

Evaluation of the cervical cancer surveillance system in Kigali City, Rwanda: a descriptive cross-sectional study, January 2023–June 2025

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Abstract

Background

Cervical cancer remains a major public health problem, particularly in low- and middle-income countries. Rwanda has strengthened cervical cancer prevention through HPV vaccination, screening, and digital surveillance systems. However, the performance of the cervical cancer surveillance system in Kigali City has not been systematically evaluated. This study assessed the performance of the cervical cancer surveillance system in Kigali City, Rwanda, from January 2023 to June 2025.

Methods

A descriptive cross-sectional evaluation was conducted using the CDC Updated Guidelines for Evaluating Public Health Surveillance Systems. Primary data were collected from 41 purposively selected healthcare providers using a structured questionnaire, while secondary data were extracted from 19923 cervical cancer screening records. The system was assessed across seven attributes: simplicity, flexibility, acceptability, timeliness, stability, usefulness, and data quality. Descriptive statistics were used to calculate attribute-specific performance scores, classified as fair (50–69%), good (70–79%), or very good ($\geq 80\%$).

Results

Among 19,923 women screened, 13,693 (68.7%) underwent HPV DNA testing and 6,230 (31.3%) underwent VIA. Overall, 728 (3.7%) women had positive screening results. HPV positivity was 14.7% among women tested for HPV, while VIA positivity was 11.7% among women screened by VIA. Only 34.1% of HPV-positive women returned for VIA triage. The surveillance system demonstrated very good performance in usefulness (91%), data quality (88%), timeliness (87%), stability (85%), and acceptability (84%), while simplicity (76%) and flexibility (71%) were rated as good. Overall, the surveillance system demonstrated good to very good performance across all evaluated attributes.

Conclusions

The cervical cancer surveillance system in Kigali City demonstrated good to very good performance, particularly in usefulness, data quality, timeliness, stability, and acceptability. However, the high loss to follow-up among HPV-positive women and moderate system flexibility may compromise its effectiveness. Strengthening follow-up mechanisms, standardizing case definitions, improving the system's adaptability, and enhancing the training and capacity of healthcare providers could improve surveillance performance and support Rwanda's cervical cancer elimination goals.

Introduction

Cervical cancer remains a significant global health burden, particularly affecting women in low- and middle-income countries(1). The primary cause of cervical cancer is persistent infection with high-risk

human papillomavirus (HPV) types (1). According to the World Health Organization (WHO) and GLOBOCAN estimates, over 600,000 new cases of cervical cancer are diagnosed annually, making it the fourth most common cancer among women worldwide (2, 3). Each year, the disease causes 340,000 to 350,000 deaths, with nearly 90% of these occurring in low-resource settings (4).

In Africa, the burden of cervical cancer is far greater than in most other regions. WHO reports that 18 of the 20 countries with the highest cervical cancer rates are located in the African Region, underscoring the continent's exceptionally high incidence and mortality (4, 5).

Although Africa is the second most populous continent and its population is projected to nearly double by 2050, it accounted for about 23% of global cervical cancer deaths in 2022, underscoring a disproportionate disease burden. Sub-Saharan Africa is most affected, with cervical cancer ranking as the leading cause of cancer-related deaths among women in many nations. This is largely due to limited access to prevention strategies, screening, and treatment services. Inadequate screening coverage and low Human papilloma virus (HPV) vaccination uptake contribute to late diagnoses and high fatality rates, with many countries still transitioning from low-quality screening methods to more effective HPV-based testing (5). The HIV epidemic further intensifies the problem, as women living with HIV face higher risks of persistent HPV infection and faster progression to invasive cancer (6). Without stronger health system interventions and wider control strategies, the burden of cervical cancer in Africa is expected to rise. To address this, WHO and its partners are supporting countries in implementing comprehensive, evidence-based strategies to reduce incidence and mortality across the life course (5). Rwanda is among the countries with a significant burden of cervical cancer with 866 new cases of cervical cancer annually, crude incidence rates of 12.5 cases per 100,000 women and an age-standardized rate (ASR) of 18.9 per 100,000. This burden is expected to increase, and the number of cases could double in the coming years if effective interventions are not strengthened (7).

