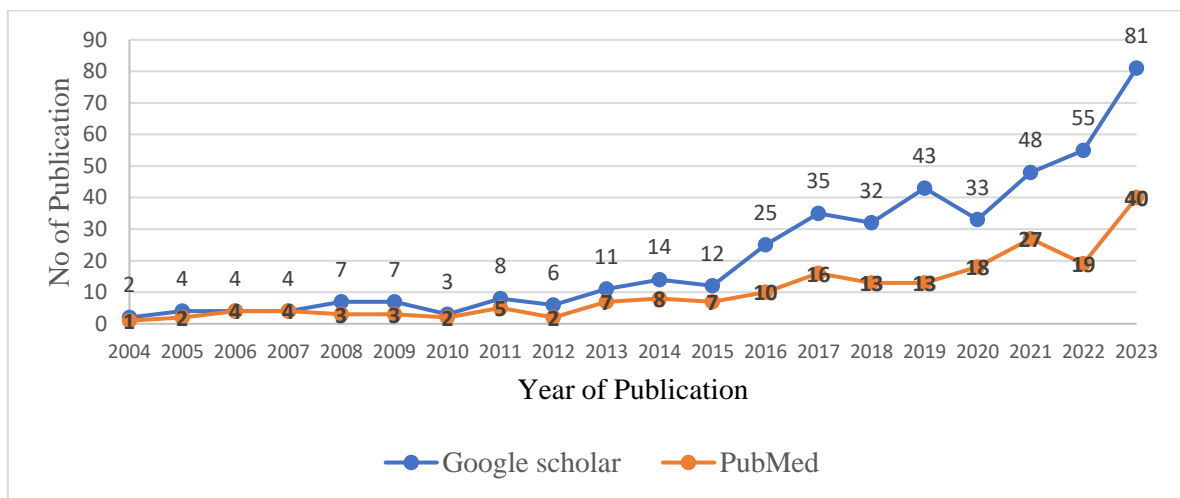


Figure 29: Trends of publications on Cancer in Uganda

Figure 29 shows that in the earlier years (2004-2009), Google Scholar indexed an average of around four articles per year, while PubMed indexed an average of approximately three articles per year. Over time, the number of publications increased for both databases, with Google Scholar reaching a peak of 81 articles in 2023 and PubMed reaching a peak of 40 articles in the same year.

For Tanzania, Google Scholar had 333 articles and 286 after cleaning, while PubMed had 347 articles retrieved, and after cleaning, 170 were deemed relevant. Figure 30 shows the article's publication trends.

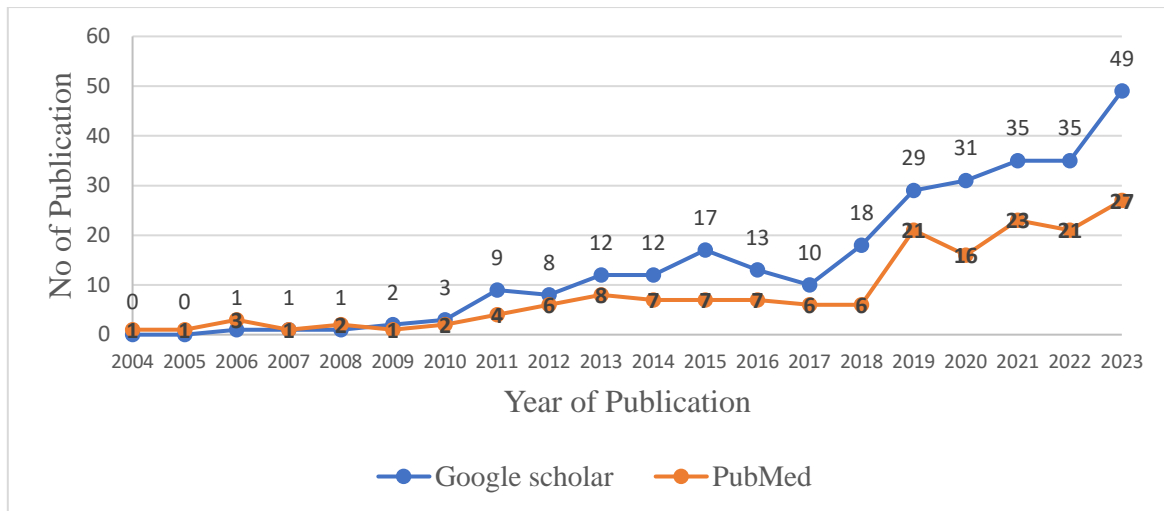


Figure 30: Trends of publications on Cancer in Tanzania

Figure 30 shows that the data had a general growth trend in the volume of scholarly publications, with Google Scholar consistently indexing more articles than PubMed. In the earlier years (2004-2008), both databases indexed very few articles, with Google Scholar averaging around 1 article per year and PubMed averaging approximately two articles per year. Over time, the number of publications increased for both databases, with Google Scholar reaching a peak of 49 articles in 2023 and PubMed reaching a peak of 27 articles in the same year.

For Rwanda, Google Scholar had 160 articles and 139 after cleaning, while PubMed had 137 articles retrieved and 69 deemed relevant after cleaning. Figure 31 shows the article publication trends. Figure 31 shows that the data in the earlier years between 2004 and 2011, both databases indexed no articles. Over time, the number of publications gradually increased for both databases, with Google Scholar reaching a peak of 23 articles in 2021 and PubMed reaching a peak of 12 articles in 2022 and 2023.

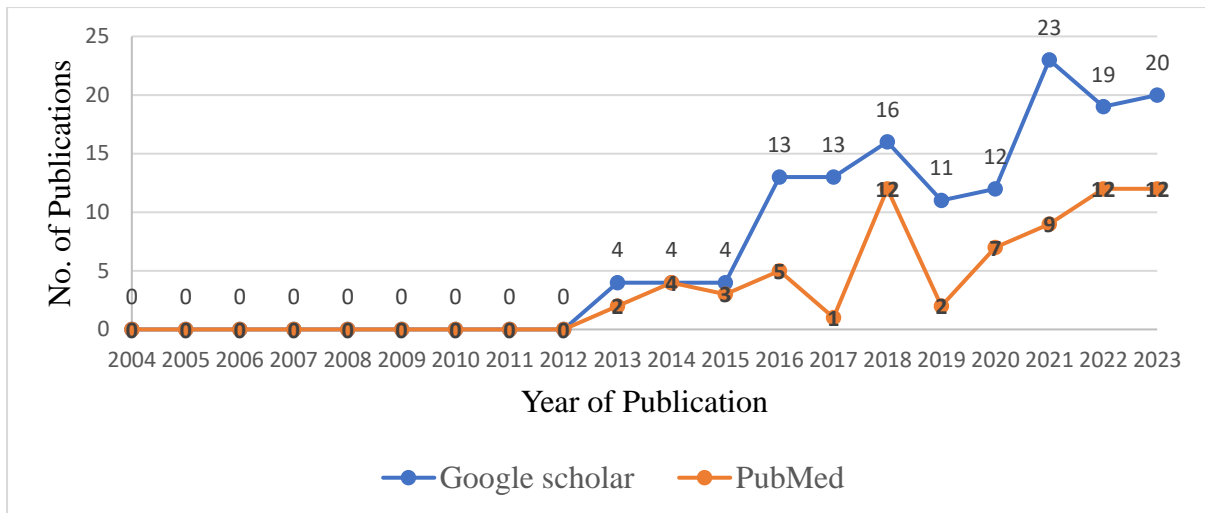


Figure 31: Trends of publications on Cancer in Rwanda

The analysis of research quantity on cancer within the EAC countries reveals a notable increase in scholarly publications over the past two decades. Across Kenya, Uganda, Tanzania, and Rwanda, both Google Scholar and PubMed indexed a growing number of articles, indicating a rising interest and research activity in understanding and addressing cancer within the region. Google Scholar consistently showed higher publication counts compared to PubMed, with peaks in publication activity observed in recent years across all countries. This upward trend suggests a heightened focus on cancer research, potentially driven by evolving healthcare priorities, increased funding, and growing awareness of the cancer burden in East Africa. The data underscores the importance of continued investment in cancer research to develop effective prevention, detection, and treatment strategies tailored to the needs of the EAC countries.

4.2.2 Types of publications

In terms of types of publications written about cancer in the EAC countries. The data hereunder represent the types of publications for each of the sampled countries. For Kenya Table 25 shows the data.

Table 25: Types of Publications on Cancer in Kenya

Types of publications (Google Scholar)	Frequency	Types of publications (PubMed)	Frequency
Journal articles	405	Journal articles	208
Thesis/dissertation	144	Clinical trial	4
Preprint	16	Comparative study	4
Conference paper	14	Case reports	1
Policy	1	Letter	1
Total	580	News article	1
		Published erratum	1
		Randomised controlled trial	1
		Interview	1
		Total	222

Table 25 shows that for Google Scholar, the highest types of publication were journal articles (405). This was followed by thesis/dissertation (144), Preprint (16), conference papers (14) and policy brief (1). PubMed, on the other hand, had the highest number of journal articles (208). There were four clinical trials, four comparative studies, one case report, one letter, one news article, one published erratum, one randomised controlled trial, and one interview.

For Uganda, Table 26 shows the data on the types of publications. Journal articles are the most popular for both Google Scholar (298) and PubMed (191). In Google Scholar, theses and dissertations are second in numbers (113), while in PubMed, comparative studies (6) follow.

Table 26: Types of Publications on Cancer in Uganda

Types of publications (Google Scholar)	Frequency	Types of publications (PubMed)	Frequency
Journal articles	298	Journal article	191
Thesis/dissertation	113	Comparative study	6
Preprint	16	Randomised controlled trial	3
Conference paper	4	Case reports	1
Book	2	Letter	1
Book chapter	1	News	1
Total	434	Review	1
		Total	204

For Tanzania, Table 27 shows the data. Journal articles were the highest in both databases. Google Scholar indexes various publication types, hence theses/dissertations (27), preprints (13), conference papers (6), books (2), news (1), and reports (1). PubMed, on the other hand, other publication types were case reports (4), comparative studies (3), clinical trials (2), and a few other types such as evaluation studies, biographies, editorials, news, observational studies, and published erratum.

Table 27: Types of Publications on Cancer in Tanzania

Types of publications (Google Scholar)	Frequency	Types of publications (PubMed)	Frequency
Journal articles	236	Journal articles	154
Thesis/Dissertation	27	Case reports	4
Preprint	13	Comparative study	3
Conference paper	6	Clinical trial	2
Book	2	Evaluation study	2
News	1	Biography	1
Report	1	Editorial	1
Total	286	News	1
		Observational study	1
		Published erratum	1
		Total	170

For Rwanda, Table 28 shows the data. Google Scholar, journal articles dominate (113). Theses and dissertations follow (22). Preprints (3) and conference papers (1) were also included in Google Scholar. On the other hand, PubMed predominantly indexes journal articles as well (63). Other types of publications, such as case reports, comparative studies, clinical trials, evaluation studies, reviews, and editorials, were also available in PubMed.

Table 28: Types of Publications on Cancer in Rwanda

Types of publications (Google Scholar)	Frequency	Types of publications (PubMed)	Frequency
Journal articles	113	Journal articles	63
Thesis/dissertation	22	Case reports	1
Preprint	3	Comparative study	1
Conference paper	1	Clinical trial	1
Total	139	Evaluation study	1
		Review	1
		Editorial	1
		Total	69

The analysis of the types of publications on cancer across EAC countries reveals that journal articles are the primary mode of dissemination of research findings. In Kenya, Uganda, Tanzania, and Rwanda, journal articles were consistently the most common type of publication indexed by both Google Scholar and PubMed, indicating the significance of scholarly research in advancing knowledge about cancer within the region. Additionally, variations in publication types were observed, with Google Scholar indexing a diverse range, including theses/dissertations, preprints, and conference papers, while PubMed primarily focused on traditional research articles but also included case reports, comparative studies, clinical trials, and other publication formats. These findings underscore the importance of diverse publishing

platforms in disseminating cancer research, catering to the varied needs of researchers, practitioners, and policymakers across the EAC countries.

4.2.3 Themes in cancer research in EAC countries

From the analysis of keywords in the titles of the publications from Google Scholar in Kenya, “Kenya” was the most common phrase, with 424 appearances. This was followed by cervical cancer screening (74), western Kenya (74), woman (68), cancer (48), cervical cancer (47), breast cancer (36), patient (35), uptake (35) and Nairobi (32). Figure 32 shows the results. These themes indicate that research has been conducted on cancer.

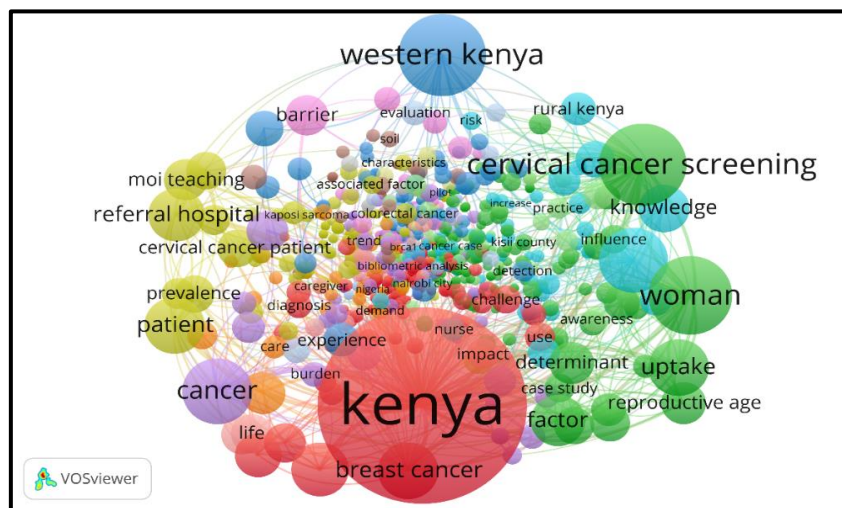


Figure 32: Themes in titles of Cancer Google Scholar research in Kenya

For PubMed, the title words had similar themes to Google Scholar. "Kenya" was the most common phrase, with 147 appearances. This was followed by Western Kenya (49), cervical cancer screening (35), women (17), cervical cancer (15), patients (12), treatments (12), and cancer (11).

The analysis of abstracts from the Google Scholar publications gave Kenya as the most frequent word. This was followed by cancer (305), cervical cancer (174), woman (109), breast cancer (101) and cervical cancer screening (69). Table 29 gives the top twenty words and their occurrences.

The analysis of abstracts gave Rwanda as the most frequent word. This was followed by cancer (63), cervical cancer (34), patient (26) and Butaro cancer centre (20). Table 32 gives the top twenty words and their occurrences.

Table 32: Themes in abstracts cancer Research in Rwanda

Word	Occurrences
Rwanda	166
Cancer	63
Cervical cancer	34
Patient	26
Butaro cancer centre	20
Breast cancer	18
Woman	14
Cervical cancer screening	10
Cancer care	9
Cancer patient	8

The analysis of cancer research themes across EAC countries, namely Kenya, Uganda, Tanzania, and Rwanda, reveals common trends and variations in research focus areas. In Kenya, research themes predominantly revolved around the country itself, with a strong emphasis on cervical cancer screening, women's health, and general cancer epidemiology. Similar trends were observed in Uganda, where research themes highlighted the country name, Uganda Cancer Institute, and prevalent issues such as patient care, cervical cancer screening, and women's health. Tanzania's research landscape mirrored Kenya and Uganda to some extent, with a notable focus on the country name, cervical cancer, and women's health. Rwanda's research themes also reflected a strong national identity, with a focus on the Butaro Cancer Centre, cervical cancer screening, and broader cancer care initiatives. Despite variations in specific research themes, common threads of cervical cancer, women's health, patient care, and cancer screening emerge across the EAC countries, underscoring the shared challenges and priorities in combating cancer within the region.

4.2.4 Evolution of the themes of cancer research in EAC countries

The study analysed how the publications have evolved in terms of themes. The publications spanned two decades between 2004 and 2023. They were divided into a decade each per country to analyse how the titles have changed in terms of themes of coverage.

For Kenya, the themes from the title words for the two decades are stipulated in Table 33.

Table 33: Evolution of cancer research themes from 2004 to 2023 in Kenya

Themes	Year 2004-2013	Themes	Year 2014-2023
Woman	9	Cervical cancer screening	69
Cancer	8	Woman	59
Factors	8	Cervical cancer	41
Breast cancer	7	Cancer	40
Cervical cancer	6	Uptake of screening	33
Cervical cancer screening	5	Breast cancer	29
Oesophageal cancer	4	Patient	29
Prevalence	4	Knowledge on cancer	25
Cervix	3	Factors	21
Epidemiology	3	Determinant of cancer	20

Table 33 shows that between 2004 and 2013, themes related to cancer and women's health were prevalent. The most frequently occurring themes were 'woman' and 'cancer' with 9 and 8 occurrences, respectively. Other common themes included 'factors', 'breast cancer', and 'cervical cancer'. The themes focused on understanding cancer epidemiology, especially in women, and exploring various factors associated with cancer. Between the year 2014 and 2023, the research focus shifted towards specific cancer types and screening practices. Cervical cancer screening emerged as the most prominent theme, with 69 occurrences indicating increased attention to preventive measures and early detection of cervical cancer. 'Woman' remained an important theme with 59 occurrences, demonstrating a continued emphasis on women's health. Other recurring themes included 'cervical cancer', 'uptake of screening', and 'breast cancer', suggesting a growing interest in understanding specific cancer types and improving screening practices.

The shift in theme occurrences over the two decades illustrates the evolution of research priorities within the field of cancer research. While women's health and cancer epidemiology were important areas of research in the first decade, the focus expanded to include cancer prevention, screening, and specific cancer types in the second decade. This evolution highlights the advancements in knowledge and changing priorities in cancer research over time in Kenya.

For Uganda, the themes from the title words for the two decades are stipulated in Table 34.

Table 34: Evolution of cancer research themes from 2004 to 2023 in Uganda

Themes	Year 2004-2013	Themes	Year 2014- 2023
Cancer	6	Patient	46
Patient	6	Cancer	39
Cervical cancer prevention	4	Cervical cancer screening	38
Cervical cancer screening	4	Woman	37
Knowledge	4	Cervical cancer	32
Woman	4	Factor	27
Attitude	3	Prevalence	21
Breast cancer	3	Knowledge	19
Cervical cancer	3	Treatment	12
Chemotherapy	3	Attitude	11

From Table 34, between year 2004 and 2013, the most common themes included 'cancer' and 'patient', both with six occurrences. 'Cervical cancer prevention', 'cervical cancer screening', 'knowledge', 'woman', and 'attitude' also emerged as significant themes. This suggests that the initial research focus was on understanding cancer as a disease, patient-centred care, and preventive measures, particularly for cervical cancer. In the years between 2014-2023, the research emphasis shifted towards specific aspects of cancer management, with 'patient' being the most frequent theme (46). The prominence of themes such as 'cervical cancer screening' (38), 'woman' (37), and 'factor' (27) highlights the growing interest in understanding the role of screening practices, focusing on women's health, and identifying various factors associated with cancer. Additionally, the increased attention on 'prevalence' (21) and 'treatment' (12) during the second decade indicates an expanding scope of research to include cancer epidemiology and therapeutic interventions.

For Tanzania, the themes from the title words for the two decades are stipulated in Table 35.

Table 35: Evolution of cancer research themes from 2004 to 2023 in Tanzania

Themes	Year 2004 - 2013	Themes	Year 2014- 2023
Breast cancer	6	Cervical cancer	31
Cervical cancer	6	Woman	28
Cervical cancer screening	6	Cervical cancer screening	26
Treatment	4	Patient	21
Woman	4	Knowledge	18
Determinant	3	Breast cancer	14
Breast cancer risk	2	Cancer	11
Cancer patient	2	Treatment	11
Cervical cancer prevention	2	Breast cancer patient	8
Experience	2	Experience	8

Table 35 indicates that in the years between 2004 and 2013, breast cancer, cervical cancer and cervical cancer screening (6) emerged as prominent themes. As research progressed into the years between 2014 and 2023, there was a notable shift in emphasis. Cervical cancer surged to the forefront, with 31 occurrences suggesting heightened awareness and intensified research efforts directed towards combating cervical cancer in Tanzania. Additionally, themes related to women's health remained prevalent, with 'woman' and 'cervical cancer screening' maintaining significance. Other recurring themes across both decades include treatment, patient care, knowledge dissemination, and the exploration of determinants influencing cancer outcomes. This evolution underscores the dynamic nature of cancer research priorities over time, shaped by emerging challenges, evolving knowledge landscapes, and shifting healthcare priorities within Tanzania.

For Rwanda, the themes from the title words for the two decades are stipulated in Table 36.

Table 36: Evolution of cancer research themes from 2004 to 2023 in Rwanda

Themes	Year 2004 - 2013	Themes	Year 2014- 2023
Patient	2	Woman	15
Breast cancer	1	Excellence	12
Care	1	Cervical cancer screening	11
Cervical cancer prevention	1	Cervical cancer	10
Comprehensive woman	1	Breast cancer	9
Control	1	Cancer	8
Gastric cancer	1	Experiences	7
Gastric outlet obstruction	1	Cancer care	6
Health systems	1	Cancer patient	6
Integration	1	Treatment	6

Table 36 shows that in the years between 2004 and 2013, there was a broad range of themes, with 'patient', 'breast cancer', and 'cervical cancer prevention' being some of the prominent themes. This shows an initial emphasis on understanding patient needs and the importance of preventive measures for breast and cervical cancer. In the years between 2014 and 2023, the research focus shifted towards women's health and specific cancer types. 'Woman' emerged as the most common theme with 15 occurrences, followed by 'excellence' (12) and 'cervical cancer screening' (11). This shift indicates an increased emphasis on women's health, improving healthcare standards, and the role of screening practices in cancer management.

The analysis of cancer research themes across EAC countries over two decades reveals notable shifts in research priorities and focus areas. In Kenya, the initial decade (2004-2013) witnessed significant attention on women's health and general cancer epidemiology, with themes such as 'woman', 'cancer', and 'factors' dominating research titles. However, in the subsequent decade (2014-2023), there was a noticeable transition towards specific cancer types and screening practices, particularly evident in the prominence of themes like 'cervical cancer screening' and 'uptake of screening'. Similarly, in Uganda, the research emphasis evolved from a broad exploration of cancer and patient-centric care in the first decade to a more targeted investigation into cancer management and screening practices in the second decade. Tanzania witnessed a shift from a balanced focus on breast cancer, cervical cancer, and screening practices in the first decade to a pronounced emphasis on cervical cancer research in the second decade. Rwanda's research trajectory also demonstrated a shift towards women's health and specific cancer types, with themes like 'woman' and 'cervical cancer screening' taking precedence in the second decade. Overall, these findings underscore the dynamic nature of cancer research priorities, influenced by emerging challenges, evolving knowledge landscapes, and changing healthcare priorities across EAC countries over time.

4.2.5 Quality of publication on cancer in EAC countries

Measuring the quality of publications using citation analysis is a widely accepted and valuable approach in the scientific community. According to Kwanya et al. (2021), citation analysis, which assesses how extensively other researchers reference scholarly work, serves as a robust indicator of research excellence. This method is grounded in the principle that high-quality research is frequently cited by peers, reflecting its influence and impact on the field. However, it is essential to acknowledge that not all scholars support this viewpoint, with some expressing concerns about the objectivity and validity of citation-based assessments. Despite these reservations, this study operates under the assumption that research with a higher number of citations is generally considered to be of higher quality and impact within the academic community.

The citation analysis for articles from Kenya, Uganda, Tanzania and Rwanda is highlighted hereunder. Table 37 shows the top-cited work for Kenya. Table 37 shows that the article with the highest number of citations, "*Medicinal plants used in treatment and management of cancer in Kakamega County, Kenya*," had 321 citations and was published in 2014. The other top-cited article was "*Perceptions of risk and barriers to cervical cancer screening at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya*" with 186 citations and was published in 2011. This was followed by "*Esophageal cancer in the North Rift Valley of Western Kenya*" with 118 citations and published in 2005. Only seven articles attained more than 100 citations. Of the 580 articles, 254 (44%) had yet to receive any citation. This indicated that 56 percent of the papers had been cited.

Table 37: Top ten most cited publications on cancer in Kenya

Cites	Authors	Title	Year
321	DO Ochwang'i, CN Kimwele, JA Oduma, PK Gathumbi	Medicinal plants used in the treatment and management of cancer in Kakamega County, Kenya	2014
186	E Were, Z Nyaberi, N Buziba	Perceptions of risk and barriers to cervical cancer screening at Moi Teaching and Referral Hospital (MTRH), Eldoret, Kenya	2011
118	J Wakhisi, K Patel, N Buziba, J Rotich	Esophageal cancer in the North Rift Valley of western Kenya	2005
116	CW Ngugi, H Boga, AWT Muigai, P Wanzala	Factors affecting uptake of cervical cancer early detection measures among women in Thika, Kenya	2012
114	JW Gatune, IK Nyamongo	An ethnographic study of cervical cancer among women in rural Kenya: Is there a folk causal model?	2005
114	IO Maranga, L Hampson, AW Oliver, A Gamal, P Gichangi	Analysis of factors contributing to the low survival of cervical cancer patients undergoing radiotherapy in Kenya	2013
102	K Patel, J Wakhisi, S Mining, A Mwangi, R Patel	Esophageal cancer, topmost cancer at MTRH in the Rift Valley, Kenya, and its potential risk factors	2013
97	M Gatumo, S Gacheri, AR Sayed, A Scheibe	Women's knowledge and attitudes related to cervical cancer and cervical cancer screening in Isiolo and Tharaka Nithi counties, Kenya: a cross-sectional.	2018
96	RK Parker, SM Dawsey, CC Abnet, RE White	Frequent occurrence of Esophageal cancer in young people in western Kenya	2010
89	MJ Huchko, EA Bukusi, CR Cohen	Building capacity for cervical cancer screening in outpatient HIV clinics in the Nyanza province of western Kenya	2011

For Uganda, Table 38 shows the top-cited work. Table 38 shows that the article with the highest number of citations, "*Knowledge, attitudes and practices on cervical cancer screening among the medical workers of Mulago Hospital, Uganda*," had 374 citations and was published in 2006. The article "*The spectrum of cancers among HIV-infected persons in Africa: the Uganda AIDS-Cancer Registry Match Study*" followed with 290 citations and was published in 2006. Article on "*Changing cancer incidence in Kampala, Uganda, 1991–2006*" followed with 273 citations and published in 2010. Fifteen articles attained more than 100 citations. Of the 434 articles, 196 (45%) had yet to receive any citation. This indicated that 55 percent of the papers had been cited.

