ORIGINAL ARTICLE

Factors associated with HIV testing among patients seeking emergent injury care in Kigali, Rwanda

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ABSTRACT

Introduction: Emergency centres (ECs) can be important access points for HIV testing. In Rwanda, one in eight people with HIV are unaware of their infection status, which impedes epidemic control. This could be addressed via increased testing. This cross-sectional study evaluated factors associated with EC-based HIV testing among injured patients at the Centre Hospitalier Universitaire de Kigali (CHUK), in Kigali, Rwanda.
Methods: Adult injury patients were prospectively enrolled between January-June 2020. Trained study personnel collected data on demographics, injury aspects, treatments, HIV testing, and disposition. The primary outcome was the completion of EC-based HIV testing. Differences between those receiving and those not receiving testing were assessed. Regression models yielding adjusted odds ratios with associated 95% confidence intervals (CI) were calculated to quantify magnitudes of effect.
Results: Among 579 patients, the majority were under 45 years of age (78.1%) and male (74.4%). The most common mechanism of injury was road traffic accidents (50.3%). EC discharge occurred in 54.4% of cases. HIV testing was performed in 221 (38.2%) cases, of which 5.9% had a positive result. HIV testing was more likely among males (aOR=1.69, 95% CI: 1.02–2.78; p=0.04), cases transported by prehospital services (aOR=2.07, 95% CI: 1.28-3.35; p=0.003) and those receiving surgical consultation (aOR=3.13, 95% CI: 1.99-4.94; p<0.001). Cases with lower acuity were less likely to be tested (OR=0.70, 95% CI: 0.55-0.90; p=0.004), as were those discharged (OR=0.28, 95% CI: 0.18-0.43; p<0.001).
Conclusion: In the population studied, most patients did not undergo HIV testing. EC-based physician directed testing was more likely among male patients and patients with greater care needs. These results may inform approaches to increase EC-based testing services in Rwanda and other similar settings with high HIV burdens.

Introduction

Substantial progress has been made in combatting HIV, yet HIV remains an ongoing global health challenge, disproportionally affecting those living in sub-Saharan Africa, where more than two-thirds of people living with HIV (PLHIV) reside [1,2]. Over the recent decade, strides have been made towards achieving the UNAIDS 90-90-90 targets, in which 90% of all people living with HIV will know their HIV status, 90% of all people with diagnosed HIV infection will receive sustained antiretroviral therapy and 90% of all people receiving antiretroviral ther-

apy will have viral suppression [3]. However, global data has shown that all 2020 targets have fallen short [3]. One of the potential drivers at play in not meeting these targets is that approximately one in eight people PLHIV in sub-Saharan Africa are unaware of their HIV status [4]. Early detection and treatment of HIV are linked to reductions in morbidity and mortality as well overall transmission. Testing is paramount in addressing the global epidemic [5].

HIV testing in sub-Saharan Africa has substantially expanded across multiple venues, however, gaps in testing access persist [4]. Emergency Centre (EC)-based HIV testing has the potential to help augment HIV

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test delivery [6]. ECs are unique contact points for HIV testing as they provide care to large numbers of patients that otherwise may not often interact within health systems. This is particularly true for injured patients which are predominantly men and younger individuals, key populations for HIV care engagement [7–10]. Furthermore, prior literature has reported high HIV prevalence among patients seeking general and injury-specific emergency care in low- middle- and high-income countries (LMIC), making the potential utility of EC-based testing provision even greater [6,11–13].

Within sub-Saharan Africa, Rwanda has been one of the leaders in addressing the HIV epidemic with its national response. The prevalence of HIV in Rwanda has been stable at 3% in the adult population, with approximately 220,000 PLHIV and with 90% of those treated attaining viral suppression [14–16]. Nevertheless, regional variations in the national program's success exist. In the capital of Kigali, HIV prevalence is at 7.3% [17]. Furthermore, up to one in eight PLHIV in Rwanda are not aware of their infection status, contributing to ongoing population transmission [18]. The identification of PLHIV in Rwanda, could be improve by further understanding the role of ECs in accessing at risk population and connecting them to HIV testing. This prospective cross-sectional study evaluated factors associated with EC-based physician directed HIV testing for injured patients at the Centre Hospitalier Universitaire de Kigali (CHUK), in Kigali, Rwanda.