A comprehensive national or sub-national surveillance system for elimination would encompass long-term surveillance of both processes and outcomes across the three core activities of vaccination, screening and treatment, as recommended by the WHO (7). WHO officially launched the Global Strategy to accelerate the elimination of cervical cancer on 17 November 2020 (2), recommending a comprehensive approach to prevention and control. The strategy includes primary prevention through HPV vaccination, secondary prevention through screening for women from the general population (from 30 years of age), and for women living with HIV. Women living with HIV should be screened every three years starting at the age of 25 and receive treatment as tertiary prevention (8).

Rwanda has significantly advanced its digital health initiatives for HPV vaccination and cervical cancer screening. In 2019, the country introduced an electronic vaccination tracker (e-tracker) for childhood immunizations, which was expanded in 2022 to include HPV. Healthcare staff now use this system to manage HPV vaccinations. Additionally, since 2020, the mUzima mobile app has been deployed in hospitals and health centers for cervical cancer screening and treatment, integrating with the OpenMRS platform. The Rwanda Biomedical Center (RBC) manages both the e-tracker and mUzima (9).

In Rwanda, cervical cancer is among the leading causes of cancer-related morbidity and mortality among women despite ongoing efforts in HPV vaccination, screening, and digital surveillance systems. Kigali City implements an integrated cervical cancer surveillance system through health facilities and national reporting platforms to support prevention, early detection, and management. However, Previous studies in Rwanda have Mainly focused on cervical cancer burden, HPV prevalence, vaccination coverage and screening outcomes, limited evidence exists on the performance of this surveillance system. Therefore, this study evaluated the performance of the cervical cancer surveillance system in Kigali City, Rwanda, from January 2023 to June 2025.

and cervical cancer screening services, limited evidence exists regarding the performance of the cervical cancer surveillance evaluation. Evaluating surveillance attributes is essential to identify operational gaps and inform improvements in data quality, reporting efficiency, and patient follow up. Therefore, this study evaluated the cervical cancer surveillance system in Kigali city using CDC guidelines (5).

Methods

Study setting

This evaluation was conducted in Kigali City, Rwanda, which comprises three districts: Nyarugenge, Kicukiro, and Gasabo. The study included four (4) district hospitals and Sixteen (16) health centres involved in cervical cancer prevention, screening, diagnosis, treatment, and surveillance.

The surveillance process begins with community awareness and health education to promote HPV vaccination and cervical cancer screening. Eligible women undergo screening using available methods, including visual inspection with acetic acid (VIA), Pap smear, and HPV testing. Women with positive or suspicious screening results undergo further evaluation, diagnosis, and appropriate treatment or referral.

Information generated throughout the screening, diagnosis, and treatment processes is recorded at health facilities and reported through relevant systems, including HMIS/DHIS2, electronic medical records, and, where applicable, the National Cancer Registry. The data are subsequently compiled and reviewed at district and national levels to support monitoring of cervical cancer trends, identify potential gaps in prevention and service delivery, and inform planning and improvements in cervical cancer prevention and control.

Map of study setting

Study Design

A descriptive cross-sectional evaluation of the Cervical Cancer Surveillance System in Kigali City, Rwanda study design was employed to evaluate the cervical cancer surveillance system in Kigali city, Rwanda. Secondary surveillance data from January 2023 to June 2025 was reviewed, while primary data

collection was conducted between November to December, 2025. The study followed the CDC's updated Guidelines 2001 to assess key attributes and focused on simplicity, flexibility, acceptability, timeliness, stability, usefulness and data quality.

Sampling method and sample size

Health facilities were purposively selected based on their provision of cervical cancer screening services and participation in the cervical cancer surveillance system. A total of 20 health facilities were included, comprising four district hospitals and 16 health centres. The selected facilities were distributed across the three districts of Kigali City: Kibagabaga District Hospital and four health centres in Gasabo District; Masaka District Hospital and four health centres in Kicukiro District; and Nyarugenge and Muhima District Hospitals and eight health centres in Nyarugenge District.