Table 38: Top ten most cited publications on cancer in Uganda

Cites	Authors	Title	Year
374	T Mutyaba, FA Mmiro, E Weiderpass	Knowledge, attitudes and practices on cervical cancer screening among the medical workers of Mulago Hospital, Uganda	2006
290	SM Mbulaiteye, ET Katabira, H Wabinga, DM Parkin	The spectrum of cancers among HIV-infected persons in Africa: the Uganda AIDS-Cancer Registry Match Study	2006
273	DM Parkin, S Nambooze, F Wabwire-Mangen	Changing cancer incidence in Kampala, Uganda, 1991–2006	2010
232	HR Wabinga, S Nambooze, PM Amulen, C Okello	Trends in the incidence of cancer in Kampala, Uganda 1991–2010	2014
227	R Ndejjo, T Mukama, A Musabyimana, D Musoke	Uptake of cervical cancer screening and associated factors among women in rural Uganda: a cross-sectional study	2016
206	A Gakwaya, JB Kigula-Mugambe, A Kavuma, A Luwaga	Cancer of the breast: 5-year survival in a tertiary hospital in Uganda	2008
197	A Gondos, H Brenner, H Wabinga, DM Parkin	Cancer Survival in Kampala, Uganda	2005
188	T Mukama, R Ndejjo, A Musabyimana, AA Halage, D Musoke	Women's knowledge and attitudes towards cervical cancer prevention: a cross-sectional study in Eastern Uganda	2017
175	AD Mwaka, CG Orach, EM Were, G Lyratzopoulos	Awareness of cervical cancer risk factors and symptoms: cross-sectional community survey in post-conflict northern Uganda	2016
131	C Nakisige, M Schwartz, AO Ndira	Cervical cancer screening and treatment in Uganda	2017

For Tanzania, Table 39 shows the top-cited work. From the Table, the article with the highest number of citations had 338 citations, titled "*Demographic, knowledge, attitudinal, and accessibility factors associated with uptake of cervical cancer screening among women in a rural district of Tanzania: three public policy implications*" and was published in 2012. This was followed by "*Knowledge of cervical cancer and screening practices of nurses at a regional hospital in Tanzania*" with 250 citations and published in 2011. The article "*Cervical cancer screening and HPV vaccine acceptability among rural and urban women in Kilimanjaro Region, Tanzania*" followed with 149 citations and published in 2015. Four articles attained more than 100 citations. Of the 286 articles, 114 (40%) had yet to receive any citation. This indicated that 60 percent of the papers had been cited.

Table 39: Top ten most cited publications on cancer in Tanzania

Cites	Authors	Title	Year
338	FS Lyimo, TN Beran	Demographic, knowledge, attitudinal, and accessibility factors associated with uptake of cervical cancer screening among women in a rural district of Tanzania: three public policy implications	2012
250	M Urasa, E Darj	Knowledge of cervical cancer and screening practices of nurses at a regional hospital in Tanzania	2011
149	MS Cunningham, E Skrastins, R Fitzpatrick, P Jindal, O Oneko	Cervical cancer screening and HPV vaccine acceptability among rural and urban women in Kilimanjaro Region, Tanzania	2015
106	PF Rambau, PL Chalya, K Jackson	Schistosomiasis and urinary bladder cancer in North Western Tanzania: A retrospective review of 185 patients	2013
92	AM Burson, AS Soliman, TA Ngoma, J Mwaiselage	Clinical and epidemiologic profile of breast cancer in Tanzania	2010
91	C Kahesa, J Mwaiselage, HR Wabinga, T Ngoma, JN Kalyango	Association between invasive cancer of the cervix and HIV-1 infection in Tanzania: the need for dual screening	2008
86	C Kahesa, S Kjaer, J Mwaiselage, T Ngoma, B Tersbol	Determinants of acceptance of cervical cancer screening in Dar es Salaam, Tanzania	2012
84	PF Rambau, PL Chalya, MM Manyama, KJ Jackson	Pathological features of Breast Cancer seen in Northwestern Tanzania: a nine years retrospective study	2011
75	EP Morse, B Maegga, G Joseph, S Miesfeldt	Breast cancer knowledge, beliefs, and screening practices among women seeking care at district hospitals in Dar es Salaam, Tanzania	2014
72	MM Mabelele, J Materu, FD Ng'ida, MJ Mahande	Knowledge towards cervical cancer prevention and screening practices among women who attended reproductive and child health clinic at Magu district hospital, Lake Zone Tanzania: a cross-sectional study	2018

Table 40 shows the top-cited work for Rwanda. The article with the highest number of citations, "*Delays in breast cancer presentation and diagnosis at two rural cancer referral centres in Rwanda*," had 208 citations and was published in 2015. It was followed by "*Prevalence and risk factors for cervical cancer and pre-cancerous lesions in Rwanda*" with 148 citations and published in 2015. The article "*Integration of Comprehensive Women's Health Programmes into Health Systems: Cervical Cancer Prevention, care and Control in Rwanda*" followed with 104 citations and was published in 2013.

Table 40: Top ten most cited publications on cancer in Rwanda

Cites	Authors	Title	Year
208	LE Pace, T Mpunga, V Hategekimana, JMV Dusengimana	Delays in breast cancer presentation and diagnosis at two rural cancer referral centres in Rwanda	2015
148	JD Makuza, S Nsanzimana, MA Muhimpundu, LE Pace	Prevalence and risk factors for cervical cancer and pre-cancerous lesions in Rwanda	2015
104	A Binagwaho, F Ngabo, CM Wagner, C Mugeni	Integration of comprehensive Women's health programmes into Health Systems: Cervical cancer prevention, care and Control in Rwanda	2013
80	LN Shulman, T Mpunga, N Tapela, CM Wagner, T Fadelu	Bringing cancer care to the poor: experiences from Rwanda	2014
59	NM Tapela, T Mpunga, B Hedt-Gauthier, M Moore, E Mpanumusingo	Pursuing equity in cancer care: implementation, challenges and preliminary findings of a public cancer referral centre in rural Rwanda	2016
48	T Mpunga, N Tapela, BL Hedt-Gauthier, D Milner	Diagnosis of cancer in rural Rwanda: Early outcomes of a phased approach to implementing anatomic pathology services in resource-limited settings	2014
42	I Mukakalisa, R Bindler, C Allen, J Dotson	Cervical cancer in developing countries: effective screening and preventive strategies with an application in Rwanda	2014
38	T Mpunga, BL Hedt-Gauthier, N Tapela, I Nshimiyimana	Implementation and validation of telepathology triage at a cancer referral centre in rural Rwanda	2016
37	GN Mody, A Nduaguba, F Ntirenganya, R Riviello	Characteristics and presentation of patients with breast cancer in Rwanda	2013
33	J Kabatende, M Mugisha, L Ntirenganya, A Barry, E Ruberanziza	Prevalence, intensity, and correlates of soil-transmitted helminth infections among school children after a decade of preventive chemotherapy in Western Rwanda	2020
33	F Rubagumya, A Costas-Chavarri, A Manirakiza, G Murenzi	State of cancer control in Rwanda: past, present, and future opportunities	2020

From Table 40, three articles attained more than 100 citations. Of the 139 articles, 60 (43%) had yet to receive any citation. This indicated that 57 percent of the papers had been cited.

Further, after checking the quality, the study correlated the number of citations for articles with the age of the articles. Table 41 indicates the correlation data for Kenya.

Table 41: Correlation analysis of citations vs age of articles for Kenya

Obs (580)	Cites	Age
Cites	1.0000	
Age	0.3072	1.0000

Table 41 shows the correlation analysis between the number of citations (Cites) and the age of articles (Age) for a sample of 580 articles from Kenya. The correlation coefficient between Cites and Age is 0.3072, indicating a moderate positive relationship. This suggests that older

articles tend to accumulate more citations over time. However, the strength of this correlation is moderate, implying that while age contributes to the number of citations an article receives, it is not the sole determinant. Other factors, such as the relevance and quality of the research, the field of study, and the visibility of the article, also play significant roles in influencing citation counts. Therefore, while there is a tendency for older articles to be more cited, many other elements also impact how frequently an article is referenced in scholarly work.

For Uganda, Table 42 show the correlation analysis.

Table 42: Correlation analysis of citations vs age of articles for Uganda

(obs=434)	Cites	Age
Cites	1.0000	
Age	0.4024	1.0000

Table 42 shows that the correlation coefficient between citations and the age of Uganda publications is 0.4024. This is a moderate positive linear relationship between the two variables. This suggests that older articles tend to have more citations in the context of Ugandan research publications.

For Tanzania, Table 43 shows the correlation analysis.

Table 43: Correlation analysis of citations vs age of articles for Tanzania

(obs=286)	Cites	Age
Cites	1.0000	
Age	0.3953	1.0000

Table 43 shows that the correlation coefficient between citations and the age of Tanzania publications is 0.3953. This is a moderate positive linear relationship between the two variables. This implies that as the age of a publication increases, there is a slight tendency for the number of citations to increase as well.

For Rwanda, Table 44 shows the correlation analysis.

Table 44: Correlation analysis of citations vs age of articles for Rwanda

(obs=139)	Cites	Age
Cites	1.0000	
Age	0.4092	1.0000

Table 44 shows that the correlation coefficient between citations and the age of Rwanda publications is 0.4092. This is a moderate positive linear relationship between the two variables. This suggests that older articles tend to have more citations in the context of Rwandan research publications.

The correlation analyses for Kenya, Uganda, Tanzania, and Rwanda revealed moderate positive linear relationships between the age of publications and the number of citations. The correlation coefficients were 0.3072 for Kenya, 0.4024 for Uganda, 0.3953 for Tanzania, and 0.4092 for Rwanda. These results indicate that, in all four countries, older publications tended to have a higher number of citations, albeit with varying degrees of association.

4.2.6 Authorship of the research on cancer in EAC countries

Of the 580 publications from Kenya, most of the articles were published by one author, 158(27.24%). This was followed by five authors, 121 (20.86%); four authors, 120(20.69%); three authors, 101(17.41%); six authors, 43(7.41%) and two authors, 37(6.38%). Figure 36 shows the social network analysis for the collaborations in Kenya.

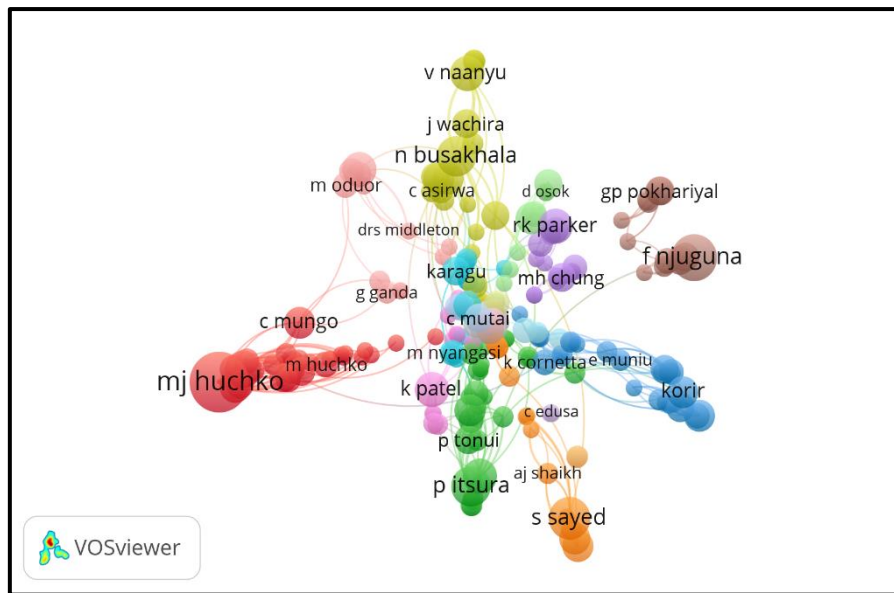


Figure 36: Co-authorship on cancer research from Kenya

Figure 36 shows that authors collaborated, with MJ Huchko (19) having many collaborations. They were followed by F Njuguna (12) and S Sayed (10) collaborations. Table 45 shows an overview of the collaboration network within a research community using links, total links strength and occurrences.

Table 45: Social network metrics for cancer research authors in Kenya

Authors	Links	Total link strength	Occurrences	Authors	Links	Total link strength	Occurrences
MJ Huchko	27	57	19	S Ibrahim	20	30	8
F Njuguna	32	46	12	D Menya	13	22	7
S Sayed	28	38	10	K Patel	20	26	7
N Busakhala	23	32	9	N Buziba	17	23	7
P Itsura	27	38	9	RK Parker	15	22	7

Table 45 provides valuable insights into the collaboration patterns, impact, and involvement of various authors within the cancer research network. Links represent the number of connections each author has within the collaboration network. F Njuguna had the highest number of links (32), indicating a strong collaboration presence and a well-connected position within the network. The total link strength indicates the overall strength or impact of each author's connections within the network. MJ Huchko (57) had the most impactful collaborations among all authors, hinting at strong and valuable research connections.

Of the 434 publications from Uganda, most of the articles were published by one author 127(29.26%). This was followed by four authors, 116(26.73%), five authors 114(26.27%), three authors 40(9.22%), six authors 20(4.61%) and two authors 17(3.92%). Figure 37 shows the social network analysis for the collaborations from Uganda. Figure 37 shows that authors collaborated, with J Orem (25) having many collaborations. They were followed by H Wabinga (21) and W Phipps (11) collaborations.

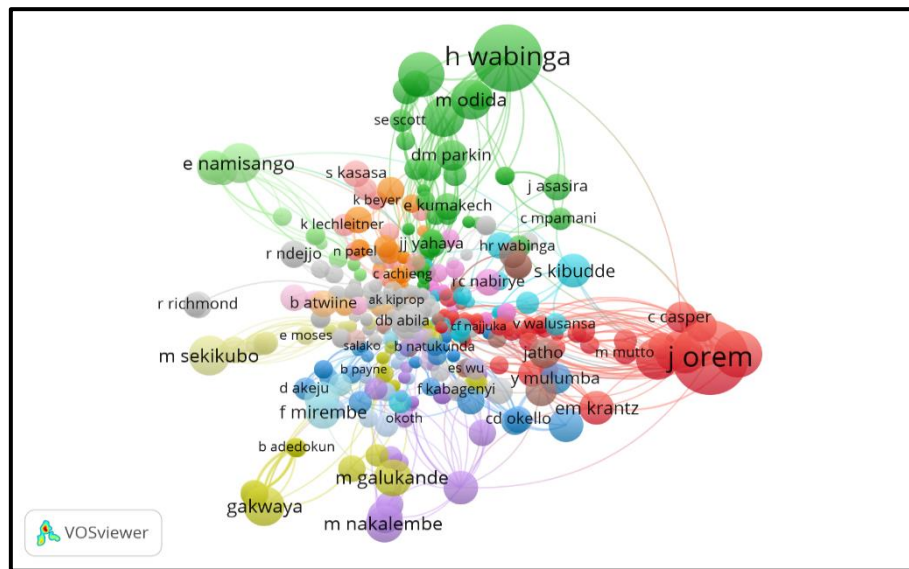


Figure 37: Co-authorship on cancer research from Uganda

Table 46 shows an overview of the collaboration network within a research community using links, total links strength and occurrences.

Table 46: Social network metrics for cancer research authors in Uganda

Authors	Links	Total link strength	Occurrences	Authors	Links	Total link strength	Occurrences
J Orem	63	91	25	E Mamisango	16	27	8
H Wabinga	43	67	21	A Gakwaya	16	27	8
W Phipps	26	46	11	M Odida	11	22	8
AD Mwaka	16	27	10	M Sekikubo	16	26	8
N Niyonzima	19	28	9	S Nambooze	17	23	8

Table 46 shows that J Orem (63) was the author with the highest links, followed by H Wabinga (43). J Orem's total link strength is the highest (91), and that of H Wabinga is the highest (67).

Lastly, J Orem (25) appears to be the most actively involved author in the network, followed by H Wabinga (21).

Of the 286 publications from Tanzania, most of the articles were published by four authors, 96(33.57%). This was followed by five authors, 92(32.17%), single authors 34(11.89%), six authors 25(8.74%), three authors 23(8.04%) and two authors 16(5.59%). Figure 38 shows the social network analysis for the collaborations from Tanzania. Figure 38 shows that authors collaborated, with C Kahesa (17) having many collaborations. They were followed by J Mwaiselage (16) and T Ngoma (13) collaborations.

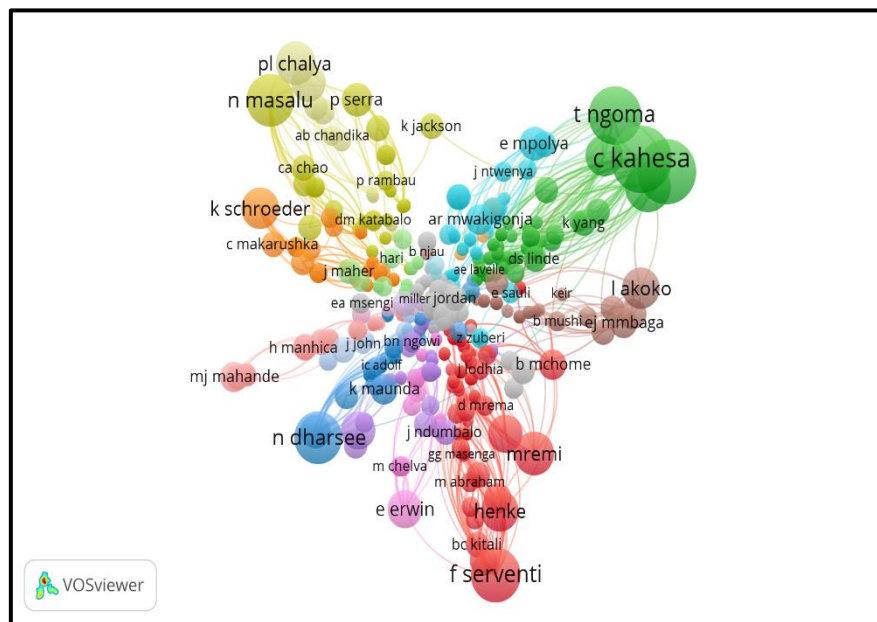


Figure 38: Co-authorship on cancer research from Tanzania

Table 47 shows an overview of the collaboration network within a research community using links, total links strength and occurrences. The table shows that the author with the highest links was J Mwaiselage (45), followed by C Kahesa (43). The total link strength of J Mwaiselage is the highest (59), and that of C Kahesa is the highest (57).

Table 47: Social network metrics for cancer research authors in Tanzania

Authors	Links	Total link strength	Occurrences	Authors	Links	Total link strength	Occurrences
C Kahesa	43	57	17	N Masalu	35	44	11
J Mwaiselage	45	59	16	K Msami	24	35	10
T Ngoma	32	45	13	A Mremi	26	28	8
F Serventi	33	45	12	PL Chalya	13	25	8
N Dharsee	35	37	11	K Schroeder	23	27	7

Of the 139 publications from Rwanda, most of the articles were published by four authors, 60(43.17%). This was followed by five authors, 32(23.02%), single authors 30(21.58%), three authors 13(9.35%), two authors and six authors each had 2(1.44%). Figure 39 shows the social network analysis for the collaborations from Rwanda.

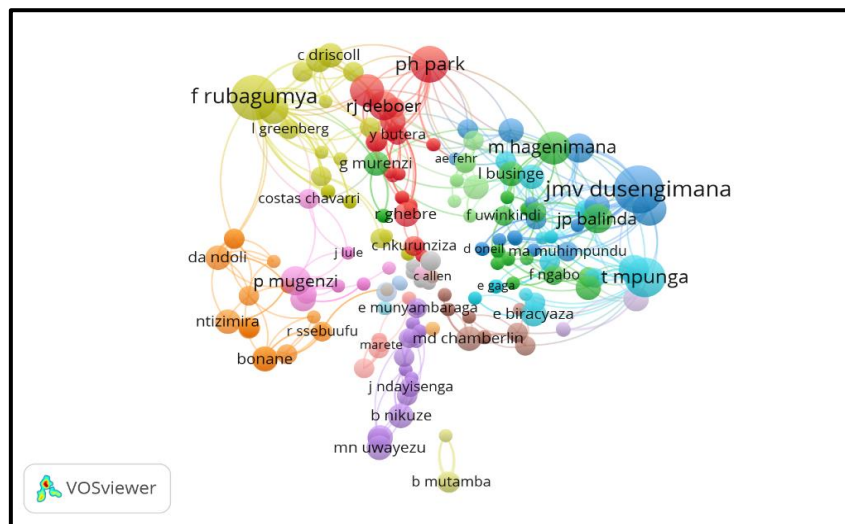


Figure 39: Co-authorship on cancer research from Rwanda

Figure 39 shows that authors collaborated, with JMV Dusengimana (17) having many collaborations. They were followed by F Rubagumya (9) and TMpunga (7) collaborations. Table 48 shows an overview of the collaboration network within a research community using links, total links strength and occurrences.

Table 48: Social network metrics for cancer research authors in Rwanda

Authors	Links	Total link strength	Occurrences	Authors	Links	Total link strength	Occurrences
JMV Dusengimana	23	29	10	C Shyirambere	15	15	5
F Rubagumya	24	31	9	LE Pace	12	15	5
T Mpunga	18	21	7	M Hagenimana	15	16	5
PH Park	21	21	6	JP Balinda	14	14	4

Table 48 show that the author with the highest links was F Rubagumya (24), they were followed by JMV Dusengimana (23). The total link strength of F Rubagumya is the highest (31) and JMV Dusengimana (29).

4.3 Cancer information search trends and cancer occurrences in the EAC countries

The analysis for this objective explored the relationship between cancer information search trends and cancer incidences in EAC countries. For statistics on cancer incidences, the study leveraged data from the Global Cancer Observatory database. The limitation of the database was that the available data was only for the year 2022. To compare the cancer search trend and cancer incidences, the study used cancer search trends for the year 2022.

For Kenya, in the year 2022, the top searches were about cancer symptoms and signs (100).

Table 49 shows the data.

Table 49: Top cancer search topics in 2022 for Kenya

Cancer Top Searches in Kenya	Relative search volume
Cancer symptoms and signs	100
Breast cancer	70
Cancer causes	65
Cervical cancer	65
Prostate cancer	40
Cancer treatment	28
Throat cancer	20
Stomach cancer	19
Colon cancer	18
Blood cancer	17
Lung cancer	17
Cancer screening	15

From Table 49, breast cancer, with a relative search volume of 70, also stands out as the most-searched-specific cancer type. Similarly, the search volume of 65 for cervical cancer highlights the importance of regular screening and vaccination, particularly for women. Additionally, people are keen to understand the underlying causes and risk factors associated with cancer development, as evidenced by the relative search volume of 65 for cancer causes. The prominence of searches related to cancer treatment (28) and screening (15) indicates a desire to understand available treatment options and the importance of early detection through

screening programs. Furthermore, the diverse range of searches for various other cancer types, such as throat, stomach, colon, blood, and lung cancers, reflects a broad interest in understanding and comparing different cancers.

Table 50 shows the data retrieved from Global Cancer Observatory databases regarding cancer incidences in Kenya in 2022.

Table 50: Cancer incidence rates for 2022 in Kenya

Cancer	Rank	(%)	Cum. risk	Cancer	Rank	(%)	Cum. risk
Breast	1	16.2	4.5	Brain CNS	17	1.6	0.23
Cervix uteri	2	13.1	3.5	Kaposi sarcoma	18	1.5	0.14
Prostate	3	8	4.2	Bladder	19	1.2	0.24
Oesophagus	4	7.5	1.5	Kidney	20	1.2	0.14
Colorectum	5	6.9	1.3	Thyroid	21	1	0.16
Stomach	6	4.2	0.88	Gallbladder	22	0.96	0.21
Leukaemia	7	3.9	0.45	Hodgkin lymphoma	23	0.94	0.08
NHL	8	3.8	0.48	Larynx	24	0.82	0.17
Ovary	9	2.8	0.99	Melanoma	25	0.59	0.12
Nasopharynx	10	2.1	0.29	Vulva	26	0.36	0.1
Lung	11	2	0.46	Salivary glands	27	0.34	0.06
Pancreas	12	2	0.44	Hypopharynx	28	0.32	0.06
Liver	13	2	0.34	Oropharynx	29	0.2	0.04
Corpus uteri	14	1.9	0.78	Vagina	30	0.13	0.06
Multiple myeloma	15	1.8	0.34	Penis	31	0.11	0.04
Lip, oral cavity	16	1.7	0.31	Testis	32	0.08	0.02

Source: GLOBOCAN (2022)

Comparing the two tables (Tables 49 and 50) helps in examining the relationship between the search interest in specific cancer types in Kenya and their actual incidence rates. From the tables, breast cancer has the highest search volume (70) and the highest incidence rate (16.2%). This shows that breast cancer is a great concern in Kenya's population. The strong relationship between search interest and incidence suggests high public awareness about this cancer type. Second on the list is cervical cancer (65 relative search volume), with a 13.1% incidence rate. Prostate cancer is the third most searched cancer type (40 relative search volume) and the third-highest incidence rate (8%). There appears to be a correlation between the relative search volumes and the incidence rates of various cancer types in Kenya, indicating that public interest and awareness are, to some extent, influenced by the prevalence of these cancers in the population. However, there are some discrepancies between search interest and cancer

incidence of oesophagus cancer. Despite being the fourth most common cancer in Kenya, oesophageal cancer does not appear in the top searches, suggesting a possible gap in public awareness. Similarly, colorectal cancer has a relatively lower search volume compared to its incidence rate, and colorectal cancer may require more awareness and educational efforts in Kenya.

For Uganda in the year 2022, the top searches were about cancer symptoms and signs (100). This was followed by prostate cancer (95), breast cancer (90) and cervical cancer (87). Table 51 shows the data.

Table 51: Top cancer search topics in 2022 for Uganda

Cancer Top Searches in Uganda	Relative search volume
Cancer symptoms and signs	100
Prostate cancer	95
Breast cancer	90
Cervical cancer	87
Cancer causes	77
Throat cancer	24
Colon cancer	23
Lung cancer	23
Blood cancer	22
Stomach cancer	18
Cervical cancer screening	17
Skin cancer	17

In terms of cancer incidences in 2022 in Uganda, Table 52 shows the data retrieved from Global Cancer Observatory databases. Data comparison from Tables 51 and 52 shows that some cancer types, such as cervical cancer (19.3% incidence rate and 87 search volume), breast cancer (8.3% incidence rate and 90 search volume), and prostate cancer (7.5% incidence rate and 95 search volume), exhibit a correlation between search interest and their prevalence. However, discrepancies exist for other cancers, like Kaposi sarcoma (11.3% incidence rate but not in the top searches) and oesophageal cancer (6.8% incidence rate but not in the top searches), indicating a potential need for targeted awareness and education efforts.

Table 52: Cancer incidence rates for 2022 in Uganda

Cancer	Rank	(%)	Cum. Risk	Cancer	Rank	(%)	Cum. Risk
Cervix uteri	1	19.3	5.7	Hodgkin lymphoma	17	1.1	0.11
Kaposi sarcoma	2	11.3	0.98	Corpus uteri	18	1.1	0.47
Breast	3	8.3	2.5	Thyroid	19	0.99	0.18
Prostate	4	7.5	5.3	Bladder	20	0.91	0.2
Oesophagus	5	6.8	1.6	Penis	21	0.88	0.35
NHL	6	6.3	0.71	Pancreas	22	0.81	0.2
Liver	7	5.5	0.99	Larynx	23	0.68	0.17
Colorectum	8	3.9	0.89	Multiple myeloma	24	0.52	0.12
Leukaemia	9	2.2	0.23	Melanoma	25	0.43	0.08
Ovary	10	2	0.62	Vulva	26	0.4	0.12
Stomach	11	1.7	0.38	Oropharynx	27	0.3	0.06
Lung	12	1.6	0.34	Salivary glands	28	0.26	0.04
Nasopharynx	13	1.5	0.23	Hypopharynx	29	0.2	0.06
Kidney	14	1.4	0.11	Testis	30	0.18	0.05
Brain CNS	15	1.3	0.19	Vagina	31	0.12	0.03
Lip oral cavity	16	1.3	0.25	Mesothelioma	32	0.09	0.01

Source: GLOBOCAN (2022)

For Tanzania in the year 2022, the top searches were about breast cancer (100). This was followed by cervical cancer (95) and cancer symptoms (78). Table 53 shows the data.