Methods

Study design, setting & population

This prospective cross-sectional study was a pilot evaluation of EC-based HIV testing and was *a priori* nested within a prospective cohort study. The cohort study evaluated injury burdens and acute EC care at CHUK [19]. CHUK is the main public referral health facility and teaching hospital in the capital city of Kigali in Rwanda. CHUK has approximately 500 inpatient beds and an EC that provides continuous 24 h care and receives approximately 20,000 visits annually. Rwanda's only Emergency Medicine (EM) post-graduate training program is also housed within CHUK [20]. The research activities were approved by the CHUK ethics committee, the University of Rwanda College of Medicine and Health Sciences, and the institutional review board of Rhode Island Hospital.

All patients greater than or equal to 18 years of age presenting to the EC for injury care were eligible for inclusion. Pregnant patients, with concurrent medical needs unrelated to the index injury, legal prisoners of the state, and those unable or declining to provide informed consent were excluded.

The Rwandan Ministry of Health has set forth a comprehensive agenda to address the HIV epidemic which aims to achieve identification of PLHIV through testing as early as possible and linking these individuals to care in a timely manner [18]. In 2008, the Ministry of Health implemented provider-initiated testing and counselling as a national policy in order to increase the opportunity for HIV testing [32]. There are no national or hospital-based HIV testing guidelines specifically for the EC clinical setting at CHUK [28]. HIV testing processes in the EC entail patients to undergo a rapid HIV test; if the results are positive, a provider requests a blood sample for confirmation with an enzyme-linked immunosorbent assay (ELISA) laboratory test.

Data collection and management

All patients presenting to the CHUK EC were screened during the recruitment periods by protocol-trained research personnel who were present at the study site 24 h a day. Due to the COVID-19 pandemic, data collection was interrupted due to nationwide restrictions requiring a cessation of research activities. Data were thus acquired during two time periods: collection occurred from January 27th-March 21st, 2020 (pre-COVID19 study period) and from June 1st-June 28, 2020 (intra-COVID19 study period) [19].

Patients were screened after the clinical staff completed initial triage and stabilisation to not impede clinical care. Patients meeting study criteria were informed of the study and interested patients were enrolled after providing informed written consent in Kinyarwanda. A legally authorised patient representative provided informed consent if the patient was unable to due to illness or incapacity.

Research personnel collected data through the first six hours of EC clinical care using structured case reporting forms entered into a secure electronic database. Prospective data were collected on patient demographics and prior medical history, injury event characteristics, triage vital signs and mental status assessment (using the Glasgow Coma Score [GCS]), injury care, HIV testing, and EC disposition. Treatment interventions for injury care in the EC were coded as binary and aggregated with receipt of any single intervention resulting in an indication of treatment. Injury severity was characterised using the Kampala Trauma Score (KTS), a validated prognostic scale in LMIC settings [21,22]. A lower KTS ($\leq$12) suggests a more severe injury state whereas a higher KTS ($\geq$13) indicates a less severe injury condition [21]. Following earlier studies, serious injuries were defined as a traumatic pathology necessitating hospital admission. Number of serious injuries was based on each individual anatomical region as classified by the Abbreviated Injury Scale [23]. If data for HIV testing or disposition from the EC were not available within the first six hours of care, patient charts were reviewed retrospectively to extract this data. This was completed at the end of the enrolment phase using a validated patient linkage and data extraction approach as previously described [21].