Healthcare providers were purposively selected based on their involvement in cervical cancer screening, surveillance, and data management. A total of 41 healthcare providers participated in the evaluation. This purposive approach ensured the inclusion of participants with relevant experience and knowledge of the cervical cancer surveillance system.

Inclusion and exclusion criteria

Health care providers such as data managers, nurses, midwives, and doctors who are directly involved in surveillance of cervical cancer were recruited to participate in this study. The study excludes those who were not involved in this surveillance system and those who were not willing to participate.

Data collection

A structured, closed-ended questionnaire was developed and adapted based on the CDC Updated Guidelines for Evaluating Public Health Surveillance Systems and administered electronically to healthcare providers using Kobo Toolbox (Supplementary File 1). The questionnaire assessed simplicity, flexibility, acceptability, stability, and usefulness of the cervical cancer surveillance system. Data reported through HMIS/DHIS2 from January 2023 to June 2025 were retrospectively reviewed to assess data quality and timeliness, while additional information was abstracted from clinical registers and the IDSR system using standardized abstraction tools. The questionnaire and abstraction tools were pre-tested at one health facility among three healthcare providers to assess their clarity, relevance, and practicality. Supplementary File 2 presents the indicators and criteria used to assess each surveillance-system attribute.

Data analysis

Data exported from Kobo Toolbox were imported into Microsoft Excel, cleaned, and analyzed using descriptive statistics. Frequencies and percentages were calculated for categorical variables, while

proportions were calculated for surveillance indicators. Questionnaire-based indicators were calculated as the proportion of “yes” responses, whereas record-based indicators were calculated as the proportion of complete or timely records among expected records.

Surveillance system attributes were scored by averaging the percentages of indicators within each attribute and classified as Fair (50–69%), Good (70–79%), or Very Good ($\geq 80\%$) (18). The dataset was assessed for completeness before analysis; missing data were minimal and did not materially affect the study findings. Results were presented using tables and charts to facilitate interpretation of the surveillance system performance.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki – Ethical Principles for Medical Research Involving Human Subjects (9). Before the data collection, the study was approved and the approval obtained from the Institutional Review Board (IRB) of the University of Rwanda College of Medicine and Health Sciences (Ref: CMHS/IRB/771/2025). All study participants provided written informed consents before participating in the study. Personal identifiers, including names, were not included in the data analysis or dissemination of the final report to ensure confidentiality.

Results

Socio-demographic and Cervical cancer screening, triage, and treatment cascade among women attending selected health facilities.

A total of 19,923 women were screened for cervical cancer, of whom 13,693 (68.7%) underwent HPV DNA testing and 6,230 (31.3%) were screened using visual inspection with acetic acid (VIA). Overall, 3.7% of all screened women tested positive for cervical precancerous lesions or HPV infection. Among women who underwent HPV DNA testing, 14.7% tested positive, whereas 11.7% of those screened using VIA had positive results. Of the 2,036 women who tested positive for HPV and required VIA triage, only 694 (34.1%) returned for follow-up.

Table 1
Sociodemographic characteristics of the participants (n = 41)

Variables	Frequency (41)	Percentage (%)
Gender		
Male	29	71
Female	12	29
Work experience		
Less than 6 months	8	20
6 months to 1 year	5	12
More than 1 year	19	46
From system launch	9	22
Occupation		
Data Manager	11	27
Medical Doctor	2	5
Registered Midwife	8	20
Registered Nurse	20	49

The Table 1 above shows sociodemographic characteristic of the participants. Majority of the participants were men 29 (71%) and women were 12 (29%) of participants. Almost half of the respondents 19 (46%) had more than a year of experience with the surveillance system, and 9 make 22% had been involved since the system's launch. Meanwhile, 13 that make 32% had less than a year of experience with the surveillance system, including 8 that make up 20% with under six months. Nurses 20 (49%), followed by data managers 11 (27%), with midwives making up 8 (20%) and medical doctors only 2 (5%). This shows that the system is mainly operated and supported by nursing staff and data managers.

Distribution of HPV screened, VIA screened, and cancer positives by district in Kigali 2023–2025.