Table 53: Top cancer search topics in 2020 for Tanzania

Cancer Top Searches in Tanzania	Relative search volume
Breast cancer	100
Cervical cancer	95
Cancer symptoms and signs	78
Prostate cancer	63
Cancer causes	57
Lung cancer	33
Colon cancer	24
Blood cancer	19
Esophageal cancer	18
Skin cancer	18
Gastric cancer	17
Liver cancer	17
Bladder cancer	16
Cancer stages	16
Ovarian cancer	16
Colorectal cancer	15
Throat cancer	12

Table 54 shows the data retrieved from Global Cancer Observatory databases regarding cancer incidences in Tanzania in 2022.

Table 54: Cancer incidence rates for 2022 in Tanzania

Cancer	Rank	(%)	Cum. Risk	Cancer	Rank	(%)	Cum. Risk
Cervix uteri	1	24.2	7.1	Melanoma	17	0.9	0.15
Prostate	2	10.7	5	Thyroid	18	0.88	0.14
Breast	3	10	2.9	Hodgkin lymphoma	19	0.86	0.09
Oesophagus	4	7.9	1.4	Corpus uteri	20	0.84	0.32
Colorectum	5	4.9	0.75	Nasopharynx	21	0.77	0.1
Kaposi sarcoma	6	3.1	0.34	Vulva	22	0.64	0.13
NHL	7	3	0.32	Larynx	23	0.59	0.11
Stomach	8	2.7	0.52	Hypopharynx	24	0.48	0.08
Bladder	9	2.5	0.46	Salivary glands	25	0.47	0.07
Liver	10	2.5	0.38	Brain CNS	26	0.43	0.04
Lung	11	1.8	0.29	Penis	27	0.31	0.13
Ovary	12	1.6	0.42	Gallbladder	28	0.3	0.05
Leukaemia	13	1.5	0.15	Multiple myeloma	29	0.29	0.05
Kidney	14	1.5	0.12	Vagina	30	0.26	0.07
Lip oral cavity	15	1.4	0.24	Oropharynx	31	0.22	0.04
Pancreas	16	1.1	0.22	Mesothelioma	32	0.11	0.02

Source: GLOBOCAN (2022)

From Tables (53-54) cancer types, such as breast cancer (10% incidence rate, 100 search volume), cervical cancer (24.2% incidence rate, 95 search volume), and prostate cancer (10.7% incidence rate, 63 search volume), exhibit a correlation between search interest and their prevalence. However, there are discrepancies between search interest and cancer incidence, such as oesophageal cancer (7.9% incidence rate) ranking fourth in incidence but not among the top searches and colorectal cancer (4.9% incidence rate) having a relatively lower search volume compared to its incidence rate. These discrepancies suggest that information searches may not always match the actual prevalence of certain cancer types.

In 2022, Rwanda's top searches were for pancreatic cancer (100), followed by prostate cancer (85) and cancer symptoms (80). Table 55 shows the data.

Table 55: Top cancer search topics in 2022 for Rwanda

Cancer Top Searches in Rwanda	Relative search volume
Pancreatic cancer	100
Prostate cancer	85
Cancer symptoms and signs	80
Breast cancer	79
Cervical cancer	55
Stomach cancer	26
Pancreas cancer	19
Colon cancer	17
Testicular cancer	9

In terms of cancer incidences in 2022 in Rwanda, Table 56 shows the data retrieved from Global Cancer Observatory databases.

Table 56: Cancer incidence rates for 2022 in Rwanda

Cancer	Rank	(%)	Cum. Risk	Cancer	Rank	(%)	Cum. Risk
Prostate	1	14.3	4.3	Thyroid	17	1.2	0.09
Cervix uteri	2	12.2	2.1	Hodgkin lymphoma	18	1.2	0.06
Breast	3	11.2	1.7	Larynx	19	0.98	0.13
Stomach	4	9.1	0.97	Vulva	20	0.9	0.13
Liver	5	5.6	0.56	Melanoma	21	0.87	0.08
Colorectum	6	5	0.49	Bladder	22	0.86	0.09
NHL	7	4.5	0.3	Multiple myeloma	22	0.86	0.09
Leukaemia	8	4.1	0.22	Pancreas	24	0.84	0.09
Lung	9	3.1	0.34	Corpus uteri	25	0.7	0.13
Ovary	10	2.7	0.43	Oropharynx	26	0.45	0.05
Brain CNS	11	2.4	0.14	Salivary glands	27	0.42	0.04
Oesophagus	12	2.2	0.24	Nasopharynx	27	0.42	0.03
Kaposi sarcoma	13	1.9	0.12	Testis	29	0.32	0.06
Kidney	14	1.5	0.06	Vagina	30	0.15	0.03
Lip oral cavity	15	1.3	0.13	Hypopharynx	31	0.04	0.01
Penis	16	1.3	0.24	Gallbladder	32	0	0

Source: GLOBOCAN (2022)

From Tables 55 and 56, cancer types, such as prostate cancer (14.3% incidence rate, 85 search volume) and breast cancer (11.2% incidence rate, 79 search volume), exhibit a relationship between search interest and their prevalence. However, discrepancies exist between search interest and cancer incidence of pancreatic cancer, which has the highest search volume but a relatively lower incidence rate (0.84%, ranked 24th); cervical cancer has a high incidence rate (12.2%, ranked second) but a moderate search volume (55), and stomach cancer has a notable incidence rate (9.1%, ranked fourth) with a relatively lower search volume (26).

4.4 Cancer information search trends and cancer informetric patterns in the EAC countries

The study examines the cancer information search trends and informetric patterns within the EAC countries, focusing on the relationship between search interest and actual information production. Table 57 shows the Pearson correlations for the Kenya data.

Table 57: Correlation analysis of cancer Web search and publications for Kenya

Kenya correlations				
		Year	Web Relative search volume	No. of Publications in Google Scholar
Year	Pearson Correlation	1	.435	.928**
	Sig. (2-tailed)		.056	.000
	N	20	20	20
Web Relative search volume	Pearson Correlation	.435	1	.323
	Sig. (2-tailed)	.056		.165
	N	20	20	20
No of Publications in Google Scholar	Pearson Correlation	.928**	.323	1
	Sig. (2-tailed)	.000	.165	
	N	20	20	20

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation statistics from Table 57 for Kenya depict the relationships between various factors related to cancer Web searches and scientific publications. The correlation coefficient between the year and Web relative search volume ($r = .435$, $p = .056$) suggests a moderate positive relationship, implying that as time progresses, there is a tendency for an increase in online searches related to cancer. Similarly, the correlation coefficient between Web relative search volume and the number of publications ($r = .323$, $p = .165$) in Google Scholar indicates a positive but relatively weak association, although not statistically significant. In contrast, the strong positive correlation of 0.928** between the year and the number of publications suggests a substantial increase in scientific research output on cancer-related topics over time, which is statistically significant at the 0.01 level.

For Uganda, Table 58 shows the Pearson correlations for the Uganda data.

Table 58: Correlation analysis of cancer Web search and publications for Uganda

Uganda correlations				
		Year	Web Relative search volume	No of Publications in Google Scholar
Year	Pearson Correlation	1	.696**	.890**
	Sig. (2-tailed)		.001	.000
	N	20	20	20
Web Relative search volume	Pearson Correlation	.696**	1	.435
	Sig. (2-tailed)	.001		.056
	N	20	20	20
No of Publications in Google Scholar	Pearson Correlation	.890**	.435	1
	Sig. (2-tailed)	.000	.056	
	N	20	20	20

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis of cancer Web searches and publications for Uganda, as depicted in Table 58, reveals significant relationships between various factors related to online search behaviour and scientific research output. There is a strong positive correlation between the year and web relative search volume ($r = 0.696$, $p = 0.001$), indicating a notable increase in searches related to cancer over time. Similarly, a very strong positive correlation exists between the year and the number of publications in Google Scholar ($r = 0.890$, $p = 0.000$), underscoring a significant rise in scholarly output on cancer topics. Additionally, a moderate positive correlation is observed between web search volume and scholarly publications ($r = 0.435$, $p = 0.056$), suggesting that as web search activity increases, so does scholarly engagement. The findings underscore the interconnectedness between online information-seeking behaviour and scientific research efforts in addressing the challenge of cancer in Uganda.

For Tanzania, Table 59 shows the Pearson correlations for the Tanzania data.

Table 59: Correlation analysis of cancer Web search and publications for Tanzania

Tanzania Correlations				
		Year	Web Relative search volume	No of Publications in Google Scholar
Year	Pearson Correlation	1	.874**	.924**
	Sig. (2-tailed)		.000	.000
	N	20	20	20
Web Relative search volume	Pearson Correlation	.874**	1	.788**
	Sig. (2-tailed)	.000		.000
	N	20	20	20
No of Publications in Google Scholar	Pearson Correlation	.924**	.788**	1
	Sig. (2-tailed)	.000	.000	
	N	20	20	20

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis for Tanzania reveals significant positive relationships between the variables studied. There is a strong positive correlation between the year and the number of publications ($r = .924$, $p < .01$), indicating that academic cancer research has consistently increased over time. Additionally, there is a significant positive correlation between Web search interest and the year ($r = .874$, $p < .01$), suggesting that public awareness, as measured by search interest, has also grown substantially over the 20 years. Furthermore, a significant

positive correlation exists between Web search interest and the number of publications ($r = .788, p < .01$). This finding suggests that increased academic research activity is associated with higher search interest, indicating that the growth in academic publications may have contributed to raising public awareness about cancer in Tanzania.

For Rwanda, Table 60 shows the Pearson correlations for the Rwanda data.

Table 60: Correlation analysis of cancer Web search and publications for Rwanda

Correlations				
		Year	Web Relative search volume	No of Publications in Google Scholar
Year	Pearson Correlation	1	.946**	.905**
	Sig. (2-tailed)		.000	.000
	N	20	20	20
Web Relative search volume	Pearson Correlation	.946**	1	.862**
	Sig. (2-tailed)	.000		.000
	N	20	20	20
No of Publications in Google Scholar	Pearson Correlation	.905**	.862**	1
	Sig. (2-tailed)	.000	.000	
	N	20	20	20

** . Correlation is significant at the 0.01 level (2-tailed).

The correlation analysis for Rwanda demonstrates significant positive relationships between the studied variables. There is a strong positive correlation between the year and the number of publications ($r = .905, p < .01$), indicating that academic cancer research has consistently increased over time. Additionally, there is a significant positive correlation between Web search interest and the year ($r = .946, p < .01$), suggesting that public awareness, as measured by search interest, has also grown substantially over the 20 years. Furthermore, a significant positive correlation exists between Web search interest and the number of publications ($r = .862, p < .01$). This finding suggests that increased academic research activity is associated with higher search interest, indicating that the growth in academic publications may have contributed to raising public awareness about cancer in Rwanda.

4.5 Modelling the interplay between cancer information demand and cancer information supply in EAC countries

Modelling the interplay between the demand and supply of cancer information across the EAC countries provides valuable insights into the dynamics of public interest and scientific research efforts in addressing cancer. The correlation analyses conducted for Kenya, Uganda, Tanzania, and Rwanda demonstrate significant positive relationships between various factors related to online search behaviour and scientific research output.

In all four countries, there is a consistent pattern of strong positive correlations between the year and both Web relative search volume and the number of publications. This indicates a temporal trend of increasing public interest in cancer-related information, as reflected in online search behaviour, alongside a corresponding rise in academic research output on cancer topics over time. Additionally, there are significant positive correlations between Web search interest and the number of publications. This suggests that heightened public awareness, as measured by search interest, may influence the volume of scientific publications.

Furthermore, the correlations highlight variations in the strength of these relationships across the EAC countries. For instance, while all countries exhibit strong positive correlations between Web search interest and the year, the correlation coefficients vary slightly, suggesting nuanced differences in the growth of public awareness about cancer. Similarly, variations in the correlations between Web search interest and the number of publications indicate differences in the extent to which academic research activity is associated with public interest in cancer information across the countries.

Building upon the insights gained from the findings analyses of cancer information demand and supply across the EAC countries, the study proposes a Web application to address this dynamic interplay. The name of the Web application is *Health Connect Centre*. The term

"*Health*" highlights the application's all-encompassing strategy for handling the several aspects of cancer information, such as the creation, sharing, and seeking of cancer knowledge. "*Connect*" draws attention to the platform's core objective of bridging the informational gaps between cancer information seekers and available resources. The term "*Centre*" designates a centralised, conveniently located hub that provides a reliable, up-to-date repository of cancer-related information. The Web application can be hosted at the Technical University of Kenya under a subdomain. The reason for hosting it at the university is that it is part of the university's research output. Additionally, the Web application will capitalise on the institution's academic strength and research output, ensuring alignment with the latest in health informatics and cancer research.

In the initial phase, the Web application is tailored to meet the diverse information needs of cancer information seekers. This phase focuses on establishing a centralised platform where users can access a comprehensive array of cancer-related information sourced primarily from Google Scholar. By harnessing data from Google Scholar, the model ensures that users have access to a broad spectrum of scholarly articles, research papers, and other academic resources pertinent to cancer. Figure 40 shows the first phase of the proposed model.

In the subsequent phase, the Web application aims to elevate the quality and scope of available information through strategic partnerships and collaborations. By forging alliances with research institutions, universities, and healthcare organisations, the phase seeks to amalgamate efforts in information production endeavours. Through these partnerships, the platform will tap into the expertise and resources of esteemed institutions, thereby broadening the spectrum of high-quality content accessible to users. Moreover, the Web application will integrate features such as doctor registrations and support groups to enrich the user experience. By facilitating interactions with healthcare professionals and fostering community support networks, the

platform endeavours to provide users with not only quality information but also a robust support system for those seeking for cancer information.

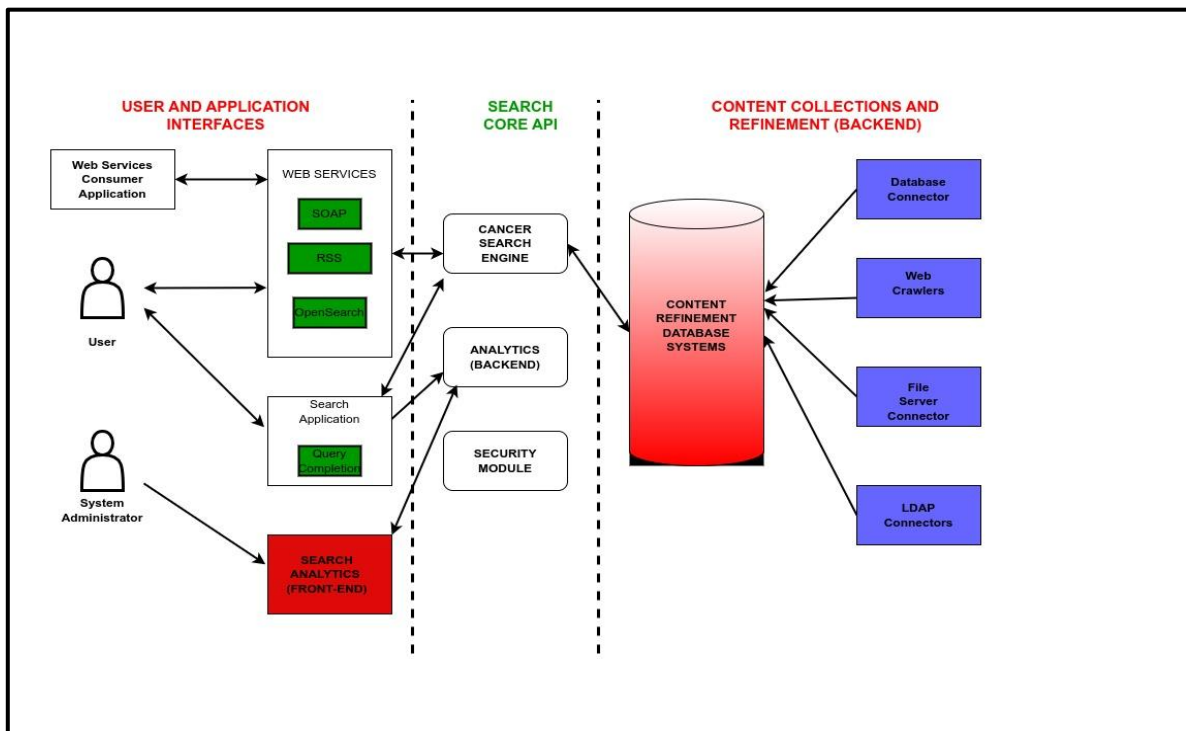


Figure 40: First phase proposed model for modelling cancer information demand and supply
 This model is designed to facilitate efficient and secure access to vast amounts of cancer-related data. It integrates various user interfaces, a robust search core API, and comprehensive backend systems to ensure that users, including researchers and administrators, can retrieve, analyse, and manage cancer research data effectively. The core segments of the model are discussed hereunder.

4.5.1 User and application interfaces

The user and application interfaces are made up of Web services, search applications, users, and system administrators. The Web services are made up of Simple Object Access Protocols (SOAP), Really Simple Syndication (RSS) and OpenSearch that operate on the Django Framework for building applications, which collectively facilitate communication, data exchange, and content discovery across various platforms and applications. SOAP serves as a

protocol integral to the exchange of structured information in the implementation of Web services. It utilises Extensible Markup Language (XML) for its message format and depends on application layer protocols, primarily Hypertext Transfer Protocol (HTTP), for the negotiation and transmission of messages. RSS, on the other hand, is a Web feed format that provides users and applications with access to updates from websites in a standardised, machine-readable format. OpenSearch comprises a suite of technologies designed to facilitate the publishing of search results in a format suitable for syndication and aggregation, thereby enhancing accessibility and interoperability across different platforms and applications. Figure 41 shows the landing page of the applications at the user's side.



Figure 41: Landing page of the application from the user side

The search application serves as a vital intermediary between users and the backend systems, facilitating user queries and enhancing the search experience. With its query completion features, the application assists users by suggesting possible completions for partially entered search terms, thereby improving the accuracy of search results and enhancing user satisfaction. By offering real-time suggestions and predictions, the search application streamlines the search process, helping users formulate precise queries and discover relevant information efficiently. This functionality not only enhances the user experience but also ensures that users can quickly

access the information they need, making the search application an indispensable tool for accessing and navigating complex datasets effectively. Figure 42 shows the search form input for the user.

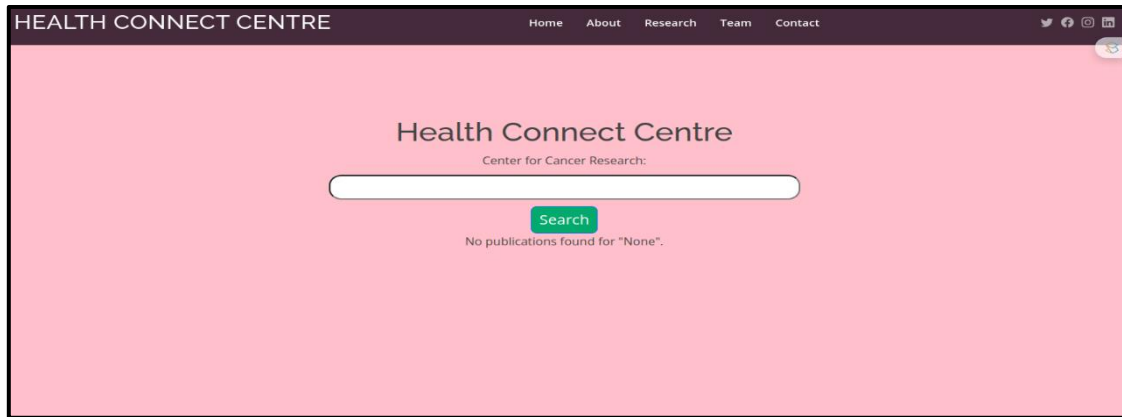


Figure 42: Search bar input for the user

Users include cancer information seekers who can be patients, researchers, healthcare professionals, or any other person interested in accessing cancer information. These users will be interacting primarily through a search application. They submit queries and receive results from the cancer search engine. Figure 43 shows the user interface and sample results retrieved from a search.

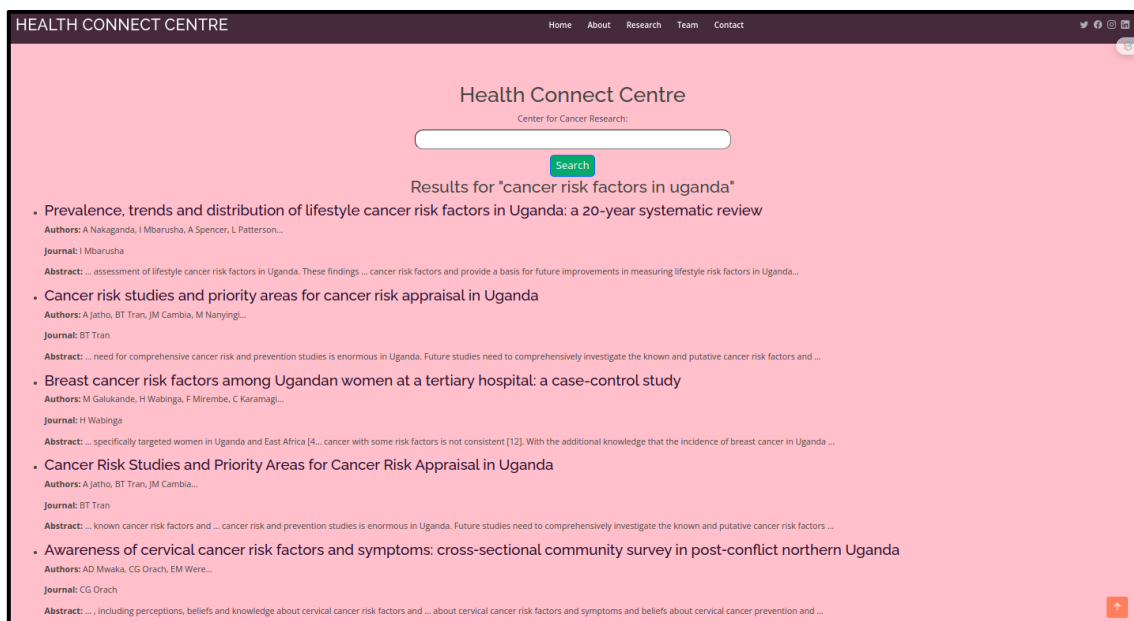


Figure 43: User interface and sample results received from a search

The system administrator oversees the operation, security, and performance of the Web application while also contributing to quality control and credibility. The administrator ensured platform integrity, data security measures through encryption protocols. This entailed TLS/SSL for safeguarding data during transmission and multi-factor authentication to enhance user access control. Additionally, WS-Security is implemented for SOAP Web services, providing message-level protection, while role-based access controls regulate access to sensitive information based on user roles.

The administrator collaborates with content managers to ensure accurate information and monitor user feedback to improve usability. By implementing data security measures and complying with standards, they uphold the platform's integrity, fostering trust among users. The system administrator is tasked with ensuring the Web application's smooth functioning. The administrator utilises front-end search analytics to monitor and manage various aspects of the system, including user engagement, popular search queries, content relevance, and system performance. By analysing search patterns and user behaviour, they can optimise search functionality, identify areas for content improvement, and make informed decisions to enhance the overall user experience.

Equipped with administrative tools and real-time analytics, the system administrator has a comprehensive view of the Web application's performance. They rely on a dashboard or interface that provides insights into search patterns, system usage, and performance metrics. This enables them to track the Web application's performance in real-time, identify any issues or anomalies, and make immediate data-driven decisions to optimise efficiency and user experience. By leveraging these tools and insights, the system administrator maintains the integrity and reliability of the system, ensuring that it meets the needs and expectations of its users while upholding security standards and performance benchmarks. Desired qualifications

include strong analytical skills, proficiency in data security, and experience in Web application management. Figure 44 demonstrates the search analytics from the administrator's interface.

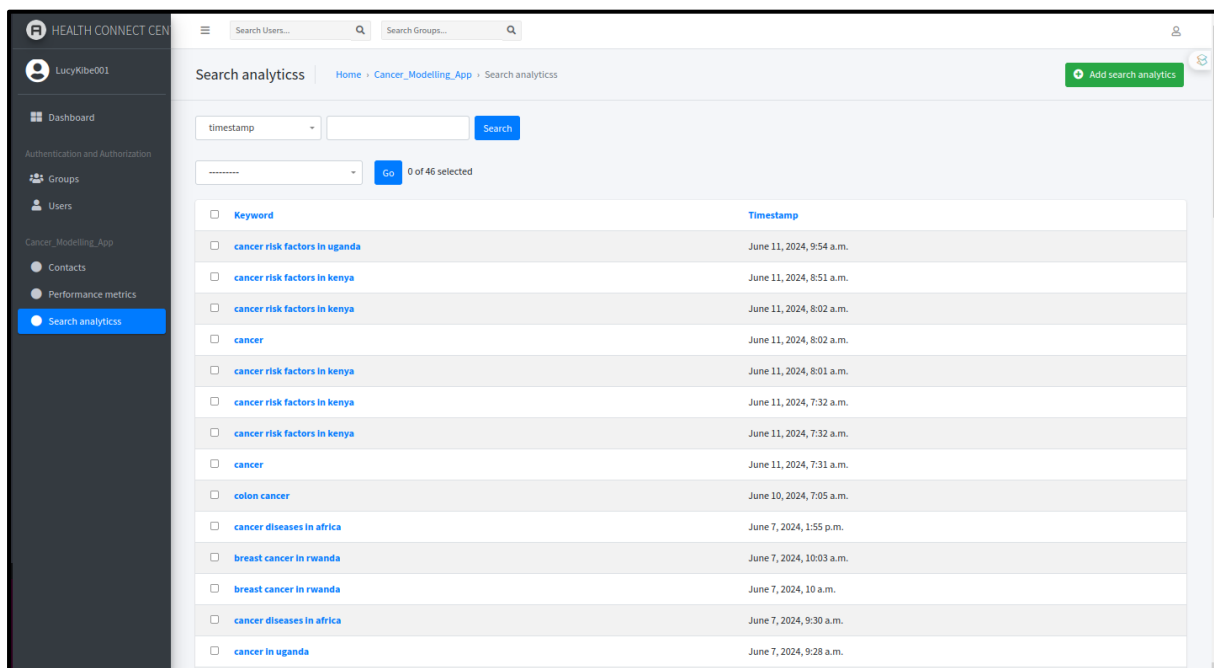


Figure 44: Search pattern from administrators end

4.5.2 Search core API

The search core API is made up of the search engine, analytics (backend), and security module. The search engine is the central component of the *Health Connect Centre* Web application utilising the third-party API from SerpApi for Google Scholar. It acts as the primary interface between the user and the backend content systems. When a user inputs a cancer-related query, the search engine processes the query and retrieves relevant information from the curated database. To ensure that the user receives the most pertinent results, the search engine uses advanced ranking algorithms to evaluate the relevance of each retrieved piece of information and rank it accordingly. Figure 45 shows the algorithm for the API service provider for the application.

```

1 from django.shortcuts import redirect, render
2 from serpapi import GoogleSearch
3 from django.conf import settings
4 from .models import SearchAnalytics
5 from .forms import ContactForm
6 from django.http import HttpResponseRedirect
7
8
9 Codimate: Options | Test this function
10 def extract_publication_info(result):
11     return {
12         'title': result.get('title'),
13         'author': result.get('publication_info', {}).get('summary', '').split('-')[0].strip(),
14         'pub_year': result.get('publication_info', {}).get('summary', '').split('-')[1].strip(),
15         'abstract': result.get('snippet', 'N/A'),
16         'journal': result.get('publication_info', {}).get('summary', '').split(',')[1].strip(),
17         'link': result.get('link', '#')
18     }
19
20 Codimate: Options | Test this function
21 def search_publications(keyword):
22     params = {
23         "engine": "google_scholar",
24         "q": keyword,
25         "api_key": settings.SERPAPI_KEY
26     }
27     search = GoogleSearch(params)
28     results = search.get_dict()
29     organic_results = results.get("organic_results", [])
30     publications = []
31     for result in organic_results:
32         publication_info = extract_publication_info(result)
33         publications.append(publication_info)
34     return publications

```

Figure 45: The algorithm for API service provider for the application

The analytics (backend) engine serves as the cornerstone for processing search queries within the realm of cancer research. By analysing search patterns, user interactions, and system performance, it provides invaluable insights that drive the refinement and enhancement of the platform. The analytics enables comprehensive data analysis to understand user behaviour, revealing trends in search activity and preferences. It creates comprehensive reports that show how the system is being used through its reporting features. It highlights user engagement and operational efficiency. These reports are instrumental for system administrators, offering a clear view of current usage dynamics and pinpointing potential areas for optimisation, ultimately contributing to more effective and user-centric cancer research tools. Figure 46 shows a summary sample of the system's analytics.