Data analysis

Data were analysed using STATA version 15.0 (Stata Corp; College Station, USA). The primary outcome of interest was the completion of HIV testing in the EC. Variables of age, systolic blood pressure, and GCS were transformed into categorical data. The epidemiologic profile of the population was characterised using descriptive statistics. For summary statistics, continuous variables were described using median values with associated interquartile ranges (IQR) and categorical variables were described using frequencies and percentages. The prevalence of HIV testing and the proportion of patients with positive tests were calculated with associated 95% confidence intervals (CIs).

Significant differences between patients receiving and not receiving HIV testing were evaluated using χ^2 or Fisher's exact tests for categorical variables and Mann-Whitney tests for continuous variables. A multivariable stepwise backward logistic regression model was employed to identify factors associated with the provision of HIV testing. Variables that were statistically significantly different between HIV testing groups were included based on an *a priori* threshold of p<0.05. The backward stepwise regression was performed with model selection employing Akaike Information Criterion (AIC) for variable removal. To assess for potential collinearity among included variables, variance inflation factors (vif) were calculated, and no collinearity was observed (all vif < 10).

Due to the interruption in data collection stemming from the COVID-19 pandemic and its potential impacts on HIV testing, stratified analyses of the multivariable regression models were completed for the pre-COVID-19 and intra-COVID-19 periods. Additionally, average weekly case enrolments and HIV testing frequency were calculated and plotted (Python 3.6.8, Python Software Foundation) for the pre-COVID-19 and intra-COVID-19 periods.

Results

A total of 864 patients seeking care for injuries were screened for study inclusion. Of these, 579 patients consented, enrolled, and were included in the analysis. Of those enrolled, 221 received EC-HIV testing, and 358 did not (Fig. 1).
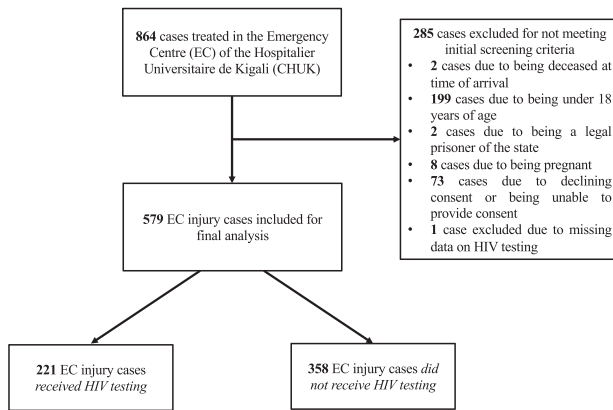
Fig. 1. Flow diagram for study population.
Patients were recruited from January 27th to March 21st and June 1st to June 28th, with a two-month period (March 22nd to May 31st 2020) of no study enrollment due to restrictions from the COVID-19 pandemic.

Fig. 2. Average weekly cohort enrolment and HIV testing.

The median age of the study population was 33 years [IQR 26-43], and 74.4% were men. The primary mechanism of injury was road traffic accidents (50.3%). A total of 133 (23.0%) patients were transported by prehospital service, and the median hours between injury and presentation to the EC was four [IQR 1, 17]. The majority of patients (76.5%) required acute EC interventions, and 54.4% of patients had emergent surgical consultation. KTS scores ranged from 11 to 16, with 31 patients having a score scores < 12 indicating more severe injury states. For final EC disposition, 54.4% of patients were discharged, 40.6% were admitted to the hospital and 0.9% died (Table 1).

A prior diagnosis of HIV was reported by 2.3% of cases. HIV testing was performed for 38.2% of patients. Among those tested 13 (5.9%) had a positive test result. In bivariate analysis stratified by EC-HIV testing, men were more likely than women to be tested (p=0.001), as were those transferred from outside health facilities (p<0.001) or transported by prehospital services (p=0.009). Patients that were tested had a significantly longer time between injury and presentation (p<0.001), and lower KTS values (p<0.001). Patients receiving emergent EC interventions (p<0.001) or surgical consultation (p<0.001) during their first six hours of care were more likely to be tested. Patients were more likely to have received HIV testing if they were admitted to the hospital as compared to those not admitted (68.3% versus. 23.5%, p<0.001). In comparison of those who received HIV testing versus those who did not, there was no statistical difference in age (p=0.539), mechanism of injury (p=0.158) and any past medical history not due to injury (Table 1).