The Fig. 3 above shows that Kicukiro district accounts for 12,391 HPV tests which is the highest in the program making 90% of total program HPV volume. Nyarugenge leads VIA-based screening (3,653 women) across its community health center network. Gasabo contributes a balanced mix of both methods HPV tests and VIA screening.

Evaluation attributes on cervical cancer surveillance system in Kigali City, November-December, 2025

Seven surveillance attributes showed good to very good performance. Findings in Table 2 revealed that a total of 41 healthcare providers participated in the evaluation of the cervical cancer surveillance system. The system was evaluated using surveillance attributes including simplicity, flexibility, acceptability, timeliness, stability, usefulness, and data quality.

The simplicity attribute scored 76% and Flexibility scored 71%, and were both rated as good. Acceptability scored 84%, Timeliness scored 87%, Stability attribute scored 85% and Usefulness scored 91%, and Data quality also scored of 88%, and all these attributes were graded as very good. With 82% data completeness in surveillance registers, 95% of respondents reported that the system regularly generates reports and is useful for early prevention and management decisions.

Overall, the cervical cancer surveillance system demonstrated good to very good performance across all evaluated attributes.

Table 2
Evaluation attributes on cervical cancer surveillance system

No	Attributes	Evaluation criteria	Results	Overall score (%)	Conclusion
01	Simplicity	Proportion of respondents who reported that surveillance reporting system is simple to use. Proportion number of reported that there is any unnecessary step in the "Cervical Cancer Surveillance System SOP is easily applicable for operational management of surveillance. Have there been any changes in case definition since the screening centre started? Did you receive training for Cervical Cancer surveillance"	32/41 = 78% 32/41 = 78% 31/41 = 77% 29/41 = 71% 32/41 = 78%	76%	Good
02	Flexibility	Number of respondents who reported that when new data elements are added, it is easy to integrate them Number of respondents who is adapted to overcome challenges during system use.	28/41 = 68% 30/41 = 73%	71%	Good
03	Acceptability	Proportion Number of respondents who reported that they have a willing to participate in cervical cancer surveillance activities. Do you think human resources are persistently available/posted in this center	39/41 = 95% 30/41 = 73%	84%	Very Good
04	Timeliness	Proportion Number of screening report submitted on time over total number of screening report	728/822 = 87%	87%	Very Good
05	Stability	Number of respondents who reported that in case of outages and power failures, your center has alternate power supply available Number of respondents who reported that Surveillance	35/41 = 85% 35/41 = 85%	85%	Very Good

No	Attributes	Evaluation criteria	Results	Overall score (%)	Conclusion
		system provides Computer for Data entry			
06	Usefulness	Number of respondents who reported that surveillance regularly generate reports from the surveillance system Number of respondents who responded that the cervical cancer surveillance is useful for early prevention and management decision making	36/41 = 88% 39/41 = 95%	91%	Very Good
07	Data quality	Number of cervical cancers screened records with complete data in register over number of cervical cancers screened data in registers Does your center have a dedicated team for surveillance	16354/19923 = 82% 39/41 = 95%	88%	Very Good

Discussions

This study showed high uptake of cervical cancer screening services in Kigali city, with HPV DNA testing being the most commonly used screening method. The HPV positivity rate of 14.7% indicates a considerable burden of HPV infection among screened women, similar to studies conducted in other sub-Saharan African countries where HPV positivity ranged between 10% and 20% among women attending screening services (23). A study conducted by Rwanda Biomedical Centre also reported increasing utilization of HPV-based screening following national scale-up initiatives (24).

However, a major challenge identified was the high loss to follow-up, as most HPV-positive women did not return for VIA triage representing a major weakness that may undermine the effectiveness of the screening programs. Similar findings were reported in studies from Kenya and Uganda, where poor linkage between screening and treatment was associated with transportation barriers, delayed communication of results, and limited patient tracking systems (25). Strengthening follow-up mechanisms, including appointment reminders, community work engagement and improved result communication is therefore critical. This gap may reduce the effectiveness of cervical cancer prevention programs by delaying diagnosis and treatment.

Among women who completed triage, only a small proportion required treatment or referral for suspected cancer, which is comparable to findings from screen-and-treat programs implemented in low-resource settings (26).