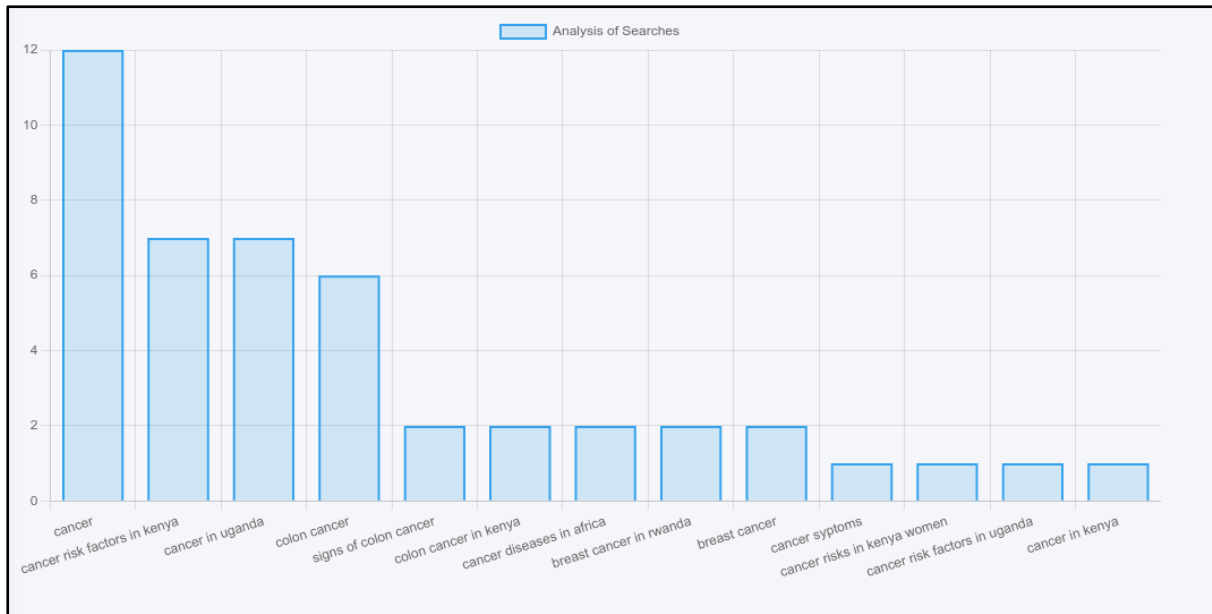


Figure 46: Summary sample of the systems analytics

The security module is crucial for safeguarding the system's integrity and ensuring robust data protection. It handles comprehensive security protocols, including authentication and authorisation processes, to maintain a secure environment. Authentication functions by verifying the identities of users and applications attempting to access the system, ensuring only legitimate entities are granted entry. Concurrently, authorisation defines and enforces the access rights of these authenticated users and applications, controlling their permissions based on predefined criteria. This module also upholds data integrity by guaranteeing the accuracy and reliability of the system's data, preventing unauthorised alterations, and ensuring that information remains untampered with and trustworthy. Through these measures, the security module fortifies the system against breaches and maintains the fidelity of its data assets. Figure 47 shows the login platform of system administrators who have access to data. Figure 48 shows the administration dashboard.

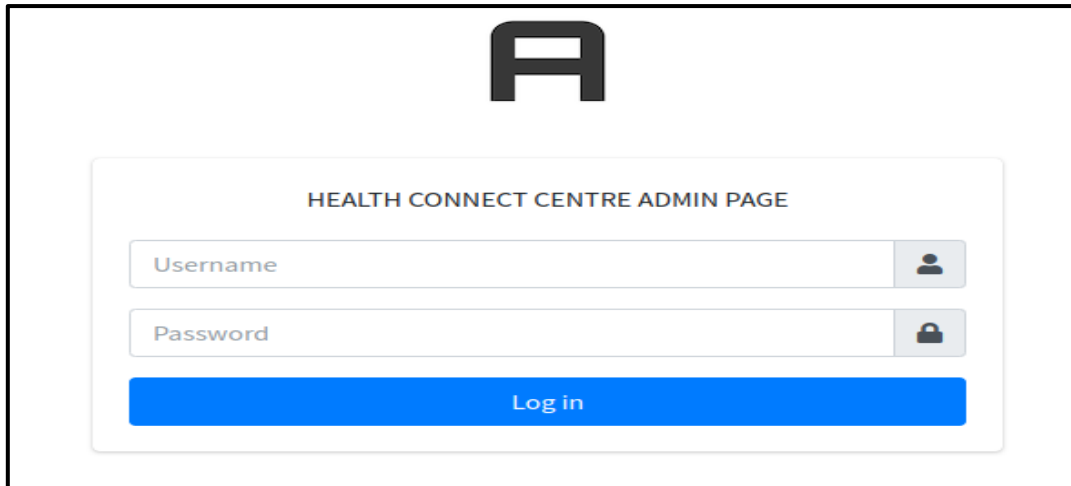


Figure 47: Login platform of system administrators

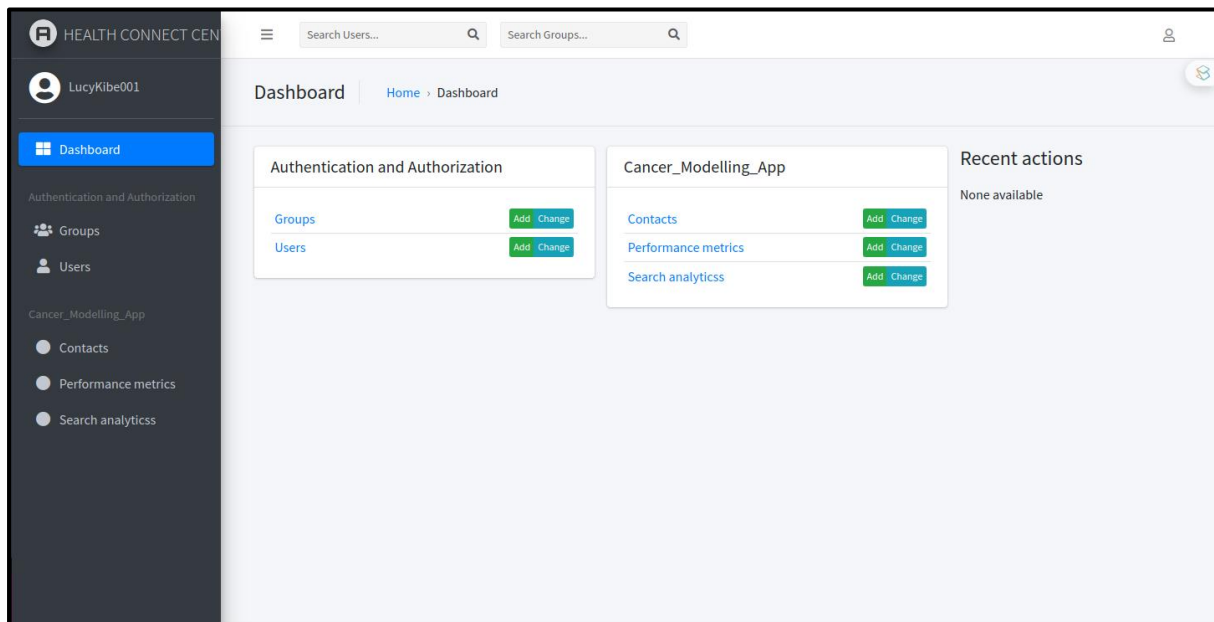


Figure 48: Administration dashboard

4.5.3 Content collections and refinement (backend)

The Content refinement database system serves as a central repository for storing and managing content, effectively supporting the search engine by aggregating data from diverse sources. This system performs data aggregation by collecting information from Google Scholar and then processes and organises it to enhance its utility and accessibility for search queries. By refining the collected data, the system ensures that the content is relevant, well-structured, and ready for efficient retrieval.

The database connector interfaces with multiple databases to fetch and update content. It plays a crucial role in maintaining the relevance and currency of data within the system by ensuring continuous access to the latest information. Through effective data retrieval and updates, the database connector ensures that the most pertinent and recent data is always available for user queries and system operations.

Web crawlers are automated tools that browse and index content from various Web sources, contributing significantly to the content database. These crawlers continuously search the Web for new and relevant information, indexing it systematically. This process is critical for keeping the content database up-to-date, as it allows regular updates with newly discovered content, ensuring that users have access to the latest information available. However, this approach also poses a risk of retrieving misinformation. The platform implemented content verification mechanisms to assess the accuracy and credibility of indexed information against trusted sources. Furthermore, a team of content managers will supervise the process, regularly reviewing indexed content and enabling timely corrections of any inaccuracies. User feedback mechanisms will also be incorporated to help identify misinformation, enhancing the reliability of the information provided to users.

The file server connector manages connections to file servers, facilitating the retrieval and integration of stored documents and files into the content database. It ensures that all relevant information, including documents and other file formats, is accessible within the database, broadening the scope of available content.

Lightweight Directory Access Protocol (LDAP) connectors interface with LDAP directories to fetch and manage user and system data. They play a vital role in maintaining up-to-date directory information, which is crucial for various system operations, particularly in areas related to user authentication and authorisation. By ensuring access to current directory

information, LDAP connectors support essential security-related functions and help maintain system integrity and security.

The cancer information demand and supply model integrates multiple components to create a robust, scalable, and secure platform for accessing and managing cancer-related information. It features a modular architecture with user interfaces, a search core API, and backend systems. The user interfaces include Web services for communication, a search application for handling queries, and administrator tools for system management. At its core, the model utilises a search engine, analytics for insights into user interactions, and a security module to ensure data integrity. The backend system aggregates, refines, and updates content from various sources through database connectors, Web crawlers, and file server connectors, with LDAP ensuring up-to-date directory information. This integration ensures comprehensive and current data availability, emphasising user experience, data security, and continuous content refinement to meet the dynamic needs of cancer research effectively.

4.6 Chapter summary

This chapter presented a comprehensive analysis of cancer information seeking and production across Kenya, Uganda, Tanzania, and Rwanda. The data was analysed using the objectives of the study. The data revealed significant information about cancer-related information seeking behaviours across the EAC region. Search queries were primarily focused on understanding the signs, symptoms, causes, and treatment options for various types of cancer, such as breast, cervical, prostate, lung, and colon cancers. This indicates a strong interest in early detection and effective treatment strategies among the population. The analysis also revealed a growing body of scholarly materials focusing on cancer research and the need for comprehensive strategies to address the cancer burden.

CHAPTER FIVE

DISCUSSION OF THE FINDINGS

This chapter focuses on interpreting and discussing the findings presented in chapter four. Interpretation involves assigning meaning to collected data and findings, allowing researchers to compare their findings with those of other studies. The main purpose is to critically discuss the significance of the findings about what is already known about modelling cancer occurrences in the EAC countries through infodemiology and extend knowledge.

5.1 Cancer information seeking trends in EAC countries

The findings are discussed under the objectives which capture cancer search terms, types of cancers, cancer management, cancer prevention and cancer awareness. This was further discussed using search interest over time, search by cities/towns, and search by related topics and queries.

5.1.1 Cancer information seeking trends

The findings of cancer search interest over time across various digital platforms in Kenya, Uganda, Tanzania, and Rwanda show distinct patterns emerge that reflect health information seeking behaviours. Web search trends revealed peaks in interest during August, September, and October, varying across countries and years. For example, in August 2019, Kenya showed significant search interest, while Tanzania peaked in September 2010. Uganda had notable searches in September 2009, and Rwanda recorded its highest interest in August 2022, highlighting varied trends. This finding aligns with the findings from Hao et al. (2019) on the impact of health awareness events on Google search frequency in the United States of America, which indicate that search volumes often surge in response to health awareness campaigns or significant health events. News searches on cancer had an irregular peak from the countries studied. Liu et al. (2020) asserted that news articles can be used to disseminate helpful health

information. Despite the irregular peaks in searches, news articles can disseminate valuable health information about cancer. These peaks often follow significant events like celebrity diagnoses or research breakthroughs, drawing public interest (Zhao et al., 2022). News stories raise awareness; educate on symptoms, prevention, and treatments; and motivate health-seeking behaviour, such as increased screenings. News media are crucial in spreading essential cancer-related information, enhancing public knowledge and encouraging proactive health measures. Negligible activity in cancer image search trends was observed across the four countries studied, indicating limited use of visual aids in cancer inquiries. This could be due to lower public reliance on images for understanding cancer or sufficient written and verbal information to meet their needs. Thus, visuals are not a primary tool in public engagement with cancer information, suggesting their potential underutilisation in enhancing awareness and understanding. The study findings disagree with Fung et al. (2020) and Zhang (2018), who asserted that images such as photos and infographics are powerful health communication tools, impacting knowledge, attitudes, and perceptions. Zhang (2018) noted that health agencies use visuals like billboards and infographics to promote healthy behaviours and present data. However, the negligible activity in cancer image searches reveals a mismatch between this supply and public demand. This indicates that despite available visual resources, people may prefer written or verbal formats for cancer information. This disconnect suggests that while health agencies provide visual content, it may not align with public preferences or search behaviours for cancer-related information. Cancer YouTube search trends reveal notable peaks in specific months across all countries, suggesting its growing role as a health information source. This finding is supported by research by Garg et al. (2024) on consumption of health-related videos and Human Papillomavirus (HPV) awareness, a cross-sectional analysis of a United States (U.S) national survey and YouTube from the urban-rural context. The findings of this study indicated that in 2022, 59.6% of U.S. adults (152.3 million) consumed health-

related videos on social media, nearly doubling from 2017 to 2022. This trend was evident in both urban (31.4% in 2017 to 59.8% in 2022; $P < .001$) and rural areas (22.4% in 2017 to 58% in 2022; $P < .001$), highlighting a significant increase in the use of videos for health information across different contexts.

The findings of the study show that cancer searches were most prevalent in Kijabe, Litein, Migori, Majengo, and Nanyuki, in Kenya. In Uganda, the highest search interests were in Ishaka, Arua, Gulu and Entebbe. Tanzania's data demonstrates a strong search focus with Kibaha, Kigoma, Arusha, and Dar es Salaam as the top cities with the highest search volumes. Rwanda shows centralised search patterns, with Ruhondo and Kigali dominating the searches. These high searches in these cities/towns could be because they have better healthcare facilities, health awareness campaigns, high Internet penetration, and literacy rates (Xu et al., 2020). Kenya, for example, Kijabe town is well-known for the African Inland Church Kijabe Hospital (AICKH), which serves the Kenyan population in many areas with services, including cancer care (Kamita et al., 2023). Litein town has AIC Litein Hospital is well known for specialised X-rays of the breast to aid in the early detection of breast cancer (Njagi, 2024). In Migori County, the presence of healthcare initiatives like the Clinton Health Access Initiative (CHAI) and *Nuru ya Mtoto*², supported by the United States Agency for International Development (USAID), which have donated cancer screening equipment, explains why Migori town has shown heightened interest among those seeking cancer information (Makokha & Satia, 2021). Nanyuki town's prominence in information-seeking about cancer can be attributed to the inauguration of the Nanyuki Teaching and Referral Hospital Cancer Clinic (Kutto, 2020). The clinic aims to reduce treatment costs for cancer patients in Laikipia County and strengthen Kenya's healthcare system's capacity to manage NCDs.

² Nuru Ya Mtoto is a USAID project funded by PEPFAR and implemented by a PATH Kenya-led consortium of Kenyan NGOs from March 18, 2021, to March 17, 2026. It supports the Kenyan government in addressing HIV/AIDS by safeguarding the rights and welfare of children and adolescents affected by HIV/AIDS. Additionally, the project raises awareness about cervical cancer screening and facilitates appropriate referrals to improve health outcomes for impacted individuals.

In Uganda, the high search interest is likely driven by the presence of health-focused institutions like Ishaka Adventist Hospital. The hospital offers cervical cancer screening, which could be the reason for the high interest in seeking cancer information in the area (Naome, 2017). Similarly, Arua and Gulu towns have regional cancer centres. These centres were developed to have fully established cancer care services, from cancer awareness, cancer detection, and cancer treatment to palliation (Nabachwa, 2022). Entebbe is well-known for cancer care through the UMC Victoria Hospital, which deals with the treatment of breast cancer, blood cancer, cervical cancer, Gastrointestinal cancer as well as head and neck cancer (Keneema et al., 2022). In Tanzania, Kibaha town could be at the top because the town has increased cancer awareness sessions and free screening services (Kiama, 2023). Kigoma town may have gained attention due to researchers discovering plants in Mahale National Park with the potential for breast cancer treatment (Kiishweko, 2018). This breakthrough follows 40 years of research that the *Centratherum anthelminticum* plant may lead to new drugs for difficult-to-treat breast cancers. The medicine extracted from these plants promises significant advancements in cancer therapy, spotlighting Kigoma's contribution to medical science. This news could have led people to curiosity to know more about Kigoma town hence its appearance among the top cities where cancer searches came from. Kigoma could also have gained attention because Grounds for Health, a non-governmental organisation dedicated to preventing cervical cancer in coffee-growing communities and beyond, held a provider training and screening campaign there (Vandervort, 2016). Teaming up with the Kanyovu Coffee Cooperatives and the Jane Goodall Institute, Grounds for Health aimed to bolster cervical cancer prevention efforts in the region. Their initiative involved training healthcare providers and conducting screening programs to enhance early detection and intervention for cervical cancer among local women. Esipisu (2020) asserted that in 2020, Arusha town was faced with cancer-causing pathogens in groundwater, which could be a contributor to people seeking

information about cancer in the town. For Rwanda, Kigali's high search volumes across multiple platforms can be attributed to its status as the capital city, which provides superior access to Internet services, healthcare information, and media outlets (Benurugo et al., 2020). Kigali's central role in national health initiatives and its higher awareness levels drive extensive searches for cancer-related content, reflecting a well-informed urban population's engagement with digital health resources (Nsabimana, 2022).

The findings of cancer-related search topics across Kenya, Uganda, Tanzania, and Rwanda showed both similarities and differences in information seeking behaviours. The similarities showed that breast, cervical, and prostate cancers emerge as the most frequently searched topics across all four countries. This findings that of Ferlay et al. (2019), which highlighted the prominent morbidity and mortality rates associated with breast and cervical cancers in East Africa usually drive extensive public engagement and information searches about these types of cancers. Similarly, Bray et al. (2018) emphasised the rising prevalence of prostate cancer among men in sub-Saharan Africa, which correlates with the observed high search volumes for prostate cancer information. The findings showed differences where colorectal cancer received more searches in Kenya and Tanzania, while Lung cancer had high searches in Uganda and Tanzania. Colorectal cancer garners more search interest in Kenya and Tanzania, possibly reflecting heightened awareness or incidence rates in these countries. According to Ferlay et al. (2019), there have been rises in colorectal cancers in Tanzania and Kenya and limited availability of endoscopic and diagnostic services, which poses a challenge for accurately staging these patients before treatment. Conversely, lung cancer emerges as a more searched topic in Uganda and Tanzania, potentially influenced by factors like smoking prevalence and environmental exposures in these regions (Bray et al., 2018). Smoking prevalence varies significantly across countries due to a blend of cultural, economic, and regulatory influences. Kenya, for example, has implemented rigorous smoking regulations compared to neighbouring

countries, potentially contributing to lower smoking rates (Gredner et al., 2021). Policies such as bans on public smoking and prominent health warnings on cigarette packaging are key deterrents (Cunningham, 2022). Economic factors also play a role; higher tobacco prices resulting from taxes and economic policies can reduce smoking rates, as observed in countries with robust tobacco control measures (Flor et al., 2021). Additionally, cultural norms and social attitudes toward smoking, coupled with effective public health campaigns promoting tobacco cessation, contribute to sustained reductions in smoking rates over time.

The findings on cancer-related queries in Kenya, Uganda, Tanzania, and Rwanda showed common interest in understanding cancer symptoms, causes, and treatment, particularly for breast, cervical, and prostate cancer. These findings corroborate Munishi et al.'s (2020) study, which found that awareness of specific cancer symptoms was high in sub-Saharan African countries. Additionally, Abdallah's (2021) study found that cultural and social factors influence cancer awareness and understanding in Tanzania. However, a study by Mugunga (2022) found low self-examination rates among Ugandan women, indicating a lower level of interest in understanding breast cancer symptoms. The discrepancy suggests that while there may be increased awareness and information availability about breast cancer, it has not translated into proactive personal health practices.

5.1.2 Types of cancer information seeking trends

The findings of the study on the types of cancer information seeking trends are discussed hereunder.

5.1.2.1 Breast cancer

The findings of the study revealed varied interest in breast cancer information seeking trends. Kenya consistently showed a high interest in information from Web (May 2009), news (March 2011), images (August 2008) and YouTube searches (late 2018). Tanzania had peaks, notably

in Web searches (May 2021) and news (December 2023). Rwanda had limited data but peaks in Web searches (November 2009). Uganda showed concentrated interest in the Web (November 2012) and YouTube searches (December 2018). The study's findings on breast cancer information seeking across Kenya, Tanzania, Rwanda, and Uganda reveal dynamic patterns influenced by multiple factors beyond health awareness months. While events like Breast Cancer Awareness Month in October typically trigger peaks in Internet searches (Nishimura & Acoba, 2022), other factors play significant roles throughout the year. Local health campaigns and events specific to each country contribute to information-seeking behaviour, such as media coverage of local health fairs or advocacy efforts by national health organizations. These initiatives often coincide with heightened public interest and search activity related to breast cancer (Olamiju, 2021). Media coverage plays a significant role in shaping search trends, with peaks often corresponding to reports on new research findings, treatment advancements, or high-profile cases of breast cancer. This influence of the media extends beyond awareness months, impacting search behaviours during various times of the year (Nishimura & Acoba, 2022). The pervasive use of digital media, including social platforms and health websites, further amplifies information dissemination and consumption year-round. Trends in search activities can reflect viral social media campaigns, influential figures sharing personal stories, or discussions on evolving health topics related to breast cancer (Olamiju, 2021).

The findings of the study for cities/towns where breast cancer searches came from show that the towns had different characteristics. In Kenya, the highest number of searches came from Machakos, Kisumu, and Nairobi. These towns could be prominent in the searches because, for example, Nairobi boasts world-renowned health facilities like the Kenyatta National Hospital and Aga Khan University Hospital, which conduct breast cancer screening and treatment programmes (Manpreet, 2022). Nairobi is also at the forefront of initiatives like the Breast

Cancer Awareness Month events organised by the Kenya Cancer Association and various corporate-sponsored health awareness drives (Riogi et al., 2022). These events not only raise awareness but also prompt individuals to seek more information online, contributing to increased search activity. Kisumu hosts Maseno University, which collaborates with healthcare providers and international organisations to conduct cancer studies and awareness programs (Topazian et al., 2016). This collaborative effort not only enhances the local understanding of breast cancer but also influences search trends as people seek credible information from academic and research sources. Maseno University, in partnership with Jaramogi Oginga Odinga Teaching and Referral Hospital, hosts the Western Kenya Cancer Care and Research Centre (WKCCRC). This centre investigates tropical infectious diseases, including human infective viruses, bacteria, and parasites, as potential risk factors for cancers prevalent in East Africa. In Uganda, Kampala was the prominent city where most breast cancer searches came from. This could be because Kampala houses major healthcare facilities such as Mulago National Referral Hospital and the Uganda Cancer Institute. These institutions are pivotal in providing specialised care and conducting widespread awareness campaigns and screenings (Scheelet al.,2020). Most of Tanzania's searches for breast cancer were from Mwanza and Dar es Salaam. Dar es Salaam is the largest city and economic hub in Tanzania and is also home to the main healthcare institutions in the country such as Muhimbili National Hospital and Aga Khan Hospital. These are the leading cancer treatment and research institutions (Crosset al., 2023). In Rwanda, Kigali was predominant in breast cancer searches. As the capital and largest city, Kigali benefits from centralised healthcare services at the Rwanda Military Hospital and King Faisal Hospital, which play crucial roles in cancer treatment and awareness campaigns (Jaganyi et al., 2018). Rwanda also has government initiatives and partnerships with international organisations, most of them in Kigali, which create health care awareness. These can be some of the reasons for the high search activity in the city (NCD Alliance, 2023).