During the study period, average injury cases in the EC ranged from 33 to 66 patients per week, with HIV testing rates ranging from 9.1% to 31.5% per week. The mean number of patients enrolled per week was not significantly different in the pre-COVID-19 and intra-COVID-19 periods, at 50 versus 45 participants respectively (p=0.28) (Fig. 2). However, there was a significant difference in the proportion of patients who received HIV testing during the pre-COVID-19 period (74.3%) versus the intra-COVID-19 period (60.2%) (p<0.001) (Table 1).

In multivariable analysis EC-based HIV testing occurred with increased frequency among male patients (OR=1.69, 95% CI: 1.02–2.78; p=0.04), cases transported by prehospital services (OR=2.07, 95% CI: 1.28-3.35; p=0.003) and patients receiving surgical consultation (OR=3.13, 95% CI: 1.99-4.94; p<0.001). Cases with lower injury severity were less likely to undergo HIV testing (OR=0.70, 95% CI: 0.55-0.90; p=0.004), as were those discharged from the EC (OR=0.28, 95% CI: 0.18-0.43; p<0.001) (Table 2).

When limiting the analysis to patients enrolled during the pre-COVID 19 period, patients transported by prehospital services and receiving surgical consultation had a significantly greater likelihood of undergoing EC-based HIV testing, compared to those discharged from the EC
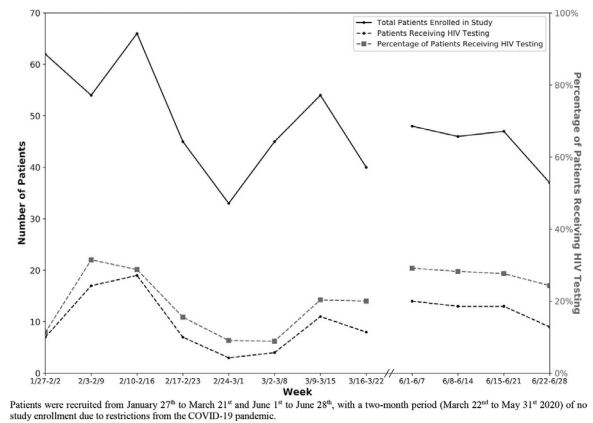
(Supplemental Table 1). For cases captured during the intra-COVID-19 time period, those with increased time between injury and presentation had a greater odds of HIV testing, whereas those discharged from the EC had lower odds (Supplemental Table 2).

Discussion

This study evaluated factors associated with the provision provider-driven HIV testing among adult injured emergency centre patients at CHUK in Kigali, Rwanda. The results demonstrate that HIV testing occurred for a minority of injured patients in the emergency centre, and that those with more severe injuries and those admitted to the hospital had a higher likelihood of undergoing HIV testing. Conversely, those who were discharged and those with less severe injuries had a lower likelihood of completing EC-based HIV testing. These data may help inform approaches to HIV care engagement to increase EC-based testing services in Rwanda and other similar settings.

In the current study, one in five patients were less than 25 years of age. It is estimated that 10% of all new HIV infections will occur among young people aged 15-24 years. As the Republic of Rwanda has identified persons within this age group as a key population for testing due to the high risk of HIV infection, the EC care setting may represent an important venue to engage this demographic [17]. Studies have shown that the ECs can be highly effective settings for testing key populations who are more likely to present for injury care and do not often seek healthcare for non-emergent conditions [11,12,24,25]. In addition to young adults, EC-based HIV testing in Rwanda may also be an access point for other important populations such as men who have sex with men and intravenous drug users as seen in other settings [26,27]. As current Rwanda national HIV guideline do not address HIV testing in Emergency Care centres [28], there is a need for increased research from Rwanda on EC-based HIV care, in order to inform implementation approaches and guidelines that will maximise identification of PLHIV in the EC.