District variations in screening approaches were also observed, with Kicukiro contributing the highest HPV screening volume due to campaign activities, while Nyarugenge had the highest VIA screening coverage through health center services. Similar programmatic differences have been reported in decentralized cervical cancer screening programs in East Africa, where outreach campaigns significantly increased screening uptake (27).

These findings highlight the need to strengthen follow-up mechanisms, improve patient navigation systems, and enhance linkage from screening to treatment to improve cervical cancer prevention outcomes.

The distribution of respondents in this evaluation shows that the cervical cancer surveillance system in Kigali City is largely operated by nurses (49%) and data managers (27%), while medical doctors represent only 5% of respondents. This pattern reflects the operational structure of many surveillance systems in low- and middle-income countries where nurses and data personnel play central roles in routine data collection, reporting, and monitoring activities. Similar findings were reported in a surveillance system evaluation conducted in Dodoma, where nurses constituted the majority of surveillance personnel and were primarily responsible for data entry and reporting tasks (19). The limited involvement of physicians in surveillance activities may influence the extent to which surveillance data are translated into clinical decision-making, although task-shifting strategies have been widely adopted to strengthen health service delivery in resource-constrained settings.

Regarding work experience, 46% of respondents had more than one year of experience, however, 32% of respondents had less than one year of experience, indicating frequent staff turnover or recent deployment. High turnover among health workers involved in surveillance systems has been documented in several African health information system evaluations and can affect continuity, data quality, and system stability. For example, a study evaluating health information systems in Rwanda found that newly deployed staff often require additional training to effectively manage digital reporting tools and surveillance indicators (20).

The gender distribution of respondents showed a higher proportion of males compared with females. While gender imbalance among surveillance personnel has been reported in some health information systems, this distribution may reflect local staffing patterns rather than systemic bias. In many public health surveillance programs, workforce composition is influenced by facility staffing structures and administrative assignments rather than gender-specific roles. Similar gender patterns have been reported in evaluations of cancer surveillance programs in Kampala, where the majority of surveillance staff were male due to the concentration of data management roles within administrative units (21).

This evaluation also identified key findings regarding the cervical cancer surveillance system in Kigali City. The system demonstrated very good performance with timeliness (87%), stability (85%), usefulness (91%), and data quality (88%) all exceeded acceptable thresholds for public health surveillance systems. These findings align with CDC guidelines for evaluating surveillance systems, which recommend timeliness above 80% and data quality above 85% as benchmarks for effective surveillance (11). A

similar evaluation of cancer surveillance systems in East Africa found comparable performance metrics, though most systems struggled to maintain consistency across all attributes simultaneously (12).

The surveillance system exhibited good flexibility (71%) with frequent case definition changes (reported by 71% of respondents) potentially introducing confusion and inconsistency in data capture. This finding is consistent with observations from a study on Rwanda's comprehensive women's health programs, which noted that while the country's health information systems are generally robust, frequent policy updates and guideline revisions sometimes outpace the capacity of health workers to adapt, particularly in decentralized facilities (13). The very good acceptability (82%) and willingness to participate (95%) demonstrate strong stakeholder engagement and recognition of the system's value for clinical decision-making, reflecting Rwanda's strong culture of health system ownership and accountability.

The minimal involvement of physicians (5% of respondents) compared to nurses (49%) and data managers (27%) suggests limited clinical engagement in surveillance activities, which may reduce the translation of surveillance data into clinical action. This pattern has been observed in other African surveillance systems, where task shifting to nurses and mid-level providers has strengthened service delivery but sometimes disconnected clinical decision-makers from epidemiological data streams. Additionally, 22% of personnel had not received training on the surveillance system, representing a significant quality assurance gap that could compromise data reliability and system performance. A comparable study evaluating health information systems in Rwanda found that training gaps were most pronounced in high turnover facilities and among newly deployed staff, highlighting the need for continuous capacity-building mechanisms(14). This study had several limitations; First, the evaluation was conducted only in selected health facilities in Kigali City, which may limit generalizability of the findings to other regions of Rwanda particularly rural settings with different health system capacities and resource availability. However, facilities from all three districts in Kigali were included to improve representativeness. Second, the study relied partly on self-reported information from healthcare providers, which may have introduced social desirability and recall bias. To minimize this bias, only personnel directly involved in the cervical cancer surveillance system were purposively selected. The study Purposive sampling and self-reported responses may have introduced bias, but participants were selected based on their direct involvement in the surveillance system to ensure informed responses.