In terms of topics related to breast cancer, data from Kenya, Uganda, Tanzania, and Rwanda showed that breast cancer was the primary search term, indicating a common interest in essential information about the disease. The related topics also included breast cancer screening, cancer, and breast cancer management across these countries. These topics are crucial as they address preventive measures, treatment options, and overall disease management strategies, which are critical components in combating breast cancer (Anyigba et al., 2021). Kenya's information seekers had an interest in male breast cancer, and Rwanda's had a focus on metastatic breast cancer. This variation highlights specific health concerns in each country. This variability in search topics underscores the diverse informational needs and health challenges related to breast cancer across EAC countries which can be influenced by local epidemiological patterns, healthcare infrastructure and cultural perceptions of breast cancer (Chen & Wang, 2021). The different search terms concerning seeking information about breast cancer can be linked to awareness campaigns, and media coverage often highlights specific aspects of breast cancer which influence what people search for online (Vraga et al., 2018). The availability of healthcare resources and services like screening programmes and treatment options also steer interest towards topics like early detection and disease management (Dutta et al., 2018). The cultural and social contexts within each country shape perceptions and priorities regarding health issues like breast cancer, influencing the types of information sought online. For example, discussions around male breast cancer in Kenya may arise due to increasing awareness campaigns targeting men's health issues (Ndungu, 2022). In contrast, Rwanda's focus on metastatic breast cancer may stem from efforts to improve outcomes for advanced-stage cases (Pace et al., 2019).

The breast cancer-related query findings across Kenya, Uganda, Tanzania, and Rwanda highlight a consistent interest in understanding breast cancer signs and symptoms as the most frequently used query in all four countries. This shared emphasis indicates a collective priority

in public health awareness across the EAC region. While each country displayed variations in additional queries—such as Kenya and Uganda focusing on causes of breast cancer, Tanzania on breast cancer stages, and Rwanda on risk factors of breast cancer—the overarching interest in signs and symptoms underscores a critical informational need. This data reflects a universal concern among individuals to recognise early warning signs, crucial for timely diagnosis and intervention. Addressing the prevalence of queries related to signs and symptoms aligns with global health strategies emphasising early detection as a critical factor in improving breast cancer management outcomes (Thrift-Perry et al., 2018). Effective communication of breast cancer signs and symptoms through various channels, including online platforms, plays a pivotal role in health education and promoting timely healthcare information seeking behaviours (Lolienkar, 2021). Tailoring public health interventions to address these specific queries can contribute to reducing barriers to early diagnosis and improving breast cancer management outcomes across the EAC region.

5.1.2.2 Prostate cancer

The findings on prostate cancer search interest over time across Kenya, Uganda, Tanzania, and Rwanda reflect diverse regional health concerns and information seeking behaviours. In Kenya, the search peaks in October 2006 and from 2011 to 2012 likely align with awareness campaigns and media coverage (Ndungu, 2022). Notably, the *MenToo Campaign*, organised by the Faraja Cancer Support Trust, was launched in 2010 and became prominent in 2011. This campaign is dedicated to raising awareness and providing support for men with prostate cancer, leveraging social media, workshops, and community outreach to educate the public on the importance of early detection and to offer support to those affected. Uganda's peaks in January 2014 and June 2022 can be linked to increased awareness from the Uganda Cancer Institute (Atuhe et al., 2023). The UCI conducts extensive public awareness campaigns, promotes cancer screening programs, and enhances healthcare capacity through training initiatives and research (Atuhe et

al., 2023). These efforts aim to educate the Ugandan population about cancer prevention, symptoms, and treatment options, encouraging early detection and improving overall cancer care outcomes in the country. Tanzania's peaks in March 2013, November 2014, and subsequent years are likely linked to educational programmes by Muhimbili National Hospital (Lyimo et al., 2020). These programs encompass community outreach, health seminars, media campaigns, and partnerships with healthcare providers to effectively disseminate information nationwide. Their primary goal is to enhance public awareness about prostate cancer and promote proactive health-seeking behaviours among Tanzanians. In Rwanda, search peaks for prostate cancer in April 2013, February 2022, and other years can be attributed to local health policies and initiatives targeting male health issues driven by the Rwandan government in collaboration with international organizations (Binagwaho et al., 2016). The April 2013 peak coincided with the launch of a nationwide prostate cancer awareness and screening campaign, conducted in partnership with *Partners in Health*³, aimed at enhancing public awareness and early detection (Mujawamariya et al., 2013). Similarly, the February 2022 peak followed the introduction of new national guidelines for prostate cancer screening, developed with support from the World Health Organization (WHO) to improve early detection and expand screening access (Rwandan Ministry of Health, 2022). Additional peaks in other years reflect the impact of regular health promotion activities, including annual Men's Health Weeks and policy changes to bolster male health services (Rukundo et al., 2020).

The findings of searches from specific cities reflect various factors shaping health information seeking behaviours and healthcare access across the region. In Kenya, Kisumu, Thika, Eldoret, and Kisii lead in prostate cancer searches. The high number of prostate cancer searches in these towns could be attributed to factors such as healthcare access and health literacy. In these urban

³ It is an international nonprofit public health organization founded in 1987. Its mission is to provide a preferential health care option for the poor, driven by a commitment to social justice and the belief that everyone has a right to quality health care, regardless of socioeconomic status.

centres, the healthcare infrastructure and access to healthcare services are more developed than in rural areas (Ngugi et al., 2017). This improved access likely leads to a greater engagement with online sources of health information. However, it is essential to note that factors such as education and health literacy play a crucial role in this trend. Research indicates that individuals with higher education and health literacy levels are more inclined to seek health information online (Mutere et al., 2016). Additionally, health awareness campaigns and media coverage have influenced the search trends in these regions, contributing to the observed patterns in online health information-seeking behaviour. In Uganda, Mbarara, Kasangati, and Kampala emerged as the key cities for prostate cancer searches. Kampala as indicated earlier hosts major healthcare institutions which are pivotal in cancer treatment and public health initiatives (Kayiwaet al., 2020). Mbarara, located in southwestern Uganda, serves as a regional centre for healthcare services, drawing patients from surrounding areas. Kasangati's prominence may reflect its proximity to Kampala and its role as a satellite town with access to urban healthcare facilities. Tanzania's prostate cancer searches came from Mwanza and Dar es Salaam. The high volume of prostate cancer searches from these cities reflects urbanisation, improved healthcare access, and heightened health literacy. Urban lifestyles in these cities often include sedentary behaviours and dietary changes that increase cancer risks (Ferlay et al., 2021). These cities also benefit from better healthcare infrastructures, offering specialised cancer diagnostics and treatment facilities, prompting residents to seek online information. Increased awareness through media campaigns and educational initiatives encourages proactive health-seeking behaviours, aligning with cultural shifts towards early detection and treatment acceptance (Moshi et al., 2019; Mutua et al., 2017). In Rwanda, Kigali stands out as the sole city with notable prostate cancer searches, owing to its status as the capital and primary urban hub. Kigali's geo-cultural characteristics, including its centralisation of healthcare services at institutions like Rwanda Military Hospital and King Faisal Hospital, play a pivotal role. These

facilities provide advanced medical care and influence health-seeking behaviours and the inclination to seek health-related information online (Binagwaho et al., 2016). The city's accessibility to specialised healthcare and the concentration of health awareness initiatives contribute to heightened public awareness and proactive engagement in health information seeking regarding prostate cancer.

The findings on related search topics to prostate cancer in Kenya, Uganda, Tanzania, and Rwanda underscore a regional emphasis on understanding the disease. In Kenya, the surge in searches related to prostate cancer, prostate cancer screening, and cancer reflects a heightened awareness driven significantly by media-led health campaigns. For instance, campaigns such as the annual Prostate Cancer Awareness Month in October initiatives by organizations like the Kenya Cancer Association (KENCANSA) and the *MenToo* campaign by Faraja Cancer Support Trust have been pivotal. These efforts utilize TV, radio, and social media platforms to educate the public about symptoms, risk factors, and early detection through screening. As a result, there has been an observable increase in online inquiries as individuals actively seek information to empower themselves about prostate health (Ndungu, 2022). Uganda showed a similar pattern with significant interest in prostate cancer. This can be a reflection of efforts by institutions such as the Uganda Cancer Institute (UCI) to enhance awareness and encourage early detection. For example, the UCI has implemented community outreach programs targeting men's health, including prostate cancer awareness campaigns through radio talk shows and community health fairs. These initiatives aim to educate Ugandan men about the importance of regular screenings and symptom awareness, ultimately aiming to reduce the burden of prostate cancer through proactive health promotion strategies (Kabukye et al., 2021). In Tanzania, searches for prostate cancer, cancer, and benign prostatic hyperplasia indicate a dual interest in prostate health driven by educational programs and awareness initiatives. For instance, the "*Men's Health Week*" organized annually by the Tanzania Ministry

of Health includes targeted sessions on prostate health. These programs educate men about the symptoms of prostate conditions, the importance of early detection through screenings, and how to distinguish between cancerous and non-cancerous prostate issues. Such initiatives are crucial in empowering men with knowledge and promoting proactive healthcare-seeking behaviours, thereby contributing to improved health outcomes (Lyimo et al., 2020). In Rwanda, searches primarily focusing on prostate cancer reflect governmental and international efforts to enhance public awareness and access to prostate health information. One significant example is the partnership between the Rwandan Ministry of Health and international organizations like the World Health Organization (WHO) to implement the Rwanda Cancer Control Program. This program includes initiatives aimed at improving cancer prevention, early detection, and treatment, with specific attention to prostate cancer. Through this collaboration, Rwanda has seen the expansion of screening programs, public education campaigns, and the integration of cancer care into the national health system, thereby increasing access to crucial prostate health information (Benurugo et al., 2020).

The findings on search queries related to prostate cancer in Kenya, Uganda, Tanzania, and Rwanda underscore regional variations in healthcare priorities and public health initiatives. In Kenya, the focus on symptoms and signs of prostate cancer may stem from increasing media coverage and community health campaigns aimed at improving awareness about men's health issues (Ndungu, 2022). Uganda's emphasis on understanding causes and symptoms reflects ongoing efforts by local healthcare providers and advocacy groups to address misconceptions and promote early detection through community outreach programs (Mwebembezi et al., 2023). In Tanzania, the interest in the clinical aspects of prostate cancer could be influenced by initiatives promoting cancer research and education within academic and medical institutions (Tindwa, 2020). Rwanda's similar focus on causes, symptoms, and treatments

aligns with governmental efforts to integrate cancer awareness into national health policies and improve access to screening and treatment services (Benurugo, 2019).

5.1.2.3 Lung cancer

The search interest in lung cancer revealed distinct patterns across East African countries. In Kenya, spikes in April 2011 and November 2015 may be attributed to localised health campaigns or media coverage that raised awareness about lung cancer symptoms and risks (Brewer et al., 2020). For example, the Cancer Care Africa program launched in Kenya aims to enhance screening and diagnostics for lung, breast, and prostate cancers (Saya, 2024). In Uganda, the spike in lung cancer-related searches in October 2011 coincided with the Annual Cancer Run campaign, a major initiative promoting healthy lung practices and reducing tobacco use. Tanzania showed significant search activity in June 2011 and December 2022, likely due to public health education efforts and media advocacy focusing on lung cancer awareness (Munishi et al., 2020). Conversely, Rwanda's lack of significant search activity may be due to lower prioritisation of lung cancer awareness campaigns or limitations in health information access nationwide (DeBoer et al., 2020).

In Kenya, significant search activity for lung cancer in Eldoret, Nairobi, and Mombasa can be attributed to localised factors influencing public interest in lung health issues. Eldoret, situated in the Rift Valley, experiences significant agricultural activities that contribute to air pollution, potentially impacting lung health and prompting increased searches related to lung cancer (Togawa et al., 2021). As the capital city, Nairobi hosts diverse occupational sectors with potential exposures to occupational hazards such as dust and chemicals, which heightens awareness and interest in lung cancer among the population (Wanjala et al., 2021). In Mombasa, cultural influences such as high smoking prevalence and air quality issues linked to urbanisation and industrial activities contribute to heightened concerns about lung health,

leading to increased online searches about lung cancer (Barako, 2023). In Uganda, the high search activity for lung cancer in Kampala and Kasangati can be attributed to the urban settings of these towns, where cultural practices and modern lifestyles intersect to influence health outcomes. As the capital city, Kampala epitomises urbanisation with its dense population and varied industrial activities, contributing to higher levels of air pollution and occupational hazards that affect lung health (Asasira et al., 2022). Kasangati, located near Kampala, shares similar urban characteristics, with a blend of traditional and contemporary lifestyles that impact smoking rates and exposure to environmental pollutants, thereby influencing the prevalence of lung cancer (Nakaganda et al., 2023). In Tanzania, the cities of Mwanza and Dar es Salaam show the highest lung cancer search volumes. Mwanza's economic growth, driven by fishing and mining, increases air pollution and occupational exposures, raising lung cancer risk (Mkenda et al., 2022). Dar es Salaam, as the commercial capital, faces severe air quality issues from traffic and industrial activities, and diverse lifestyle factors, such as higher smoking rates, amplify interest in lung cancer (Buckle et al., 2022). Kigali, Rwanda's capital, shows primary lung cancer search, which can be linked to smoking prevalence and exposure to indoor and outdoor pollutants affecting respiratory health, sparking interest in lung cancer awareness and prevention (Bikomeye et al., 2021).

The findings on lung cancer search topics across Kenya, Uganda, Tanzania, and Rwanda show distinct regional interests and emphases on different aspects of the disease emerging. Kenya and Uganda demonstrate a comprehensive interest in lung cancer, covering symptoms, causes, and treatment options, which reflects their efforts to bolster cancer awareness and education (Chesumbai et al., 2024). Tanzania's focus on symptoms of lung cancer suggests a concerted effort to understand clinical presentations and diagnostic pathways, likely influenced by healthcare access and varying levels of health literacy (Lombe et al., 2023). In contrast, Rwanda shows a predominant interest in signs and symptoms of lung cancer, potentially

indicating a prioritisation of early detection and symptom recognition strategies in public health campaigns (Niyibizi et al., 2023). Munishi et al. (2020) highlight challenges in Tanzania related to healthcare access and information dissemination, which could impact the population's understanding of lung cancer causes and treatment.

5.1.2.4 Colon cancer

The findings on colon cancer search patterns show varying factors driving interest and awareness. In Kenya and Uganda, peaks in search interest, notably in 2011 and 2020, coincide with impactful events such as national cancer awareness campaigns, health initiatives led by organisations like the Kenya Cancer Association and Uganda Cancer Institute, and public health efforts like the "*Jadudi Cancer Walk*" in Kenya, which raises awareness about various cancers including colon cancer (Biko, 2020). In Tanzania, concentrated searches in 2020 and subsequent years may stem from initiatives by the Ocean Road Cancer Institute (ORCI) focusing on community outreach, free screenings, and educational programs to enhance health literacy on colon cancer symptoms and prevention (DeBoer et al., 2020). Since 2020, Tanzania's Ocean Road Cancer Institute (ORCI) has launched various initiatives to address colon cancer. ORCI has conducted extensive awareness campaigns to educate Tanzanians about the risks, symptoms, and prevention of colon cancer (Hansen, 2022). These efforts are complemented by screening programs designed to promote early detection and improve treatment outcomes. ORCI offers a range of treatment options, including surgery, chemotherapy, and supportive care for colon cancer patients (Akoko et al., 2023). Furthermore, ORCI engages in research to advance knowledge and disseminate findings to healthcare professionals and the public, contributing to ongoing efforts in colon cancer prevention and management (Msami et al., 2021). These initiatives underscore ORCI's dedication to combating colon cancer in Tanzania through comprehensive healthcare strategies and community education. In Rwanda, search peaks in 2013 and 2020 reflect efforts by the Rwanda Biomedical Centre (RBC), which

employs media campaigns, community health workers, and mobile clinics to educate the public and promote early detection strategies for colon cancer and other cancers (Umeokonkwo et al., 2024).

The findings from searches by cities in Kenya, Ruiru, Nairobi, and Mombasa emerged as high in searches on colon cancer. In Uganda, Kampala and Kasangati emerged at the top of colon cancer searches. In Tanzania, Dar es Salaam emerged as the top city, while in Rwanda, Kigali was the city with the top searches on colon cancer. These towns/cities are in urban areas, which have a high rate of consumption of sedentary lifestyle, red meat and processed food consumption, which are known to be a contributor to colon cancer (Francescangeli et al., 2019; Katzke et al., 2018).

Findings on colon cancer-related topics and queries across Kenya, Uganda, Tanzania, and Rwanda have garnered substantial search interest. In Kenya, there is a notable emphasis on colorectal cancer, as evidenced by high search volumes, with related queries about symptoms and causes indicating a keen interest in health education (Cheboi et al., 2023). Uganda similarly shows significant interest in colorectal cancer, particularly in symptoms and causes, highlighting a proactive approach to public health awareness (Wekha et al., 2021). Tanzania's searches also emphasise symptoms and causes of colorectal cancer, suggesting a concerted effort to educate the population on clinical aspects (Lombe et al., 2023).

5.1.2.5 Cervical cancer

The peaks in cervical cancer search interest across East African countries can be attributed to various specific factors unique to this type of cancer. In Kenya, the spike in July 2009 and November 2010 could be linked to awareness campaigns or public health initiatives, such as the introduction of the HPV vaccine aimed at preventing cervical cancer, which likely stimulated increased interest and information-seeking behaviours (Njuguna, 2022; Sakwa,

2022). In Kenya, July and November are pivotal for health-related activities and awareness efforts, particularly concerning cervical cancer and HPV vaccination campaigns. These periods witness targeted initiatives aimed at promoting public health. The introduction of the HPV vaccine has been a significant driver of increased interest and information-seeking behaviours regarding cervical cancer prevention (Njuguna, 2022). These initiatives include nationwide vaccination drives targeting young girls to prevent Human Papillomavirus infection, a primary cause of cervical cancer. Health facilities and NGOs also intensify efforts to offer cervical cancer screening services, coupled with public awareness campaigns emphasising prevention strategies and early detection (Sakwa, 2022). In Uganda, the highest search interest in May 2009 may be associated with the launch of national cervical cancer screening programmes, which heightened awareness about early detection and treatment (Petersen et al., 2022). Tanzania's concentrated searches in June 2016 and subsequent years reflect the impact of health policy changes that include mobile health clinics and outreach programs targeting rural communities, thus increasing awareness and search activity among Tanzanians seeking information about cervical cancer (Li et al., 2022). In Rwanda, the peaks observed in 2022 and 2023 could be linked to new public health initiatives focused on cervical cancer awareness and prevention, thereby fostering heightened interest and search queries related to cervical cancer (Rahemtulla, 2023).

In Kenya, cities Nakuru, Kisumu, Eldoret, and Nairobi exhibited notable cervical cancer information-seeking behaviours for several reasons. These cities are major urban centres with diverse populations, where access to healthcare information and services is relatively higher compared to rural areas (Oluoch, 2021). These cities also host various healthcare facilities, including Nakuru Level 5 Hospital and Moi Teaching and Referral Hospital in Eldoret. These provide specialised care and increase residents' awareness of cervical cancer (Makau-Barasa et al., 2020). Also, urban areas benefit from more extensive media coverage and health

campaigns, further enhancing public awareness about cervical cancer prevention, screening, and treatment options (Ndungu & Sakwa, 2020). In Uganda, Mbarara and Kampala were prominent in cervical cancer searches. This could be linked to the vibrant civic engagement, advocacy networks and strong community health programmes that are supported by facilities like Mbarara Regional Referral Hospital and Mulago National Referral Hospital (Downing et al., 2023). Tanzania's Mbeya and Dar es Salaam had significant search activity for cervical cancer. Mbeya Referral Hospital enhances Mbeya's focus on community-based health programs and educational outreach, while Dar es Salaam benefits from its status as Tanzania's largest city, facilitating access to specialised healthcare and research institutions such as Muhimbili National Hospital (Mayige et al., 2022). In Rwanda, Kigali's pronounced interest in cervical cancer searches correlates with its geo-cultural characteristics and concerted health initiatives. As the capital city and major urban centre, Kigali hosts centralised healthcare facilities like Rwanda Military Hospital and King Faisal Hospital, which play pivotal roles in cervical cancer management (Asempah & Wiktorowicz, 2023). Government-led campaigns, bolstered by international partnerships, prioritise awareness and screening programs that target the urban population's healthcare needs. Community health efforts in Kigali further amplify public awareness and education about cervical cancer, reflecting a collaborative approach to addressing women's health issues in Rwanda's urban hub.

The findings on cervical cancer-related topics across Kenya, Uganda, Tanzania, and Rwanda had similar interest in topics such as cancer, cervical cancer staging, cervical screening, and cancer screening. These keywords highlight a collective focus on comprehending the stages, screening methods, and broader aspects of cervical cancer across East Africa. Similarly, the queries related to cervical cancer—focused on signs and symptoms, causes, and screening—are consistently prominent across all four countries. Research by Obol et al. (2020) in Uganda supports the finding that there is significant attention to HPV vaccination programmes

alongside general information seeking about cervical cancer. Jedy-Agba et al. (2020) similarly highlight the prevalent interest in staging and screening methods across East Africa, indicating a consistent focus on these critical aspects of cervical cancer management. However, Daka (2022) noted variations in information-seeking behaviours in Tanzania, emphasising challenges related to accessing comprehensive and timely information about cervical cancer in rural areas.

5.1.3 Cancer management

The findings on information seeking about cancer management are discussed hereunder.

5.1.3.1 Cancer symptoms and signs

The findings for search trends for cancer symptoms and signs across Kenya, Uganda, Tanzania, and Rwanda showed diverse factors influencing search interest. In Kenya, the surge in searches in July and August 2019 coincides with intensified public health messaging and significant health news raising cancer awareness (Auma et al., 2023). Uganda's peak in December 2011 and further peaks in May 2012 and April 2014 correlate with national campaigns promoting HPV vaccination and advocacy efforts by healthcare professionals and cancer survivors engaging in public education, fostering broader interest in cancer symptoms (Shin et al., 2021). In Tanzania, intense search interest in April 2022 and June 2023 aligns with governmental initiatives like establishing cancer screening centres and public health campaigns about cancer prevention (Kassa et al., 2024). Rwanda's significant spike in January 2014 and August 2022 is linked to new cancer treatment facilities or the introduction of health insurance schemes covering cancer care, enhancing public engagement (Nkurunziza, 2021).

The findings on search trends for cancer symptoms and signs across Kenya, Uganda, Tanzania, and Rwanda show different cities that had searches. In Kenya, Meru, Nanyuki, Nyeri, and Nairobi stood out. The high search activity in Meru could be attributed to the news from June

2020, which reported on a "*Meru village plagued by cancer*"⁴ and called for further research into the issue (Muchui, 2020). This coverage highlighted the community's urgent need for more investigation and understanding of the cancer prevalence in the area. In Nyeri, the County Assembly has proactively advocated for establishing a fully functional cancer centre (Ndirangu, 2024). During a recent session before adjourning until June 11, 2024⁵, a County Assembly member expressed concern about the increasing prevalence of cancer in Nyeri County. According to reports from the Ministry of Health, the incidence of cancer in 2020 was alarmingly high at 2,127 cases per 100,000 people. They emphasised the urgent need for improved healthcare infrastructure to address this growing health challenge in the region. Kampala, Dar es Salaam, and Kigali, as stated earlier in prior discussions, have been central in their countries by leading cancer awareness and management.

The findings on search-related topics for cancer symptoms and signs across East Africa highlight both common themes and distinct interests. In Kenya, there was significant search interest in colorectal cancer and general signs and symptoms. This aligns with findings by Kabiru et al. (2021), which emphasise a growing concern for various colorectal cancers among Kenyan populations. In Uganda, there was a predominant focus on the signs and symptoms of cancer. These results were in line with Mwaka et al. (2021), which indicate that information seeking about symptoms of breast cancer helps in the early management of the disease. In Tanzania, the searches encompassed signs and symptoms of breast cancer, colorectal cancer and lung cancer. Munishi et al. (2020) asserted that Tanzanians had high levels of cancer risk factors related to lifestyle. However, increased awareness and cancer warning based on symptoms can help in cancer management. In Rwanda, the focus on cancer as a general topic, with a particular interest in colorectal and lung cancers, mirrors broader health information-

⁴<https://nation.africa/kenya/counties/meru/The-village-plagued-by-cancer/1183302-5329056-pa56gk/index.html>

⁵<https://www.kenyanews.go.ke/assembly-urges-the-executive-to-establish-a-fully-functional-cancer-centre/>

seeking behaviours. This trend can be attributed to the country's efforts in health education and awareness campaigns to increase public knowledge about cancer prevention, symptoms, and treatment options. Specifically, colorectal and lung cancers receive attention, likely due to their significant impact on public health and the efforts of organizations like the Rwanda Biomedical Center and international health partners in promoting awareness. Such initiatives encourage proactive health-seeking behaviours and empower Rwandans to make informed decisions about their health (Ndahindwa et al., 2019).

The findings on search queries related to cancer symptoms and signs across Kenya, Uganda, Tanzania, and Rwanda provide insights into regional interests and concerns. In Kenya, breast cancer symptoms and signs are the most searched, indicating a significant focus on understanding breast cancer indicators alongside general signs and symptoms of cancer. This aligns with studies emphasising breast cancer as a prevalent concern in Kenya (Kassaman, 2023). In Uganda, cervical cancer symptoms and signs dominate, underscoring a primary interest in cervical cancer detection, with notable queries also about breast and prostate cancers (Mwaka et al., 2021). Tanzania's queries highlight a focus on breast cancer symptoms and signs, as well as a broader interest in cancer symptoms overall, including cervical and prostate cancers (Hansen, 2022). Rwanda's searches are diverse, reflecting interests in breast, colon, lung, prostate, and stomach cancers, suggesting a comprehensive curiosity about various cancer types (Kizubet al., 2022).

5.1.3.2 Cancer treatment

The findings on search trends for cancer treatment information across Kenya, Uganda, Tanzania, and Rwanda illustrate diverse levels of interest and information-seeking behaviours. In Kenya, sporadic peaks in Web searches occurred in November 2005, April 2011, November 2011, and March 2012, indicating intermittent but significant interest over time. This aligns

with studies suggesting that access to cancer treatment information may be sporadic or limited in some regions (Francies et al., 2020). The fluctuations in search activity could stem from challenges such as restricted access to reliable information sources or periodic awareness campaigns rather than sustained public engagement. Conversely, Uganda experienced a notable peak in September 2014, followed by sustained interest in February and April 2016, and subsequent peaks in February 2017 and November 2022, indicating periodic surges in public demand for treatment-related information. These spikes in search interest likely correspond to significant events, such as the Uganda Cancer Institute's annual Cancer Run campaign. This initiative, which aims to raise awareness about cancer prevention and treatment, has been a pivotal event influencing public interest and search trends regarding cancer-related issues in Uganda (Omotoso et al., 2023).

On the other hand, Tanzania demonstrated intense interest in cancer treatment searches like in January 2017 and April 2022. The irregularity in these peaks suggests that while significant interest exists during specific periods, there may be gaps in information availability or varying levels of Internet access across different demographics. In Rwanda, socioeconomic disparities, limited Internet access, and varying levels of health literacy among different demographics can influence search trends for health-related topics like cancer. For instance, rural communities may experience lower Internet penetration levels than urban areas, limiting their ability to access and search for health information online. Socioeconomic disparities also play a role, as individuals from lower-income households may have less access to devices or Internet connectivity required for online searches. Additionally, disparities in health literacy across different demographic groups can affect the frequency and intensity of health-related searches, impacting how information about diseases like cancer is sought and accessed (Holden et al., 2021). These findings highlight the importance of consistent and accessible information channels tailored to local contexts, addressing barriers to information access across East Africa.

However, contradictory studies suggest that the sporadic nature of these peaks could be due to different factors. For instance, some researchers argue that while Internet access and health literacy are essential, there might be other underlying cultural or systemic barriers affecting information-seeking behaviours (Smith et al., 2020).

The findings on cancer treatment search by city across East Africa highlight significant disparities in information-seeking behaviours among urban centres. Eldoret and Mombasa were prominent for cancer treatment searches in Kenya. Factors beyond healthcare infrastructure could drive these cities' prominence. These cities are regional hubs known for their cultural diversity and economic activities, influencing access to healthcare services (Ouma, 2021). Additionally, community health initiatives and advocacy campaigns are crucial in raising awareness about cancer treatment options and encouraging proactive health-seeking behaviours among residents. These efforts contribute to heightened interest in cancer-related searches as individuals seek information on available treatments, support services, and prevention strategies. Kampala's dominance in Uganda can be attributed to its role as the capital and the centralisation of healthcare services, including cancer treatment facilities (Settumba, 2022). In Rwanda, Kigali's searches for cancer treatment align with efforts by the Rwanda Biomedical Centre to enhance health information dissemination and accessibility (NCD Alliance, 2023).

In Kenya, the predominant focus on chemotherapy and radiation therapy underscores the country's reliance on conventional treatment approaches across a spectrum of cancer types, supported by well-established healthcare protocols and infrastructure aimed at delivering effective cancer care (Makau-Barasa et al., 2020). Specific mentions of breast cancer chemotherapy and management further highlight Kenya's targeted efforts to address specific health concerns, demonstrating a tailored approach to treatment strategies (Shaikh et al., 2022).

Uganda's comprehensive approach to cancer treatment, as revealed in its word cloud emphasising chemotherapy, radiation therapy, and specific cancers like breast and prostate cancer, aligns with studies highlighting advancements in healthcare through institutions such as the Uganda Cancer Institute, which offer specialised care and treatment options (Downing et al., 2023). Tanzania's emphasis on chemotherapy and general therapy reflects broad-based efforts to combat cancer and improve patient outcomes, with initiatives focusing on enhancing treatment infrastructure and accessibility nationwide (Lambin & Nyysölä, 2022). Similarly, Rwanda's strategic focus on chemotherapy, radiation therapy, and specific cancers like breast, cervical, and colorectal cancer underscores targeted interventions by the Rwanda Biomedical Centre to strengthen healthcare systems and promote early detection and treatment through public health initiatives (Rubagumya et al., 2020). However, contrasting studies advocate for the integration of complementary and alternative therapies alongside conventional treatments, citing potential benefits in enhancing overall quality of life and addressing holistic patient needs, including physical, emotional, and spiritual aspects (Fitzsimmons et al., 2019). These perspectives highlight ongoing discussions in cancer care, emphasising the importance of balanced treatment approaches tailored to regional healthcare contexts across East Africa.

The findings on cancer treatment-related queries across Kenya, Uganda, Tanzania, and Rwanda highlight distinct information seeking behaviours related to cancer treatment. In Kenya, the significant focus on understanding chemotherapy side effects and exploring treatment options for prostate and cervical cancers reflects a concentrated interest in treatment outcomes and management strategies, as noted in studies (Manduku et al., 2020). Similarly, Uganda's queries revolved around cancer treatment, particularly addressing cervical and prostate cancers, alongside concerns about breast cancer treatments and the side effects of chemotherapy, aligning with national healthcare priorities and research findings (Mattila, 2023). Tanzania showed a notable prevalence of queries related to the side effects of chemotherapy and

treatments for prostate and breast cancers, indicating substantial public concern about treatment impacts and available options, as supported by recent research (Lyimo et al., 2020). In Rwanda, the focus was on chemotherapy and treatments for prostate cancer in search queries that highlights specific areas of interest within the country's healthcare system, reflecting ongoing research and healthcare initiatives (Kizub et al., 2022).

5.1.3.3 Cancer risk factors

The findings on search trends related to cancer risk factors in Kenya, Uganda, Tanzania, and Rwanda revealed a substantial interest in understanding various aspects of cancer. Topics such as breast cancer, cervical cancer, prostate cancer, and risk factors for various cancers emerged prominently. This widespread interest underscores a regional awareness of cancer types and their associated risk factors, showing a proactive approach towards health information seeking behaviours. Ferraris et al. (2023) highlight that public health campaigns and educational initiatives play a crucial role in enhancing community awareness about cancer risk factors, thus influencing search behaviours. Moreover, the emphasis on risk factors for specific cancers like breast and cervical cancer suggests a targeted effort to promote early detection and preventive measures (Dare et al., 2021).

Conversely, studies challenging these findings argue that the frequency of search queries does not necessarily correlate with actual knowledge or awareness levels among the population. For instance, research by Schillinger (2020) suggests that while there may be high search interest in cancer topics, the depth of understanding and application of preventive measures could vary significantly due to factors such as health literacy disparities and access to accurate information. Furthermore, disparities in Internet access and digital literacy skills across different socioeconomic groups within these countries could potentially skew the

representation of public interest in cancer risk factors through online search data (Arias-López et al., 2023).

The findings on search trends related to cancer risk factors queries showed search interest in understanding specific aspects of cancer, particularly the risk factors associated with cervical, prostate, and breast cancers. Cervical cancer risk factors were the most frequently queried. This aligns with findings from studies emphasising the importance of awareness and education in mitigating cervical cancer risk factors, such as HPV infection and lack of screening programmes (Sakwa, 2022). Similarly, the high interest in prostate cancer causes and risk factors highlights a growing awareness of prostate cancer's impact and the need for early detection strategies tailored to this demographic (Berenguer et al., 2023). Moreover, breast cancer risk factors garnered substantial attention (16.18%), underscoring ongoing efforts to promote breast health awareness and preventive measures. The inclusion of general risk factors for cancer (7.35%) suggests a broader interest in understanding common factors contributing to various types of cancer, reinforcing the importance of comprehensive cancer prevention efforts across the region (Kashyap et al., 2022).

5.1.4 Cancer prevention and awareness

The findings on information seeking about cancer prevention, awareness and screening are discussed hereunder.

5.1.4.1 Cancer prevention

The findings on searches about cancer prevention revealed diverse themes specific to each region. However, a prominent and recurring focus on cancer prevention was evident across the countries. This finding aligns with studies emphasising the critical role of prevention strategies in reducing cancer incidence, such as lifestyle modifications and vaccination against HPV for cervical cancer prevention (Soerjomataram & Bray, 2021). The findings showed the presence

of specific cancer types, for example, prostate, cervical, lung, and colorectal cancer prevention, and showed interest in understanding preventive measures tailored to these prevalent cancers. Some studies challenge these findings by arguing that the prominence of specific topics in the findings does not necessarily correlate with actual public knowledge or behaviour change. For instance, research by De-Jesus et al. (2021) suggests that while awareness of cancer prevention strategies may be high, adoption rates of healthy behaviours and participation in screening programmes may vary due to cultural, socioeconomic, or structural barriers. Furthermore, discrepancies in digital literacy and access to reliable health information could skew the representation of public interest in cancer prevention topics through online queries (Hasannejadasl et al., 2022).

The findings from cancer prevention-related queries showed a significant focus on specific types of cancer and various preventive measures. Prostate cancer prevention emerges as the most frequently queried topic. This aligns with global trends highlighting prostate cancer as a significant concern due to its prevalence and impact on male health (Culp et al., 2020). Similarly, significant interest in cervical cancer prevention underscores efforts to combat this preventable cancer through vaccination and screening programmes (Rathod et al., 2023). Breast cancer prevention queries reflect widespread awareness of the importance of early detection and lifestyle modifications in reducing breast cancer risk (Bellhouse et al., 2021). The inclusion of general queries on cancer prevention, such as cancer prevention foods, prevention and control of cancer, and cancer prevention diet, suggests a holistic approach to understanding preventive strategies encompassing dietary habits and broader lifestyle choices. Moreover, the query of how to prevent cancer naturally indicates a public interest in alternative or complementary approaches to cancer prevention, which may include herbal remedies or lifestyle adjustments (OBrien et al., 2022). Contradictory viewpoints argue that while there is

significant interest in cancer prevention topics based on search queries, the actual implementation of preventive measures could be hindered by socioeconomic disparities, limited access to healthcare resources, or cultural beliefs that may influence health behaviours differently (Wilderink et al., 2022). For instance, research by Brown et al. (2022) suggests that although information seeking behaviours are common, translating knowledge into actionable behaviours may face challenges.

5.1.4.2 Cancer screening

The findings on cancer screening-related topics had a predominant theme revolving around screening for specific types of cancer, prominently including breast, cervical, colorectal, and prostate cancers. This aligns with global health priorities, emphasising early detection as a critical strategy to reduce cancer mortality rates (WHO, 2020). The significant focus on breast cancer screening reflects ongoing efforts to promote mammography and other screening methods crucial for early detection among women (Luo et al., 2022). Similarly, queries related to cervical cancer screening, such as pap tests, underscore initiatives to combat this preventable cancer through regular screening programs (Rahemtulla, 2023). Prostate cancer screening also garners attention, reflecting efforts to enhance awareness and access to screening among men at risk (Ferlay et al., 2019).

5.1.4.3 Cancer awareness

The findings on cancer awareness related topics showed several significant themes in the public interest and information-seeking behaviours. At the forefront is breast cancer, indicating a strong focus on this particular cancer type, possibly influenced by extensive awareness campaigns and advocacy efforts globally (Omotoso et al., 2023). The prominence of breast cancer awareness campaigns, events, and initiatives underscores the ongoing efforts to educate and mobilise communities in support of breast cancer prevention and early detection (WHO,

2020). Cancer screening emerges as another critical theme, reflecting public interest in understanding the importance of early detection through screening programmes such as mammography and pap smears (Lemmo et al., 2022). This aligns with global health strategies promoting screening as a critical component in reducing cancer mortality rates (Gopal & Sharpless, 2021). The inclusion of themes like cancer awareness months, the symbolism of pink for breast cancer awareness, and promotional materials such as posters and ribbons further highlight the widespread support and visibility of cancer awareness initiatives in public.

The findings on search interest in cancer awareness showed significant insights into public interest in breast cancer awareness. This could be linked to the Breast Cancer Awareness Month annual campaign period (Schliemann et al., 2020). This campaign plays a pivotal role in raising awareness globally and promoting early detection efforts. However, alternative viewpoints might suggest that while digital queries demonstrate a strong interest in awareness campaigns, translating this awareness into tangible health outcomes can be challenging, particularly in underserved communities (Chidambaram et al., 2024). A study by Vrinten et al. (2019) emphasises the importance of targeted interventions that address barriers to healthcare access and ensure equitable participation in screening programs, particularly among vulnerable populations.

5.2 Informetric patterns of cancer information in EAC countries

The findings on the informetric patterns of cancer information supply and demand are discussed hereunder.

5.2.1 Quantity of research on cancer in East African Community countries

The findings on cancer research output within EAC showed an increase in scholarly publications over the last two decades from Google Scholar and PubMed indices. This trend reflects a growing focus on addressing the challenges of cancer within the region, likely driven

by evolving healthcare priorities, increased funding opportunities, and heightened awareness of the cancer burden.

For instance, in Kenya, both Google Scholar and PubMed show a consistent rise in indexed publications, with Google Scholar consistently indexing more articles than PubMed. Similarly, Uganda, Tanzania, and Rwanda exhibited an increasing trend in cancer publications over time, with both databases reflecting growth in indexed articles. The differences between the two indices can be attributed to Google Scholar's broader coverage, which encompasses a more comprehensive range of scholarly outputs beyond traditional medical databases (Gusenbauer & Haddaway, 2020). Researchers increasingly utilise Google Scholar due to its accessibility and comprehensive indexing, which includes conference papers, preprints, and grey literature not typically indexed by PubMed. Google Scholar consistently records higher publication counts compared to PubMed across these countries, highlighting its role as a comprehensive resource for researchers seeking diverse scholarly outputs (Merga et al., 2020).

The rise in the quantity of cancer publications over the years can be attributed to several factors. Firstly, advancements in medical research and technology have expanded opportunities for studying cancer, encouraging more researchers to contribute findings (Pramesh et al., 2022). Secondly, increased international collaborations and partnerships have facilitated knowledge sharing and research capacity building within East Africa (Nyirenda et al., 2021). Additionally, heightened awareness of cancer's impact on public health has prompted governments and organisations to prioritise funding for research initiatives aimed at its prevention, treatment, and improved patient outcomes (Puyol et al., 2021). Contrary to these perspectives, some studies argue that the sheer volume of publications may be influenced more by publication biases and competitive academic environments than by genuine advancements in the field. Vlasschaert et al. (2020) contend that the pressure to publish frequently and the competitive

nature of academic promotions have led to a proliferation of lower-quality studies, often characterised by selective reporting and methodological flaws rather than substantive advancements in cancer research. Similarly, Leising et al. (2022) highlight that the incentive structures in academia prioritise quantity over quality, resulting in an inflation of publications that may not necessarily reflect meaningful contributions or advancements in cancer research. These viewpoints suggest that the increase in cancer-related publications could be partially attributed to systemic issues within the academic and research communities rather than solely to technological and collaborative progress.

5.2.2 Types of publications

The findings on cancer research publications across EAC countries showed the dominance of journal articles as the primary mode of disseminating scholarly findings. This trend is consistent across Kenya, Uganda, Tanzania, and Rwanda, where both Google Scholar and PubMed index a substantial number of journal articles, which reflect the rigorous peer-review process and the academic scrutiny prevalent in cancer research. According to a study by Pomare et al. (2022), which explores publication trends in healthcare research, the prominence of journal articles aligns with their findings that peer-reviewed literature remains central to scholarly communication and knowledge advancement. Similarly, Chambers (2023) emphasises the critical role of journal articles in establishing credibility and disseminating evidence-based practices within the healthcare sector. Cooper et al. (2019) state that the inclusivity of Google Scholar in capturing diverse research outputs beyond traditional journals, such as theses/dissertations, preprints, and conference papers, enhances accessibility and knowledge dissemination. This is in line with the varied publication types indexed by Google Scholar across the sampled countries, illustrating a comprehensive approach to scholarly communication that accommodates different stages and formats of research dissemination. Additionally, Gusenbauer and Haddaway (2020) acknowledge the value of PubMed in

cataloguing specialised literature types like clinical trials, comparative studies, and case reports, which are crucial for informing clinical practice and healthcare policy.

Contrary to these findings, some studies argue that alternative modes of dissemination and regional barriers impact the visibility and accessibility of research findings. For instance, a study by Kakuhikire et al. (2021) in rural Uganda highlights the significant role of local and regional conferences, workshops, and community-based platforms in disseminating cancer research, arguing that these modes are more effective in engaging local healthcare professionals and stakeholders who may not have regular access to international journals. Moreover, Paez (2017) suggests that the reliance on journal articles might overlook valuable grey literature and locally published works that are often critical for addressing region-specific cancer challenges. They emphasise that language barriers, limited Internet access, and the costs associated with publishing in high-impact journals can restrict the contribution and visibility of researchers from EAC countries in the global academic landscape, thereby highlighting the need for more inclusive and locally focused dissemination practices.

5.2.3 Themes in cancer research in EAC countries

Cancer research across Kenya, Uganda, Tanzania, and Rwanda showed distinct yet interconnected themes. In Kenya, a significant volume of research focuses on keywords such as "Kenya," "cervical cancer screening," "Western Kenya," and "woman," indicating a dedicated effort to address epidemiological patterns and healthcare needs, particularly in women's health concerning cervical and breast cancers. Studies like Njuguna (2022) and Muinde (2022) underscore Kenya's commitment to enhancing cervical cancer screening and management strategies. These studies highlight ongoing efforts aligned with national health priorities, emphasising local contexts and challenges. Similarly, Mutebi (2018) contributes by

shedding light on breast cancer trends in Kenya, illustrating the broader interest in cancer epidemiology within the country.

In contrast to the emphasis on women's health and specific cancer types in Kenyan research, some studies suggest a need for broader cancer research agendas. For example, Omotoso et al. (2023) argue that cancer research in Kenya disproportionately focuses on cervical and breast cancer while neglecting other prevalent cancers, such as prostate and colorectal cancer. Their study indicates that there is insufficient attention to cancers affecting men and highlights gaps in research related to male-specific and less-publicised cancers, which are also critical for comprehensive cancer control. Additionally, Manduku et al. (2020) criticise the existing focus on women's cancers, noting that the current research agenda fails to adequately address paediatric cancers and cancers linked to genetic predispositions. They emphasise that an inclusive approach, integrating various demographic factors and cancer types, is necessary to develop a more effective national cancer research strategy in Kenya, advocating for balanced attention across all forms of cancer affecting different population groups.

In Uganda, the cancer research landscape was characterised by keywords such as "Uganda," "Uganda Cancer Institute," "cancer," and "cervical cancer screening," emphasising the efforts to advance healthcare and address prevalent cancer challenges. Studies like Mutyaba et al. (2019) and Nabachwa (2022) highlight Uganda's institutional efforts and strategies in disease management, particularly in women's health, through targeted research and interventions. These studies underscore Uganda's commitment to improving cancer outcomes and patient care through focused initiatives. Conversely, perspectives differ in studies like Bender-Ignacio et al. (2017) and Auma (2021), which focus on broader health surveys and specific aspects of HPV and HIV co-infection dynamics. These studies provide alternative insights that broaden

the understanding of Uganda's healthcare challenges beyond the specific keywords identified, offering comprehensive public health strategies.

In Tanzania, the dominant cancer research themes were "Tanzania," "cervical cancer," "Northern Tanzania," and "woman," which showed efforts to explore regional disparities in cancer prevalence and optimise healthcare delivery. Studies such as Runge et al. (2019) and Lyimo et al. (2020) support this focus by examining cervical cancer trends and screening practices in Northern Tanzania. These studies emphasise the role of local institutions like the Ocean Road Cancer Institute in shaping research agendas and implementing targeted interventions. However, studies like Rick et al. (2021) and Sood et al. (2021) provide alternative perspectives, focusing on broader challenges in cancer control and healthcare infrastructure across Tanzania. These studies discuss issues such as access to treatment, resource limitations, and regional disparities in cancer care, contributing to a nuanced understanding of Tanzania's efforts in cancer research and healthcare delivery.

In Rwanda, cancer research themes were characterised by keywords like "Rwanda," "Butaro Cancer Centre," "cervical cancer screening," and "breast cancer", which shows the country's commitment to advancing healthcare initiatives and improving cancer care. Studies such as Park et al. (2018) and Habinshuti et al. (2022) support this emphasis by documenting Rwanda's efforts in cervical cancer screening programmes and the role of specialised centres like the Butaro Cancer Centre in providing accessible, quality care. These studies underscore Rwanda's proactive approach to addressing cancer challenges through community-based interventions and innovative healthcare practices tailored to local needs. However, studies like Fadelu et al. (2022) and Rubagumya et al. (2020) may offer dissenting perspectives by highlighting challenges in healthcare infrastructure and disparities in cancer care access across different regions of Rwanda. These studies provide insights into broader healthcare disparities and

systemic challenges that impact the implementation of national cancer initiatives, offering a more critical view compared to the positive narrative suggested by the identified keywords.

5.2.4 Evolution of the cancer research themes in EAC countries

The evolution of cancer research themes across Kenya, Uganda, Tanzania, and Rwanda from 2004 to 2023 highlights significant shifts in focus and priorities within each of the countries.

The evolution of cancer research themes in Kenya from 2004 to 2023 showed a shift from broad explorations of women's health and cancer epidemiology to more focused efforts on preventive strategies and specific cancer types. Vallone et al. (2022) demonstrated this shift by documenting an increased focus on preventive measures, such as vaccination and early screening programmes, particularly for cervical and breast cancers, which have become more prominent in recent research agendas. Similarly, Williams et al. (2019) noted a growing emphasis on community-based interventions and health education aimed at reducing cancer incidence through early detection and lifestyle modifications. Furthermore, a study by Maalim (2022) highlighted the trend towards specialised research on cancers with high local prevalence, including prostate and oesophageal cancers, indicating a refined approach to addressing specific public health challenges in Kenya. However, contrasting this focused evolution, Torres-Vitolas et al. (2021) argued that while there is a visible shift towards specific cancers, research on broader cancer epidemiology and the socio-economic determinants of cancer remains underexplored. They suggest that this oversight could limit the understanding of cancer trends and impede the development of holistic cancer control strategies that consider diverse risk factors across different population groups.

The evolution of cancer research themes in Uganda from 2004 to 2023 illustrates a transition from general explorations in cancer and patient care towards more specific investigations into cancer management, screening practices, and epidemiology. Namara et al. (2021) supported

this transition by highlighting the recent focus on developing and implementing national screening programmes for cancers like cervical and breast cancer, which have improved early detection rates and management strategies. Additionally, Kiyonga and Atwine (2019) documented a shift towards tailored cancer management practices, including the adoption of context-specific treatment protocols and palliative care models that reflect Uganda's healthcare challenges and resource limitations. Moreover, research by Nansubuga et al. (2020) showed an increased emphasis on epidemiological studies that analyse cancer incidence patterns and risk factors specific to the Ugandan population, thereby facilitating more effective public health interventions. Contrarily, Mugisha and Mutungi (2018) argued that while there has been progress in specific areas, a disproportionate amount of research still concentrates on patient care rather than innovative cancer management and screening practices, indicating a lingering need for comprehensive research that addresses the full spectrum of cancer care in Uganda.

The research in Tanzania moved from general themes such as "breast cancer" and "cervical cancer screening" (2004-2013) to more nuanced areas focusing on "knowledge," "treatment," and specific aspects of "cervical cancer" and "breast cancer" (2014-2023). Mrema et al. (2018) indicated that the shift towards focusing on knowledge of specific cancers is due to information seekers' need to know how each cancer affects them. Similarly, a study by Ngowi et al. (2020) underscored the evolving research focus on cancer treatment advancements, particularly in breast cancer management, highlighting novel therapeutic approaches and their impact on patient outcomes. Furthermore, Mahande et al. (2019) discussed the increased emphasis on knowledge dissemination through health education campaigns, which have contributed to raising awareness about cervical and breast cancers among Tanzanian communities. However, contrasting this trajectory, Kishimba et al. (2017) argued that despite advancements in specific cancer research areas, there remains a notable gap in research funding and infrastructure

support, hindering comprehensive cancer control efforts in Tanzania and limiting the scope of research diversity and impact.

The evolution of cancer research themes in Rwanda from 2004 to 2023 highlights significant shifts in research priorities from patient care and preventive measures, such as breast and cervical cancer, to greater emphasis on women's health, healthcare quality improvement, and targeted cancer screening programs. Some studies support this shift, for example, Kabagema et al. (2022) reported a significant increase in cervical cancer screening coverage from 17.5% in 2012 to 70.3% in 2019, indicating a successful implementation of targeted screening programmes. Ong et al. (2024) also highlighted a 33% increase in breast cancer screening from 2015 to 2019, further supporting the effectiveness of targeted cancer screening initiatives. However, Sibomana et al. (2023) found that despite these shifts, disparities in cancer screening and treatment outcomes persist based on socioeconomic status and geographic location, highlighting the need for continued efforts to ensure that all Rwandans have equal access to cancer care.

5.2.5 Quality of publication on cancer in EAC countries

The quality of the publication was measured using citation analysis. The findings are discussed hereunder.

5.2.5.1 Citation analysis

The findings of the citation patterns of cancer research publications across Kenya, Uganda, Tanzania, and Rwanda showed that only a small proportion of articles achieved significant citation counts, with the majority receiving limited or no citations. This aligns with broader trends identified in bibliometric studies. For instance, Nicolaisen and Frandsen(2019) found that a substantial percentage of scholarly articles across various fields remain uncited, highlighting a prevalent issue in academic publishing. Their findings mirror the data observed

in the EAC countries, where a significant portion of cancer research publications have not been cited. Similarly, Rice et al. (2020) emphasised that in the biomedical research domain, only a minority of papers garner substantial citations, supporting the observation that most articles from Kenya, Uganda, Tanzania, and Rwanda fall into a category of low citation impact, with only a few surpassing 100 citations. Further supporting this trend, Mutebi et al. (2022) bibliometric analysis across African nations highlighted the challenges in achieving high citation rates in healthcare research, including cancer studies. Their study aligns with the observed citation rates in the EAC countries, reinforcing the notion that a significant proportion of research outputs, despite their potential relevance, do not receive widespread academic attention or citations. Wang et al.'s (2020) research into global health citation patterns also identified disparities based on regional and disciplinary factors, which resonate with the differing citation rates observed in Kenya, Uganda, Tanzania, and Rwanda. This suggests that regional variations and publication dynamics contribute to the varied citation impacts across these countries. Additionally, Cash-Gibson et al. (2018) findings on factors influencing citation counts, such as journal impact factor and publication accessibility, further explain why many articles in these countries may have low citation rates, as factors like the journal's reach and the article's accessibility can significantly affect citation numbers.

Conversely, some studies challenge the adequacy of traditional citation metrics in fully capturing the impact of research, particularly in developing regions. Gupta and Kumar (2019) argued that citation counts might not accurately reflect the quality or importance of research outputs from developing countries due to factors like language barriers, limited access to scholarly databases, and regional biases. This critique suggests that while citation counts provide some insight, they may not fully capture the value of cancer research publications addressing local health issues in Kenya, Uganda, Tanzania, and Rwanda. Similarly, Sedighi (2020) advocated for the use of alternative metrics, such as altmetrics, to assess the broader

societal and policy impact of research. They highlight the limitations of traditional citation metrics and propose a more comprehensive evaluation of research impact that includes social media engagement, policy influence, and public interest. Their perspective implies that the true impact of cancer research in these countries might be understated if assessed solely by citation counts, suggesting a need for broader evaluative frameworks to capture the multifaceted contributions of such research. Altmetrics provides a modern approach to assessing the impact and engagement of scholarly research by measuring various online activities. Unlike traditional citation metrics, which count academic citations, altmetrics capture a broader spectrum of influence, including social media mentions, news articles, policy document citations, blog discussions, and interactions on platforms like Mendeley and Wikipedia. These metrics offer insights into how research resonates with audiences beyond academia, such as policymakers, practitioners, and the general public. By reflecting online engagement and public interest, altmetrics provide a more comprehensive view of a research's societal impact and practical relevance, complementing conventional citation-based evaluations and offering a more nuanced understanding of its reach and influence.

5.2.5.2 Correlations analysis of citations and age of articles

The correlation analyses of cancer research publications in Kenya, Uganda, Tanzania, and Rwanda revealed a moderate positive linear relationship between publication age and citation counts, with correlation coefficients of 0.3072 for Kenya, 0.4024 for Uganda, 0.3953 for Tanzania, and 0.4092 for Rwanda. These findings indicate that older publications tend to accumulate more citations over time. The findings of the study corroborate those of other studies. For instance, Aksnes et al. (2019) conducted a comprehensive analysis across disciplines, showing that older publications generally receive more citations due to their cumulative visibility and influence within the academic community. Similarly, Piwowar et al. (2018) emphasised the longer citation window that benefits older articles, allowing them to

gain citations as they become integrated into scholarly discourse. Additionally, Yang et al. (2023) discussed "*citation ageing*," where older articles have more opportunities to be cited over time due to their enduring presence in the literature. This concept reinforces the trend observed in Kenya, Uganda, Tanzania, and Rwanda, indicating that older cancer research publications are more likely to have accumulated citations.