Conclusions

The cervical cancer surveillance system in Kigali City demonstrates strong foundational performance with very good timeliness, stability, usefulness, and data quality and high acceptability among health care providers. The system effectively supports early detection and management decisions, with high stakeholder acceptance and willingness to participate. Nonetheless, high loss of follow-up among HPV positive women and only moderate flexibility partly driven by frequent case definition changes, limit its impact on cervical cancer prevention. Strengthening patient follow-up, standardizing case definitions, enhancing training and improving system adoptability should be prioritized to maximize the contribution

of surveillance system to Rwanda's cervical cancer elimination goals and to improve outcomes for women in Kigali city.

Declarations

Disclaimer

This study has been supported by the University of Rwanda through the U.S. Centers for Disease Control and Prevention (CDC) funds under the terms of the Field-Based FETP Training Activities, and funding was provided specifically for data collection.

Competing interests

This study declared no competing interests.

Author Contribution

A.U, B.U, V.N, B.I, and J.C.N conceptualized the study, collected, analyzed and interpreted the data. A.U, S.N and J.N drafted the first version of the manuscript. J.C.N, B.U, I.H.E, VU and V.N reviewed the results of the manuscript. All authors approved the final version of the manuscript

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Data Availability

The dataset used in this study will be available from the corresponding author upon reasonable request.