Contrary views on citation patterns are presented by Jurgens et al. (2018), who argued that citation behaviours vary widely across fields and are influenced by the novelty of research. They contend that in rapidly evolving disciplines, newer publications may attract citations more quickly due to their immediate relevance and impact. Similarly, Sugimoto and Larivière (2018) suggested that ground-breaking research can garner substantial citations shortly after publication, challenging the notion that older publications inherently accumulate more citations. While the observed positive correlation between publication age and citation counts in East African countries aligns with general bibliometric trends, these perspectives highlight that the relationship between age and citations is nuanced and can differ based on specific research fields and the novelty of findings.

5.2.6 Authorship of the research on cancer in EAC countries

The findings on authorship patterns in cancer research publications reveal distinct trends across Kenya, Uganda, Tanzania, and Rwanda. In Kenya and Uganda, solo authorship is notably prevalent, with a significant portion of articles (27.24% in Kenya and 29.26% in Uganda) authored by single individuals. This reflects a reliance on individual contributions, possibly due to limited collaborative opportunities or the prominence of individual researchers in these countries' academic landscapes. Aksnes et al. (2019) suggested that solo authorship is more common in regions with developing research infrastructure, aligning with the observed dominance in Kenya and Uganda. However, this contrasts with broader scientific community

trends where collaborative research is typically encouraged and rewarded. Alrehaili et al. (2024) argued that collaboration enhances scientific work by pooling diverse expertise and resources, leading to more innovative outcomes. This highlights potential opportunities in Kenya and Uganda to foster more collaborative research environments, which could enhance the visibility and impact of their cancer research.

On the other hand, Tanzania and Rwanda exhibit a different trend with a strong preference for collaborative research involving mid-sized teams. In Tanzania, 33.57% of publications involve four authors, followed closely by five-author teams at 32.17%. Similarly, in Rwanda, 43.17% of publications are authored by teams of four, with teams of five accounting for 23.02%. This indicates that more established research networks facilitate teamwork and shared contributions in cancer research. Patel et al. (2019) noted that co-authorship often leads to higher citation counts and more significant academic impact, as multi-authored papers benefit from combined networks and reputations. This aligns with observed trends in Tanzania and Rwanda, suggesting that collaborative practices contribute to more impactful and widely recognised research outcomes. Adams et al. (2019) emphasised the advancements and impact associated with international and interdisciplinary collaborations, reflecting the dynamic and collaborative nature of cancer research teams in Tanzania and Rwanda. These insights suggest that collaborative approaches in these countries foster dynamic and influential cancer research environments.

5.3 Cancer information search trends and cancer occurrences in the EAC countries

The findings of cancer information search trends and incidence rates showed significant correlations between high search interest and the prevalence of certain cancers across different EAC countries. In Kenya, breast cancer and cervical cancer showed notable correlations with their respective incidence rates. Similarly, in Uganda, prostate cancer and cervical cancer

closely corresponded with their incidence rates. In Tanzania, breast cancer, cervical cancer, and prostate cancer closely aligned with their high incidence rates, while in Rwanda, prostate cancer and breast cancer demonstrated close correspondence with their respective incidence rates. Supporting these findings, studies such as those by Lippi and Cervellin (2019) highlighted a strong correlation between online search volumes for specific cancers and their incidence rates, suggesting that public interest often mirrors actual disease prevalence. Eysenbach (2006) emphasised the concept of "infodemiology," affirming the positive correlation between online search trends for health-related topics and actual disease incidence rates. Huang et al. (2021) further demonstrated that search trends for cancer symptoms and treatments correlate well with cancer incidence and mortality data. Patel et al. (2020) found that Google search data can predict cancer incidence trends, particularly for commonly searched cancers like breast and prostate cancer. Ziakas and Mylonakis (2023) supported this view by showing that Google search trends often mirror actual disease incidence, indicating their reliability as a proxy for understanding public interest in specific diseases.

On the contrary, some studies such as those by Dasgupta et al. (2020) have highlighted inconsistencies between online search trends and cancer incidence rates, particularly in developing countries. Phillips et al. (2018) suggested that public search behaviours may not always accurately reflect actual cancer prevalence. He and Li (2021) argued that search trends might sometimes reflect heightened public anxiety or media coverage rather than actual disease prevalence, potentially leading to mismatches between search data and cancer incidence rates. He and Li (2021) argued that online search trends can be influenced by media coverage and health campaigns, potentially skewing the correlation with actual disease incidence rates. These perspectives underscore the importance of interpreting search data cautiously and considering contextual factors when assessing cancer prevalence.

5.4 Cancer information search trends and cancer informetric patterns

The analysis of cancer information search trends and informetric patterns across EAC countries showed a positive correlation between Web search volume for cancer information and the number of scientific publications on cancer-related topics. Supporting these findings, studies such as Mavragani et al. (2018) highlighted a strong positive correlation between Internet search trends and scientific output in the field of oncology, indicating that higher levels of public interest in cancer are associated with increased research productivity. These studies underscore the utility of search data as a proxy for public health concerns and research priorities, reinforcing the link between online information-seeking behaviour and scientific research production in the context of cancer. Similarly, Soroya et al. (2021) explored global trends in health information-seeking behaviour and scholarly productivity, finding consistent patterns where regions experiencing increased search queries on specific health issues, such as cancer, tend to produce more scientific publications addressing those topics. This correlation reflects a dynamic interplay between public health priorities and scientific inquiry. However, a contrasting view is presented by Gupta and Kumar (2019), who argued that while Web search volume can indicate public interest, it may not always translate into increased scientific publications in developing regions. This means that high levels of online searches for cancer information do not necessarily result in more research output, highlighting the need for improved research infrastructure and support in these areas.

5.5 Modelling cancer information demand and supply

The proposed cancer information demand and supply model for the *Health Connect Centre* aligns with findings from various studies that emphasise the importance of integrating advanced technology to enhance access and management of health-related information. Studies such as Tudor (2022), Kent (2019), and Stark et al. (2019) highlighted the use of machine learning, AI models, and predictive analytics to improve cancer prediction, treatment response

analysis, and early detection. These technologies, akin to the sophisticated search core API and analytics in the *Health Connect Centre* model, aim to provide accurate, timely, and comprehensive information crucial for researchers, healthcare professionals, and policymakers. By leveraging advanced search capabilities, secure data handling, and continuous content aggregation, the model supports the dynamic needs of cancer research and public health initiatives, contributing to enhanced decision-making and patient outcomes, as seen in various technological healthcare advances discussed in prior studies.

5.6 Chapter summary

This chapter discussed the findings of the study in relation to prior studies. It identified distinct patterns in health information searches related to cancer, analysing temporal trends, geographic variations in queries, and the prevalent types of cancer attracting attention. The study revealed that peaks in search interest often align with health awareness campaigns such as Breast Cancer Awareness Month, influencing search behaviours. Major cities/towns such as Kijabe, Nairobi, Kampala, Dar es Salaam, and Kigali exhibit substantial search volumes driven by factors like strong healthcare infrastructure, targeted awareness initiatives, and improved Internet accessibility. Primary areas of interest include breast, cervical, prostate, lung, and colon cancers, reflecting local epidemiological profiles, cultural perspectives, and healthcare priorities. The chapter emphasised the importance of tailored health communication strategies to meet diverse informational needs and enhance cancer awareness and prevention efforts across the EAC countries. Additionally, the informetric analysis highlighted a rising scholarly focus on combating the region's cancer burden through increased research output, particularly in cervical, breast, and prostate cancers, despite ongoing challenges such as limited citation impact and regional research disparities.

CHAPTER SIX

SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter summarises the findings, conclusions, and recommendations as well as the theoretical, policy, and practical implications. It explores the diverse facets of cancer information demand and supply across the EAC region. The chapter delves into validating theoretical frameworks such as the Monitoring and Blunting Theory, the Health Belief Model, and Wilson's Model of Information Behaviour, illustrating their relevance in understanding the region's demand and supply of cancer information. The chapter also outlines suggestions for future research to advance cancer information demand and supply.

6.1 Summary of the findings

The study's findings are summarised hereunder based on the study's objectives.

6.1.1 Cancer information search trends in the EAC countries

Examining cancer search interest over time across Kenya, Uganda, Tanzania, and Rwanda reveals varied patterns across different search platforms. In Kenya, Web searches peaked notably in June 2005 and July 2019, with significant spikes also being observed in the news and YouTube searches during these periods. Uganda showed pronounced peaks in Web searches in November 2011 and scattered interest across news and YouTube platforms in the subsequent years. Tanzania exhibited peaks in Web searches in March 2010 and August 2020, aligning with sporadic peaks in image and YouTube searches during these periods. Rwanda's search interest peaked in August 2022 and June 2011, with notable activity in Web and YouTube searches.

Cancer search interest across cities in Kenya, Uganda, Tanzania, and Rwanda varies across Web, image, YouTube, and news platforms. In Kenya, cities like Kijabe, Litein, and Nyeri showed high Web search volumes, with Migori and Kitui demonstrating significant interest in

image searches. YouTube searches were prominent in Majengo and Kajiado, while Nanyuki led in news searches. Uganda exhibited active Web searches in Ishaka, Mbarara, and Mbale, significant image searches in Arua and Gulu, and notable YouTube activity in Gulu and Kampala, with Entebbe and Kampala leading in news searches. Tanzania showed a strong Web search activity in Kibaha, Dodoma, and Mbeya, with notable image searches in Kigoma and Mbeya and prominent YouTube searches in Arusha and Dar es Salaam. High interest in news also showed in Dar es Salaam. Rwanda demonstrated significant Web search activity in Ruhondo, Huye, and Kinanzi, with prominent YouTube searches in Kinanzi and Kigali, and Kigali leading in both image and news searches.

The related topics and queries for general cancer searches indicated a high interest in understanding the different types of cancers, particularly breast, cervical, and prostate cancers. Search trends for cancer symptoms highlighted issues such as early symptoms of cancer, breast cancer symptoms, and cervical cancer symptoms, including understanding early warning signs and symptoms of specific cancers. The data showed that people in EAC countries were particularly interested in the causes of breast cancer, cervical cancer, and prostate cancer, with general interest also high in understanding the environmental and lifestyle factors contributing to cancer. There was a substantial interest in understanding risk factors for specific cancers such as breast, cervical, and prostate, pointing to a need for information on modifiable risk factors and preventive measures.

Queries regarding cancer prevention focused on dietary and lifestyle changes, as well as natural prevention methods, with prostate, cervical, and breast cancers being the most searched-for prevention information, indicating a robust public interest in practical measures to reduce cancer risk. The search behaviour revealed a high demand for information on screening methods for cervical, breast, and prostate cancers, with significant interest in understanding the costs and local availability of screening programs, particularly in Kenya. The findings showed

that breast cancer awareness was the most prominent theme, with substantial interest in awareness campaigns, symbols like pink, and events such as Breast Cancer Awareness Month.

6.1.2 Informetric pattern of cancer information in the EAC countries

The analysis of cancer research output across Kenya, Uganda, Tanzania, and Rwanda revealed a substantial volume of scholarly activity addressing various aspects of cancer. Each country demonstrated a commitment to understanding and mitigating the impact of cancer through research endeavours. While Kenya and Uganda show slightly higher research outputs than Tanzania and Rwanda, all countries contributed significantly to the regional knowledge base on cancer.

Publications on cancer in the EAC countries encompass a variety of formats, including research journal articles, thesis, reviews, case studies, and policy papers. These publications serve diverse purposes, from reporting epidemiological data and clinical findings to exploring socio-cultural factors influencing cancer care and prevention strategies. The diversity in publication types reflects a holistic approach towards addressing the multifaceted challenges of cancer across the region.

Research themes in the EAC countries underscore the region's priorities in combating cancer. Kenya focuses significantly on cervical and oesophageal cancers, Uganda on cervical cancer screening and HIV-associated cancers, Tanzania on demographic factors and HPV vaccine acceptability, and Rwanda on breast cancer diagnosis delays and integrated women's health programs. These themes highlight country-specific concerns while collectively contributing to a comprehensive understanding of cancer epidemiology and healthcare practices in East Africa. The evolution of cancer research themes in EAC countries reflects dynamic shifts in healthcare priorities and research interests. Initial studies focused on epidemiology and disease prevalence, gradually expanding to socio-cultural determinants, healthcare accessibility, and

intervention efficacy. This evolution underscores a progressive adaptation to emerging challenges and opportunities in the region's cancer prevention, diagnosis, and treatment.

Publication quality in EAC countries varies, with a notable proportion of studies receiving significant citation counts, indicating sustained relevance and impact. However, challenges persist, as evidenced by many publications with minimal citation impact. Enhancing publication quality requires addressing visibility gaps, ensuring publishing in high impact journals and promoting dissemination strategies that reach both academic and healthcare practitioner audiences effectively. Authorship patterns in cancer research across EAC countries typically involve collaborative efforts among small teams of researchers, fostering interdisciplinary approaches and knowledge exchange. Influential authors in terms of collaborations and number of papers such as MJ Huchko in Kenya and J Orem in Uganda play pivotal roles in shaping research agendas and driving impactful outcomes. Strengthening author collaboration networks can enhance research quality and visibility, promote knowledge dissemination, and facilitate sustainable improvements in cancer care across the region.

6.1.3 Cancer information search trends and cancer occurrences in the EAC countries

In Kenya in 2022, breast cancer emerged as the most searched-for cancer type, with a relative search volume of 70, closely followed by cervical cancer at 65. These search volumes correlated with their respective incidence rates of 16.2% for breast cancer and 13.1% for cervical cancer. Prostate cancer also garnered significant interest, with a search volume of 40, despite its lower incidence rate of 8%. However, cancers such as oesophageal and colorectal, which have high incidence rates in Kenya, did not show proportionate search volumes.

In Uganda, cancer searches in 2022 were predominantly focused on cancer symptoms (100), prostate cancer (95), breast cancer (90), and cervical cancer (87). These high search volumes align closely with their respective incidence rates: cervical cancer at 19.3%, breast cancer at

8.3%, and prostate cancer at 7.5%. This correlation suggests strong public awareness and interest in these prevalent cancers. However, cancers like Kaposi sarcoma and oesophageal cancer, despite their significant incidence rates, did not receive substantial search interest.

In Tanzania, breast cancer (100) and cervical cancer (95) were the top search topics in 2022, reflecting high public interest and awareness. These search volumes correspond well with their respective high incidence rates of cervical cancer at 24.2% and breast cancer at 10%. Prostate cancer also showed considerable interest, with a search volume of 63 and an incidence rate of 10.7%. However, there were discrepancies noted, particularly for cancers like oesophageal and colorectal, which have notable incidence rates but did not match their search volumes.

In Rwanda, the most searched topics in 2022 were pancreatic cancer (100), prostate cancer (85), and cancer symptoms (80). The search volumes for prostate cancer (14.3% incidence rate) and breast cancer (11.2% incidence rate) aligned well with their respective incidence rates, indicating a high level of awareness among the Rwandan population. However, there were discrepancies for cervical and stomach cancers, where high incidence rates did not fully align with search volumes.

6.1.4 Cancer information search trends and cancer informetric patterns in the EAC countries

The findings on cancer information search trends and informetric patterns across Kenya, Uganda, Tanzania, and Rwanda revealed significant insights into the relationship between online search behaviour and scientific publications. In Kenya, strong positive correlations were observed between the number of scientific publications on cancer and Web search volume ($r = 0.323$, $p = 0.165$). Similarly, Uganda exhibited strong positive correlations between Web search volume and publications ($r = 0.435$, $p = 0.056$). Tanzania demonstrated robust correlations between Web search interest and scientific publications on cancer: $r = 0.788$, $p <$

0.01. Similarly, Rwanda showed consistent growth in Web search interest and scientific publications related to cancer, with significant positive correlations observed between Web search volume and publications ($r = 0.862$, $p < 0.01$). These findings underscore the interconnected nature of public information-seeking behaviour and academic research in addressing cancer within the EAC, highlighting opportunities for targeted interventions further to bolster awareness and research efforts across the region.

6.1.5 Modelling the interplay between cancer information demand and cancer information supply in EAC countries

The study examined the dynamics of cancer information demand and supply across Kenya, Uganda, Tanzania, and Rwanda. Significant positive correlations between online search behaviour and scientific research output indicate a growing public interest in cancer-related information and increased academic research publications.

The study proposes the "*Health Connect Centre*" Web application, which will be a centralised platform hosted at the Technical University of Kenya. This initiative bridges informational gaps by providing comprehensive access to cancer-related information from Google Scholar. This centralisation enhances quality control by consolidating diverse resources into a single hub, where content undergoes rigorous vetting for accuracy and relevance. This approach promotes trust and confidence among users. The platform features intuitive interfaces for search and interaction, integrates analytics to understand user behaviour, and emphasises data security with robust protocols. By providing centralised access to reliable cancer information, the application enhances accessibility, fosters community engagement, and supports evidence-based decision-making in cancer management across the EAC. Future phases involve enhancing content quality through collaborations with research institutions and integrating user-centric features like doctor registrations and support groups.

6.2 Conclusion

The cancer information search trends in the EAC countries highlight the diverse and evolving needs of the population regarding cancer-related information. There is a demand for accessible online resources addressing concerns about cancer symptoms, causes, risk factors, prevention, screening, and awareness campaigns, as evidenced by high search volumes for specific cancer types and related queries. Analysis shows significant variation in information-seeking behaviour across different platforms and cities within each country. Web searches often peak during specific years, potentially tied to health campaigns or media coverage. YouTube has emerged as a preferred platform for health-related content, particularly in urban areas. These findings underscore the importance of tailored health communication strategies that consider local contexts and preferences to effectively enhance awareness, prevention, and treatment efforts in these communities, promoting informed decision-making and improving overall health outcomes across East Africa.

The cancer research works highlight a robust engagement of EAC countries in cancer research, characterised by diverse thematic focuses, evolving research priorities, and collaborative authorship patterns. While significant strides have been made in understanding and addressing cancer challenges, disparities in publication impact and research quality underscore areas for improvement. Continued investment in interdisciplinary research, enhanced collaboration networks, and targeted dissemination strategies are crucial to advancing cancer care and management within the EAC.

Cancer information search trends and incidence rates across Kenya, Uganda, Tanzania, and Rwanda showed a clear correlation between the public's interest in specific cancers and their actual incidence rates, notably seen with high search volumes and incidence rates for breast and cervical cancers. This correlation reflects robust public awareness and proactive

information-seeking behaviours regarding these prevalent cancers. However, disparities persist, particularly evident with cancers like oesophageal cancer and Kaposi sarcoma, which exhibit high incidence rates but relatively low search volumes. These disparities underscore significant public awareness and education gaps, highlighting the need for targeted health campaigns to improve knowledge and promote early detection strategies for these less-discussed cancers.

Cancer information search trends and informetric patterns across Kenya, Uganda, Tanzania, and Rwanda showed a consistent increase in Web search interest related to cancer and a corresponding rise in scientific publications over time across all countries studied. This trend underscores a growing public awareness and academic engagement in addressing cancer in the region. Also, the strong positive correlations found between Web search volumes and the number of scientific publications indicate a mutually reinforcing relationship. Higher public interest in cancer is linked with increased academic research output, potentially leading to better knowledge dissemination and advancements in healthcare practices.

The study highlights the increasing public interest in cancer-related information and the growing academic research output in Kenya, Uganda, Tanzania, and Rwanda. The proposed "*Health Connect Centre*" Web application helps consolidate and vet comprehensive cancer information from reputable sources like Google Scholar. The platform aims to build user trust and facilitate evidence-based decision-making in cancer management across the EAC by ensuring rigorous quality control and offering intuitive interfaces, robust analytics, and stringent data security. The initiative will focus on enhancing content through strategic collaborations and implementing user-centric features to support regional healthcare advancements further.

6.3 Recommendations

Based on the findings and conclusions of this study, the researcher makes the following recommendations:

6.3.1 Enhanced public awareness campaigns

Based on the findings that revealed disparities in search volumes for cancers such as oesophageal cancer and Kaposi sarcoma, despite their significant incidence rates, it is evident that there are substantial gaps in public awareness of some types of cancer within the EAC. These gaps highlight a disconnect between public interest and understanding of lesser-known cancer types, which could hinder early detection and timely intervention efforts. The study recommends that local health authorities implement targeted public awareness campaigns in collaboration with non-governmental organisations and healthcare providers. These campaigns should educate the population about symptoms, risk factors, and early detection methods for these less-discussed cancers. These initiatives empower individuals to recognise symptoms early, seek timely medical advice, and improve health outcomes through early detection and intervention by raising awareness and improving knowledge levels. This will address current information gaps and stimulate increased demand for comprehensive cancer information. This, in turn, will enhance the overall supply of relevant and timely health resources, promoting better cancer management across the region.

6.3.2 Community engagement

Based on the findings related to cancer information search trends and informetric patterns in the EAC countries, the study underscores a strong correlation between the public interest in cancer topics and the volume of scientific research output. This highlights the significant influence of public information-seeking behaviour on academic research activities in the region. Therefore, effective community engagement is essential. Local communities, academic

institutions, healthcare providers, and non-governmental organisations should collaborate to disseminate accurate and culturally relevant information about various aspects of cancer through multiple channels. This includes organising community workshops, seminars, and health campaigns in urban and rural areas. Utilising digital platforms and social media to reach a wider audience, alongside traditional methods like pamphlets and community meetings, will ensure comprehensive coverage and engagement. By enhancing public awareness and knowledge, these efforts not only empower individuals to make informed health decisions but also foster a supportive environment for ongoing research and educational initiatives tailored to the unique needs of each country within the EAC.

6.3.3 Tailored information resources

The study identified significant search interest and high volumes for specific cancers such as breast, cervical, and prostate within the EAC, highlighting a strong demand for comprehensive cancer-related information. The study recommends developing tailored information resources to meet these information needs. These resources should provide accessible and relevant content on symptoms, causes, prevention strategies, and available screening programs. By addressing these identified needs, health organisations, educational institutions, and governmental health departments across the region are well-positioned to implement this recommendation. Their collaboration can ensure that the content is accurate, culturally sensitive, and readily accessible, empowering individuals to make informed health decisions and fostering proactive information-seeking behaviours. This collaborative effort bridges the gap between public interest and scientific knowledge and enhances the overall dynamics of cancer information demand and supply within the EAC.

6.3.4 Collaborative research initiatives

The study highlighted diverse thematic foci and publication outputs across Kenya, Uganda, Tanzania, and Rwanda, emphasising the need for enhanced interdisciplinary collaboration to address regional cancer challenges effectively. Therefore, advocating for collaborative research initiatives is crucial and strongly recommended. By fostering partnerships among researchers from diverse disciplines and countries, this approach harnesses synergies to comprehensively tackle the complex facets of cancer prevention, treatment, and patient care. Pooling resources and expertise enables countries to collectively advance research agendas, improve data quality, and expedite the translation of research outcomes into impactful healthcare practices. This collaborative strategy enriches the regional knowledge base on cancer. It promotes sustainable enhancements in healthcare delivery throughout the EAC, positively impacting the demand for and supply of cancer-related information.

6.3.5 Improving publication quality and impact

The study revealed variations in publication impact and citation counts across EAC countries, indicating opportunities to enhance the visibility and relevance of regional cancer research outputs. To address this, stakeholders such as academic institutions, research bodies, and policymakers should implement strategies to improve publication quality. These strategies include mentorship programs for emerging researchers, increased funding for research projects, and enhanced dissemination efforts through open-access platforms and international collaborations. Enhancing the credibility and impact of EAC cancer research can facilitate the wider adoption of evidence-based practices and innovations in cancer management.

6.3.6 Continuous monitoring and evaluation

The study highlighted dynamic shifts in cancer information search trends and informetric patterns across Kenya, Uganda, Tanzania, and Rwanda, revealing varying levels of public

interest and engagement over time. Establishing mechanisms for continuous monitoring and evaluation within the EAC is essential. Utilising the proposed *Health Connect Centre* Web application platform analytics, stakeholders such as local communities, healthcare providers, academic institutions, and non-governmental organisations can regularly assess the effectiveness of awareness campaigns and research initiatives, adapting strategies based on evolving public health needs. The platform continuously collects real-time data on user interactions, search queries, and content engagement, enabling immediate insights into cancer-related topics of high public interest. By analysing these trends, stakeholders can identify emerging public concerns and evaluate the reach and impact of awareness campaigns. The platform also tracks the dissemination and utilisation of research findings, assessing their influence on public knowledge and clinical practices. This continuous monitoring allows for adaptive strategies, personalised content delivery, and stakeholder coordination, ensuring that cancer awareness efforts remain relevant and effective. This proactive approach supports ongoing improvements in research and healthcare practices across the region.

6.3.7 Support the "*Health Connect Centre*" initiative

The proposed "*Health Connect Centre*" represents a pivotal initiative to provide comprehensive access to scholarly cancer information across the EAC. This platform underscores the interconnected nature of public information-seeking behaviour and academic research, offering a hub for healthcare professionals, researchers, and the general public to access up-to-date and extensive information on cancer. By consolidating resources and facilitating knowledge exchange, the "*Health Connect Centre*" addresses the supply aspect by increasing the availability of high-quality, evidence-based information. It supports healthcare professionals with the latest research findings, treatment protocols, and preventive strategies, thus enhancing their ability to deliver informed care. On the demand side, the platform meets the public's and researchers' needs by providing easily accessible and relevant information tailored to their

inquiries. This availability encourages proactive health-seeking behaviours and informed decision-making among the public and supports researchers in identifying gaps and opportunities for further study. By fostering collaborative efforts among stakeholders, the "*Health Connect Centre*" promotes advancements in regional cancer care strategies, empowering healthcare professionals with the necessary tools and supporting policymakers with evidence-based data to shape effective health policies.

6.3.8 Enhance Internet infrastructure

The study revealed significant disparities in cancer information search trends between urban and rural populations, highlighting the need for improved connectivity. Enhancing broadband services and ensuring reliable mobile network coverage will facilitate consistent access to online health resources, as many individuals in these areas depend on mobile devices. Collaborating with telecommunications companies to offer affordable data plans and establishing community Wi-Fi initiatives can further promote accessibility. Additionally, providing public access points, such as community centres and libraries equipped with Internet access, will support those without personal connectivity. By prioritising Internet infrastructure development, EAC countries can improve access to vital cancer information, enabling better health-seeking behaviours and informed decision-making, ultimately fostering long-term engagement with digital health resources among diverse populations.

6.4 Implications of the study

The study implications are as discussed hereunder.

6.4.1 Policy implications

Significant disparities in public awareness and information-seeking behaviours across Kenya, Uganda, Tanzania, and Rwanda underscore the need for targeted health communication strategies. Policymakers should prioritise infodemiology research to identify and address these

disparities effectively, ensuring that accurate and culturally relevant cancer information reaches diverse populations. In collaboration with health organisations and research institutions, national governments should spearhead the development of digital platform accessibility initiatives, such as the proposed "*Health Connect Centre*" Web application. Ministries of Health in each country should lead efforts to create and maintain a national cancer information portal accessible via mobile devices, with support from tech companies and telecommunications providers, to bridge digital divides and reach remote areas effectively.

Governments should integrate comprehensive cancer education into community health centres to enhance public education. This initiative should be developed in collaboration with the Ministries of Education to ensure that relevant educational materials are distributed and regular information sessions are conducted. Education ministries should implement school-based cancer awareness programmes into national school curricula to educate young people about cancer prevention and early detection.

Support for infodemiology initiatives is crucial for leveraging user-generated data to inform targeted health interventions and policies. National research councils, supported by health ministries and international funding agencies, should allocate grants for analysing user-generated data. Policies should mandate capacity-building programmes in health communication, data analysis, and digital tools for healthcare professionals, researchers, and community leaders. These programmes should be developed in collaboration with universities, professional associations, and international health organisations.

Interdisciplinary collaboration is essential for implementing effective cancer management strategies. Under government oversight, national task forces comprising healthcare professionals, educators, technologists, and community leaders should be established. These task forces should develop and implement policies that establish robust mechanisms for

monitoring and evaluating health communication initiatives. Regular assessments and adaptations should be conducted to meet evolving public health needs, with support from research institutions and non-governmental organisations specialising in public health.

By implementing these policies and initiatives, policymakers can create an enabling environment for effective cancer information dissemination. This approach will empower informed health decision-making within communities and ultimately enhance cancer prevention, diagnosis, and treatment outcomes across the EAC.

6.4.2 Practice implications

The research underscores the transformative potential of integrating infodemiology into healthcare practices within the EAC. The proposed Web application, "*Health Connect Centre*," is designed to leverage user-generated data and online trends, providing healthcare providers with valuable insights into the information-seeking behaviours and preferences related to cancer. By centralising access to this data, the platform enables the analysis of search patterns and user interactions, allowing healthcare providers to tailor cancer management strategies to the specific needs and realities of diverse populations within the region. This approach ensures that cancer prevention, diagnosis, and treatment initiatives are more accurately aligned with the evolving public health landscape, enhancing the effectiveness and reach of healthcare interventions.

The study's findings reveal a dynamic landscape of public interest and engagement with cancer-related information, highlighting varying awareness and knowledge gaps. Integrating infodemiology into healthcare practice enables practitioners to develop sophisticated algorithms and tools. These tools can effectively analyse and interpret online search trends, social media discussions, and user queries related to cancer. This means delivering personalised care recommendations based on prevalent concerns and misconceptions for oncologists. Public

health officials can enhance patient education by addressing specific informational needs identified through data analysis. Additionally, healthcare administrators can optimise resource allocation for cancer prevention and treatment, ensuring that interventions are targeted where they are needed most.

Moreover, by harnessing infodemiology, healthcare systems can streamline communication channels and improve the dissemination of evidence-based information. This proactive approach strengthens public health messaging and fosters community engagement and participation in cancer awareness initiatives. Through targeted interventions informed by infodemiology, healthcare practitioners can bridge information gaps, combat misinformation, and empower individuals to make informed decisions about their health.

Additionally, integrating infodemiology into healthcare practices supports continuous monitoring and evaluation of health communication strategies. This ensures that interventions remain responsive to evolving public health needs and preferences. By adopting innovative approaches rooted in infodemiology, healthcare systems in the EAC can enhance their capacity to adapt to technological advancements and societal trends, ultimately improving cancer management outcomes across the region.

6.4.3 Theory implications

This study enriches theoretical frameworks on information demand and supply by providing empirical insights into how access to accurate health information influences health behaviours and outcomes, particularly in the context of cancer within the EAC. By validating and expanding existing theories, this research contributes new knowledge that enhances the understanding of information-seeking behaviours and their implications for public health.

The findings align with the Monitoring and Blunting Theory, illustrating how individuals cope with health-related stress by seeking detailed cancer information. This theory's validation

underscores its relevance in explaining varied information-seeking behaviours during health crises, highlighting the role of information as a coping mechanism. The study validates the Health Belief Model by demonstrating how perceptions of susceptibility, severity, benefits, and barriers influence cancer-related health behaviours. The high search volumes for breast and cervical cancer symptoms reflect perceived high risks and severity, emphasising the model's applicability in understanding health-related actions. Additionally, identifying perceived benefits (such as early detection) and barriers (like access to healthcare facilities) enriches this framework, illustrating their impact on information-seeking behaviours and health decision-making. Wilson's 1996 Model of Information Behaviour is effectively applied in analysing cancer information search trends and informetric patterns within the EAC.

The proposed "*Health Connect Centre*" Web application represents a transformative technological solution that improve cancer information demand and supply across the EAC. This initiative operationalises infodemiology insights to tailor information delivery based on real-time user preferences, optimising information supply to effectively meet diverse information demands. The study underscores the importance of interdisciplinary collaboration in advancing cancer research and management strategies. By providing a collaborative platform for researchers, healthcare providers, and policymakers to access and contribute to comprehensive cancer data, the "*Health Connect Centre*" fosters innovation and knowledge exchange. This collaborative approach supports the theoretical frameworks discussed by demonstrating how information supply and demand dynamics can be enhanced through collaborative efforts and technological advancements.

This study enhances theoretical frameworks by validating existing theories and providing empirical evidence of their applicability in understanding and addressing cancer-related information demand and supply within the EAC. The "*Health Connect Centre*" bridges information gaps and transforms how information demand and supply are managed,

contributing to improved cancer prevention, diagnosis, and treatment outcomes across the region.

6.5 Recommendation for further studies

The study suggests several avenues for further research, including investigating how socio-economic and cultural factors influence cancer information-seeking behaviours and health information access. It also recommends assessing the impact of digital health interventions on cancer awareness, early detection practices, and lifestyle modifications through a longitudinal study that integrates epidemiological data. Additionally, the study proposes examining longitudinal trends and seasonal variations in online cancer information searches, performing a temporal analysis of cancer information-seeking behaviour. Another suggested area of research is exploring the role of digital platforms in cancer awareness campaigns, specifically studying the impact of online health information on public health behaviours and outcomes. Additionally, further study is recommended to validate the first phase of the proposed model for modelling cancer information demand and supply. This would involve testing the model's effectiveness in predicting information needs and ensuring supply mechanisms are appropriately aligned to meet these needs, thereby enhancing the efficiency and reach of cancer information dissemination in the EAC region.

6.6 Chapter Summary

This study investigated the dynamics of cancer information demand and supply within the EAC countries using infodemiology, providing insights with potential implications for health information seeking behaviour theory development, policy formulation, and practical applications in public health and information sciences. The analysis of cancer information search trends between 2004 and 2023 from the EAC countries revealed distinct patterns in public awareness and information-seeking behaviours. Breast, cervical, and prostate cancers

featured prominently due to their high incidence rates and public interest. The informetric analysis highlighted a robust scholarly output on cancer research across the region. The study highlighted a strong bidirectional relationship between online search behaviours and cancer occurrence rates, emphasising the interplay between information demand and supply. This relationship was further explored by demonstrating how public interest shapes academic agenda, underscoring the importance of aligning research with public health needs to enhance relevance and impact. Furthermore, the study's modelling of cancer information demand and supply identified pathways to enhance accessibility and relevance within the EAC. The proposed "*Health Connect Centre*" Web application is a prime example of centralising cancer information, promoting collaboration, and optimising delivery through infodemiology. Theoretical frameworks of Monitoring and Blunting Theory, Health Belief Model, and Wilson's Model were validated and extended, reaffirming their applicability in understanding health information dynamics. The study's recommendations focus on targeted health communication, community engagement, and ongoing evaluation to sustain progress in cancer care across the region. By addressing knowledge gaps and leveraging infodemiology insights, this research contributes significantly to informed decision-making, shaping effective health policies, enhancing research collaboration, and ultimately improving public health outcomes in the EAC.

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APPENDICES

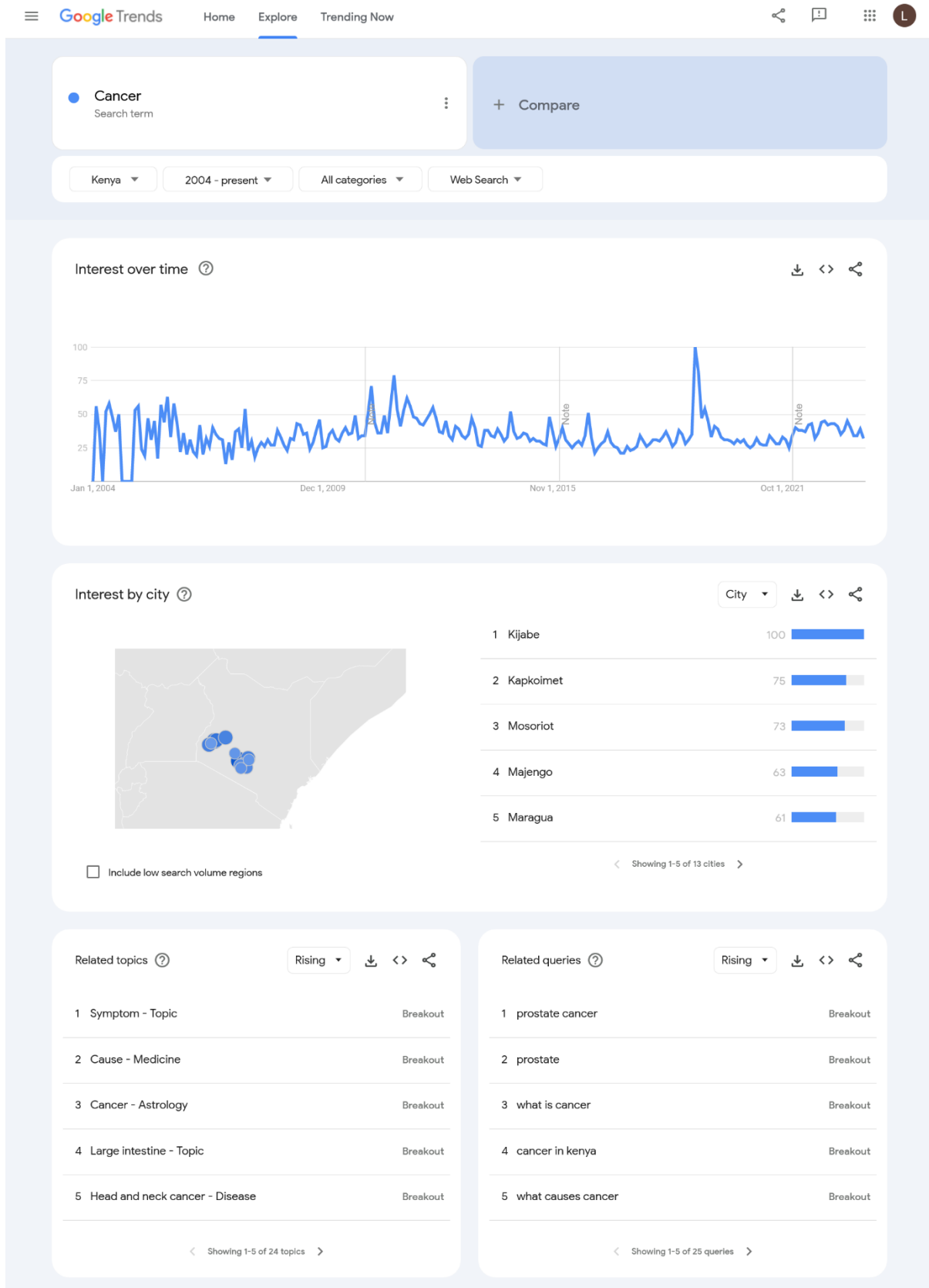
Appendix 1 Work plan

Activity	Detail of Activity	Deliverable	Timeline
School Defence	Correct the proposal based on comments given during defence.	Corrected proposal	November 2023
Faculty Defence	Correct the proposal based on comments given during defence.	Corrected proposal	January 2024
SGAS Defence	Correct the proposal based on comments given during defence.	Corrected proposal	March2024
Research Permits	Apply for the NACOSTI permit and Ethical clearance	Permit and Ethical clearance	March 2024
Pilot testing	Pilot testing of all the research instruments and techniques	Pilot testing report	March 2024
Finalisation of research tools	Responding to the findings of the results of the pilot tests	Final research instruments and techniques	April 2024
Data collection	Collect data	Raw research data	May 2024
Data processing and analysis (Chapter 4)	Compile chapter 4	Complete chapter 4	June 2024
Compilation of research findings	Compile chapter 5& 6	Completer chapter 5 and 6	July 2024
Thesis presentation for examination	Final thesis presentation to SGAS for examination	Present thesis examination for examination	August 2024
Dissemination of research outcomes	Develop 2 journal articles	2 journal articles	September 2024

Appendix 2: Budget for the research

Budget Items	Quantity	Cost/Unit	Amount (KES)
Expendable supplies			
Purchase of stationery (printing paper, binding materials, marker pens, e.t.c)	1	40,000	40,000
Purchase of analytics software (SPSS and Atlas.ti)	2	30,000	60,000
Data cleaning and analysis	2	20,000	40,000
Sub-total			140,000
Research Permits			
NACOSTI	1	5,000	5,000
Ethical clearance	1	20,000	20,000
Sub-total			25,000
Documentation, publication costs, conferences			
Thesis copy editing and proofreading fee	1	40,000	40,000
Thesis printing for examination	6	1,000	6,000
Final thesis printing	10	2,000	20,000
Publication cost (open access journal)	1	70,000	70,000
Conference registration fees	1	50,000	50,000
Sub-total			186,000
Total Budget			351,000
Total	351,000.00		

Appendix 3: Sample Google Trends Search



Appendix 4: Harzing's Publish or Perish sample search

Harzing's Publish or Perish (Windows GUI Edition) 8.9.4538.8589

File Edit Search View Help

My searches

Trash

Search terms	Source	Papers	Cites	Cites/year	h	g	hI,norm	hI,annual	hA	acc10	Search date	Cache date	Last
✓ "Cancer" "Kenya" [title]	Google Sch...	200	6083	103.10	45	69	20	0.34	12	20	10/11/2023	10/11/2023	

Google Scholar search [Help](#)

Authors: Years: 0 - 0

Publication name: ISSN:

Title words: "Cancer" "Kenya"

Keywords:

Maximum number of results: 200

Cites	Per year	Rank	Title
✓ 3	3.00	6	A bibliometric analysis of cancer research funders and collaborators in Kenya: 2007-2017
✓ 39	4.33	145	A comparison of two visual inspection methods for cervical cancer screening among HIV-infected women in Kenya
✓ 32	1.45	103	A minimum estimate for the incidence of gastric cancer in Eastern Kenya
✓ 0	0.00	75	A qualitative exploration of factors that influenced health literacy among women diagnosed with breast cancer in Kenya during their car
✓ 16	5.33	153	A qualitative exploration of women's experiences with a community health volunteer-led cervical cancer educational module in Migori c
✓ 0	0.00	73	A System Dynamics Model Of The Impact Of E-health Systems On Cervical Cancer Vaccination In Kenya
✓ h 72	8.00	56	Abandonment of childhood cancer treatment in Western Kenya
✓ 6	6.00	96	Access to and affordability of world health organization essential medicines for cancer in Sub-Saharan Africa: examples from Kenya, Rw
✓ 9	1.80	112	Access to breast cancer treatment services in Mombasa County, Kenya: a quality of care analysis of patient and survivor experiences
✓ 32	4.00	152	Accuracy of visual inspection with acetic acid to detect cervical cancer precursors among HIV-infected women in Kenya
✓ 27	6.75	150	Aflatoxin exposure from milk in rural Kenya and the contribution to the risk of liver cancer
✓ h 52	7.43	80	Aggressive breast cancer in western Kenya has early onset, high proliferation, and immune cell infiltration
✓ h 47	4.70	134	Alcohol and Acetaldehyde in African Fermented Milk Mursik—A Possible Etiologic Factor for High Incidence of Esophageal Cancer in W
✓ 12	3.00	182	An ethnobotanical survey of plants used for the treatment and management of cancer in Embu County, Kenya

Citation metrics [Help](#)

Publication years: 1964-2023

Citation years: 59 (1964-2023)

Papers: 200

Citations: 6083

Cites/year: 103.10

Cites/paper: 30.42

Cites/author: 1882.05

Papers/author: 83.44

Authors/paper: 3.45

h-index: 45

g-index: 69

hI,norm: 20

hI,annual: 0.34

hA-index: 12

Papers with ACC >= 1,2,5,10,20:
144,133,74,20,1

Paper details [Help](#)

Select a paper in the results list (to the left of this pane) to see its details here.

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Anne-Wil Harzing
Publishing in academic journals
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Windows taskbar: Search, Start menu, Task View, File Explorer, Microsoft Edge, Word, Outlook, Harzing's Publish or Perish, Windows Defender, System tray: Network, Volume, ENG US, 2:07 PM, 10/11/2023

Appendix 5: Pilot Study report

Introduction

The researcher carried out a pilot study using data for Uganda. The Pilot study was conducted between 16th to 20th March, 2024. The researcher subjected the search terms to the Google Trends and Harzing's Publish or Perish tools.

Summary of the findings based on the objectives and research questions are:

Objective One: Cancer information search trends in the East African Community countries from 2004 to 2022.

This objective was to answer the question:

- i. *What are the trends in cancer information search in East African Community countries from 2004 to 2022?*

The data for this objective was collected using Google Trends and the formulated search terms. Google Trends produced data in terms of relative search interest (RV) over time. Relative search interest is a measure of how frequently a term is searched compared to its peak popularity within a specified period and geographic region. The search terms gave data on interest over time, interest by city/town, rising and top-related topics and queries. For example, the search term "Cancer" in Uganda relative search volume was high (RV-100) in March 2007. In terms of regional searches in Uganda, the Western Region showed the highest level of interest at 100. This suggested a strong focus on cancer-related topics in the Western Region compared to other regions. The Northern and Eastern Regions followed closely behind with scores of 88 and 86, respectively, indicating a relatively high level of interest in these areas as well. Meanwhile, the Central Region exhibits a slightly lower level of interest with a score of 84. In terms of other related topics that the information seekers checked in relation to cancer were: "Medical sign" at 14. Specific cancer types such as "Cervical cancer" and "Breast cancer" also show substantial attention, scoring 13 and 12 respectively. Symptom and cause-

related terms like "Symptom" and "Cause" rank slightly lower but still garner notable scores of 11.

The researcher identified that some of the search terms were not linked to the research question and hence updated them to meet the research need as indicated in the data collection procedure and piloting sections. The researcher also found it prudent to change the year to 2023 instead of 2022 because the study will be conducted in 2024. Thus, searches for the year 2023 can be found on Google already. This was done to all the objectives and research questions.

Objective Two: Examine the informetric pattern of cancer information in the East African Community countries from 2004 to 2022.

This objective was to answer questions on:

- ii. How has the volume and type of cancer-related publications evolved within the East African Community countries from 2004 to 2022?*
- iii. What are the trends of authorship of cancer-related publications within the East African Community countries from 2004 to 2022?*
- iv. How have cancer-related publications from the East African Community countries been cited between 2004 and 2022?*
- v. How do informetric patterns in the dissemination of cancer information through various media channels differ within the East African Community countries between 2004 and 2022?*
- vi. To what extent is cancer information in the East African Community countries accessible through open-access platforms between 2004 and 2022?*

The data for this objective was collected using Harzing's Publish or Perish and formulated search terms. The research questions on volume, types of cancer-related publications, and citations of cancer publications were well met. For example, in terms of volume of publication, in 2004 there were just two (2) publications. By 2013, the number had risen to 20, marking a significant leap. From 2014 onwards, there is a more pronounced surge, with publication numbers steadily climbing. The trend peaks in 2023, reaching 77 publications.

The research question on trends of authorship of cancer-related publications needed to be more specific and meet the need for the research. The researcher reformatted the question to:

- a) *What are the patterns of collaboration networks among authors of cancer-related publications on the East African Community countries from 2004 to 2023?*

This research question will enable the researcher to analyse data on collaborations and network characteristics (degree of centrality, network density), and the impact of collaboration. This led to addition of tool of data analysis and visualisation. The use of Vosviewer only gave the visuals of the network and statistics of links. This did not give other metrics that gauge a social network like degree of centrality hence the addition of use of Gephi tool to help in the social network analysis metrics.

The research questions on informetric patterns and dissemination on various media channels and open access issues could not be met by the data retrieved. While Harzing's Publish or Perish provides valuable insights into scholarly impact and citation patterns, it did not capture data related to media dissemination or open access issues. This led to the scrapping of the questions and adding questions in relation to titleswords, and abstracts. The replacement questions are:

- a) *What are the predominant themes covered in the titles and abstracts of the cancer-related publications from the East African Community countries from 2004 to 2023?*
- b) *How do the themes of the cancer-related publications from the East African Community countries reflect evolving research?*

Similar to the search terms from Google Trends, the search terms of Harzing's Publish or Perish were also updated to ensure they retrieved publications related to cancer issues.

Objective Three: Analyse the relationship between cancer information search trends and cancer occurrences in the East African Community countries.

This objective was dealt with by use of the below questions:

- vii. *What is the correlation between the trends in cancer information searches and cancer incidences in the East African Community countries between 2004 and 2022?*
- viii. *To what extent can the analysis of cancer information search trends between 2004 and 2022 provide insights into the prevalence and distribution of cancer cases in the East African Community countries?*

Google Trends provided search interest data over time for the research's search terms, while Harzing's Publish or Perish provided data on cancer incidence rates and prevalence. Correlating the two sets of data gave insight into the relationship between information-seeking behaviour and cancer occurrences.

Objective Four: Infer the association between cancer information search trends and cancerinformetric patterns in the East African Community countries;

This objective was dealt with by use of the below question:

- ix. *What associations can be inferred between the observed cancer information search trends and the informetric patterns of cancer-related information from 2004 to 2022 in the East African Community countries?*

Google Trends provided search interest data over time, while Harzing's Publish or Perish provided informetric data using the search terms. Correlating the two sets of data gave an insight into the relationship between information-seeking behaviour and information production. The data from question was deemed sufficient.

Objective Five: Model cancer information demand and supply in the East African Community countries.

This objective was dealt with by use of the below questions:

- x. *What factors contribute to the demand for cancer information in the East African Community countries, and how have they evolved over the years between 2004 and 2022?*

- xi. How can the supply of cancer information resources between 2004 and 2022 in the East African Community countries be characterised and modelled?*
- xii. What insights can be gained from modelling the interplay between the demand and supply of cancer information from 2004 to 2022 in the context of the East African Community countries?*

The data collected could not answer the question on factors that contribute to the demand for cancer information, so it was plucked out. Questions from Objective Two had already answered the question on the supply of information resources, so it was also removed. The last question was deemed sufficient to deal with the objective.

Based on all the above observations from the data collected, the researcher:

- Revised the timelines of the data collection from 2004 – 2022 to 2004 – 2023 in all objectives and research questions;
- Revised the search terms in line with information seeking and information supply;
- Added research questions on analysing title words and abstract words. This was left out and is linked to qualitative data collection and analysis;
- Added Gephi data analysis research tool to help in social network analysis;
- Removed repetitive research questions.

Appendix 6: School of Graduate and Advanced Studies letter of introduction to NACOSTI



THE TECHNICAL UNIVERSITY OF KENYA

Heri Selesse Avenue, P. O. Box 52425, Nairobi, 00200, Tel: +254 (0)0 342672, 2249974, 2251380, 341639,
Fax: 2219689, Email: reg@tku.ac.ke, Website: www.tuk.ac.ke

**Office of the Director
School of Graduate and Advanced Studies**

REF: AIIIX/03795P/2020

13th March, 2024

The Chief Executive Officer
National Commission for Science, Technology & Innovation
NACOSTI Building, Off Waiyaki Way
P.O. Box 30623 - 00100
Nairobi, KENYA.

Tel: 020 400 7000/0713788787/0735404245

Dear Sir/Madam,

REF: APPLICATION FOR RESEARCH PERMIT

This is to inform you that Ms. Lucy Wachera Kibe is a registered PhD student in the Department of Information and Library Science, School of Information and Social Sciences, The Technical University of Kenya. The course is offered by Coursework, Research and Thesis. The title of her Thesis is "Modelling Cancer Occurrences in the East African Community Countries through Infodemiology."

Ms. Kibe has defended her research proposal and is currently proceeding for field work which will involve data collection using approved surveys and research methods.


This is to kindly request you to issue her with a research permit.

Prof. Joseph O. Lalah
Director- School of Graduate and Advanced Studies &
PROFESSOR OF CHEMISTRY



File Copy: SGAS PhD IKM, Student File
JOL/eva

Appendix 7: NACOSTI Permit

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 139516	Date of Issue: 15/March/2024
RESEARCH LICENSE	
	
<p>This is to Certify that Ms. Lucy Wachera Kibe of Technical University of Kenya, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Baringo, Bomet, Bungoma, Busia, Elgeyo-Marakwet, Embu, Garissa, Homabay, Isiolo, Kajiado, Kakamega, Kericho, Kiambu, Kilifi, Kirinyaga, Kisii, Kisumu, Kitui, Kwale, Laikipia, Lamu, Machakos, Makueni, Mandera, Marsabit, Meru, Migori, Mombasa, Muranga, Nairobi, Nakuru, Nandi, Narok, Nyamira, Nyandarua, Nyeri, Samburu, Siaya, Taita-Taveta, Tanariver, Tharaka-Nithi, Transzoia, Turkana, Uasin-Gishu, Vihiga, Wajir, Westpokot on the topic: MODELLING CANCER OCCURRENCES IN THE EAST AFRICAN COMMUNITY COUNTRIES THROUGH INFODEMOLOGY for the period ending : 15/March/2025.</p>	
License No: NACOSTI/P/24/33925	
139516	
Applicant Identification Number	Director General NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
	Verification QR Code
	
NOTE: This is a computer generated License. To verify the authenticity of this document, scan the QR Code using QR scanner application.	
See overleaf for conditions	

Appendix 8: Ethical clearance permit



CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18

Direct Line: 0772894438

Email: info@chuka.ac.ke,

P. O. Box 109-60400, Chuka

Website: www.chuka.ac.ke

19th March, 2024

REF: CUIERC/NACOSTI/502

TO: Lucy Wachera Kibe

RE: Modelling Cancer Occurrences in the East African Community Countries Through Infodemiology.

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812*. The approval period is 19th March, 2024 – 19th March, 2025.

This approval is subject to compliance with the following requirements;

- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC*.
- iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC*.

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY

Appendix 9: Plagiarism report

Lucy Chapters ONE to SIX			
ORIGINALITY REPORT			
5%	4%	2%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	repository.tukenya.ac.ke Internet Source	<1%	
2	Lucy Kibe, Tom Kwanya, Hesbon Nyagowa. "Harnessing fourth industrial revolution (4IR) technologies for sustainable development in Africa: a meta-analysis", Technological Sustainability, 2023 Publication	<1%	
3	drsiddharthturkar.in Internet Source	<1%	
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6	"Environmental Activism and Global Media", Springer Science and Business Media LLC, 2024 Publication	<1%	
7	Submitted to Kenyatta University Student Paper	<1%	