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Figures

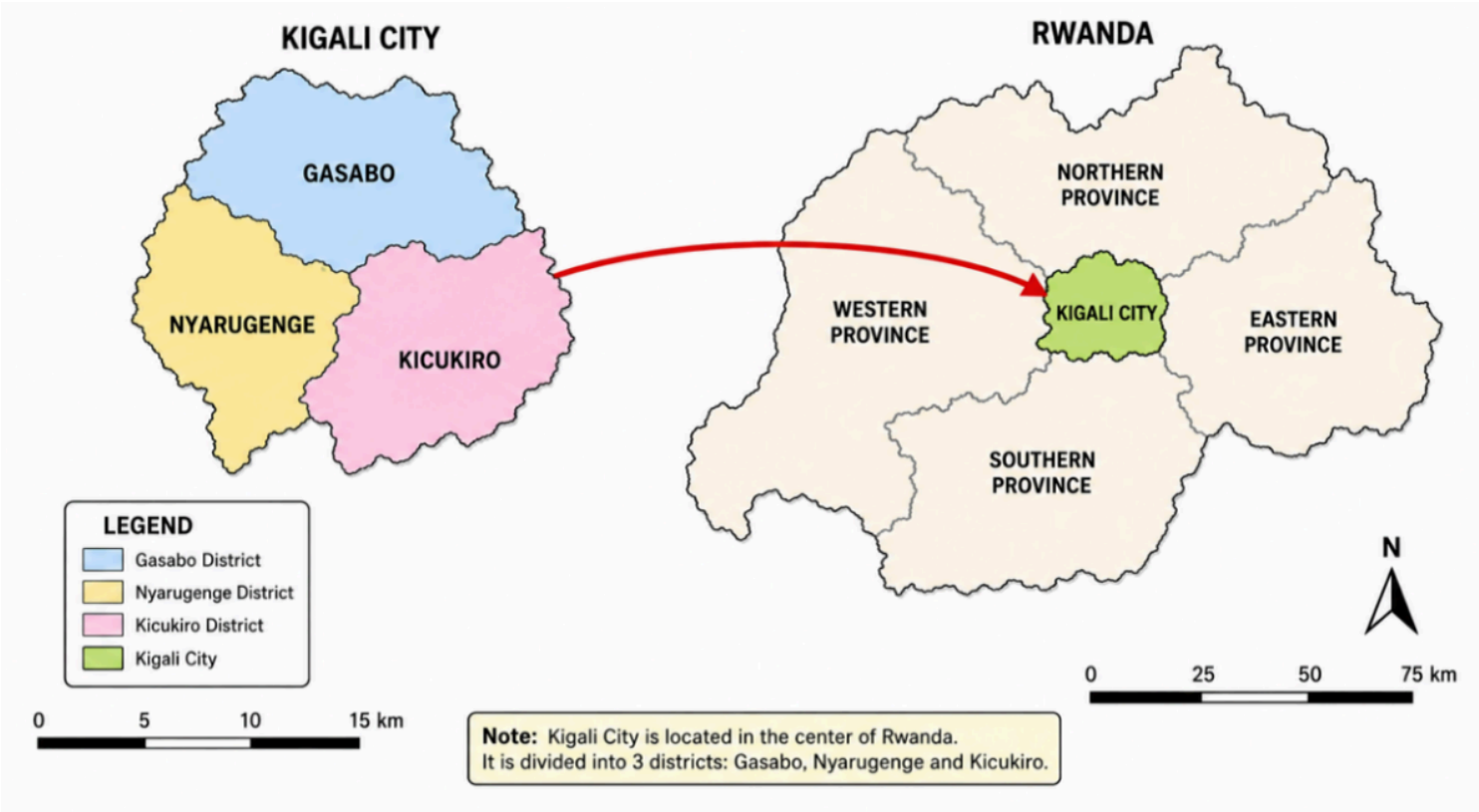


Figure 1

Geodemographic map of Kigali City.

Algorithm for Cx Ca Screening and treatment

General population

Screening with HPV test

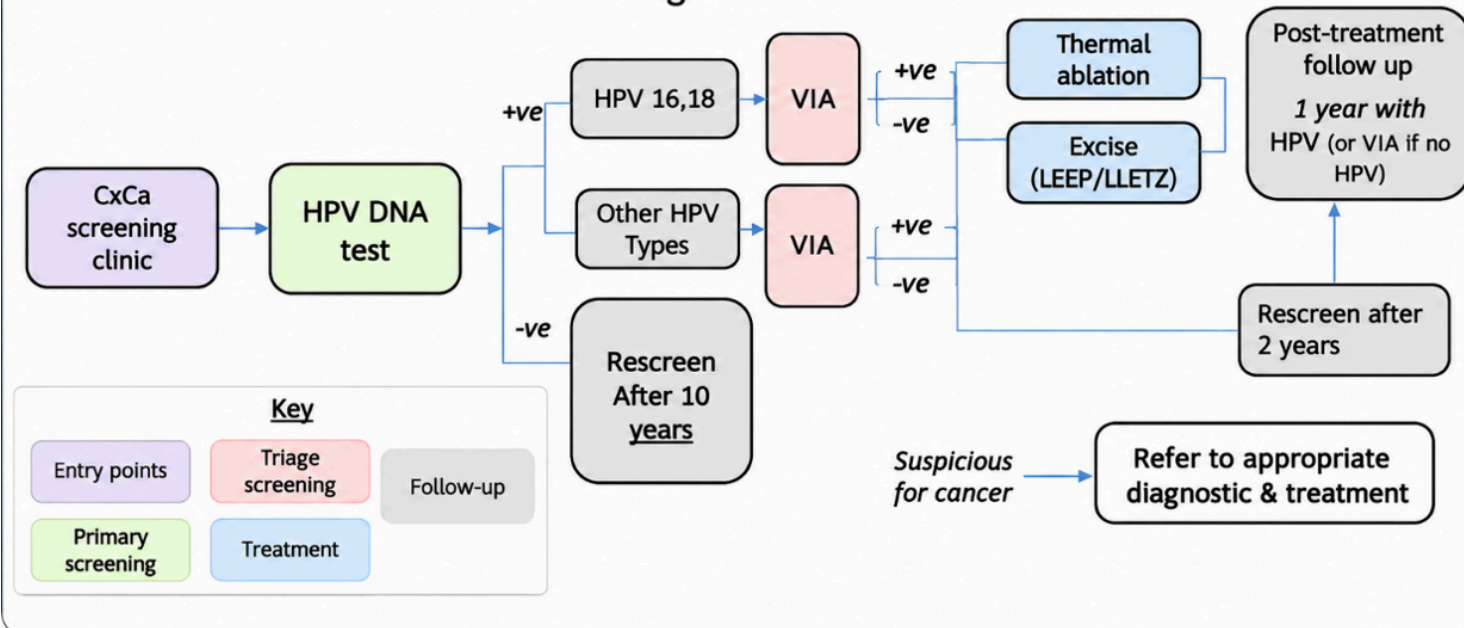


Figure 2

Flowchart of cervical cancer screening in Kigali City adopted from Rwanda National Guideline(10).

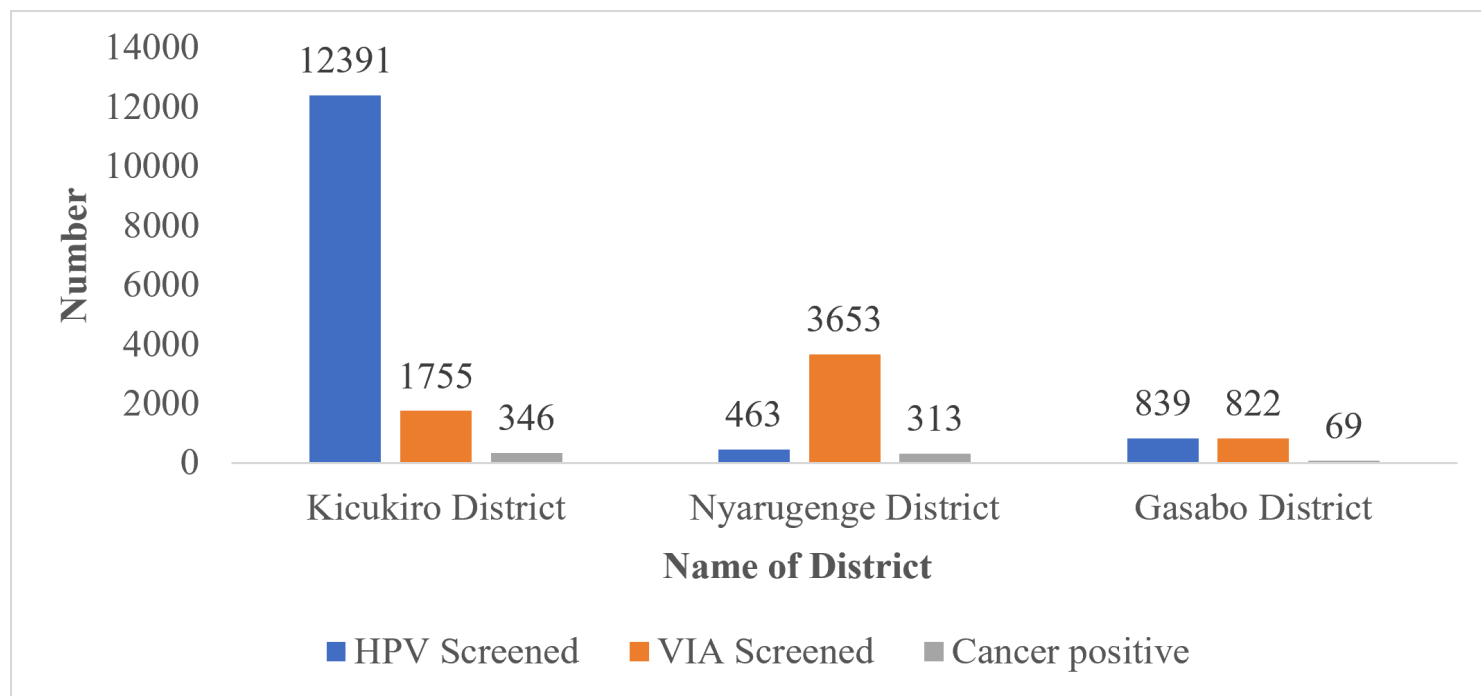


Figure 3

District comparison – total HPV screened, VIA screened, and cancer positives (all periods combined)