The current data found that HIV testing was more likely among those with more severe injuries, those requiring emergent EC interventions, and those admitted to the hospital. Although the cause of this is not certain it is possible that these severity factors influence clinical decision-making regarding HIV testing as these patients may require more invasive procedures such as surgery and may spend more direct time with physicians making them more likely to be tested by the provider-driven approach in the study setting. However, focusing testing efforts on these patients represents a missed opportunity to test patients discharged from the EC (the majority of patients presenting with injuries). While increasing delivery of EC-based HIV testing may have barriers due to competing priorities and complexities of implementation, other studies have found an increase in identifying PLHIV in need of treatment when HIV testing

Table 1
Population characteristics and characteristics by HIV test completion.

Variable	Number (%)(n=579)	Subjects Not Completing HIV Testing (n=358)	Subjects Completing HIV Testing (n=221)	P-Value
Age:				0.54
18-24	115 (19.9%)	74 (20.7%)	41 (18.9%)	
25-44	337 (58.2%)	211 (58.9%)	126 (57.0%)	
45-64	92 (15.9%)	55 (15.4%)	37 (16.4%)	
≥65	35 (6.0%)	18 (5.0%)	17 (7.7%)	
Sex				0.001
Male	431 (74.4%)	247 (69.0%)	184 (83.3%)	
Female	147 (25.4%)	110 (30.7%)	37 (16.7%)	
Missing	1 (0.2%)	1 (0.3%)	0 (0.0%)	
Number of Serious Injuries[a]				<0.001
0	101 (17.4%)	46 (12.9%)	55 (24.9%)	
1	440 (76.0%)	280 (78.2%)	160 (72.4%)	
2+	38 (6.6%)	32 (8.9%)	6 (2.7%)	
Hours Between Injury and Presentation: Median (IQR)	4 (1-17)	3 [1–12]	8 [2–26]	<0.001
Systolic Blood Pressure (mm Hg): Median (IQR)				0.002
≥90	570 (98.4%)	357 (99.7%)	8 (3.6%)	
<90	9 (1.6%)	1 (0.3%)	213 (96.4%)	
Glasgow Coma Scale				<0.001
13-15	542 (93.6%)	351 (98.0%)	191 (86.4%)	
9-12	26 (4.5%)	6 (1.7%)	20 (9.1%)	
3-8	11 (1.9%)	1 (0.3%)	10 (4.5%)	
Kampala Trauma Score: Median (IQR)	15 (14-15)	15 [14–15]	14 [14–15]	<0.001
Patient Transferred from Another Health Facility				0.009
Yes	254 (43.9%)	142 (39.7%)	112 (50.7%)	
No	325 (56.1%)	216 (60.3%)	109 (49.3%)	
Patient Transported by Prehospital Services				<0.001
Yes	133 (23.0%)	56 (15.6%)	77 (34.8%)	
No	440 (76.0%)	298 (83.2%)	142 (64.3%)	
Missing	6 (1.0%)	4 (1.1%)	2 (0.9%)	
Past Medical History[b]				
None	490 (84.6%)	303 (84.6%)	187 (84.6%)	0.99
HIV	13 (2.3%)	8 (2.2%)	5 (2.3%)	0.98
Cardiac Condition	13 (2.3%)	12 (3.4%)	11 (5.0%)	0.33
Pulmonary Condition	6 (1.0%)	9 (2.5%)	4 (1.8%)	0.58
Renal Condition	1 (0.2%)	3 (0.8%)	3 (1.4%)	0.55
Neurologic Condition	1 (0.2%)	1 (0.3%)	0 (0.0%)	0.43
Diabetes	5 (0.9%)	0 (0.0%)	1 (0.5%)	0.20
Cancer	0 (0.0%)	0 (0.0%)	0 (0.0%)	N/A
Other	40 (6.9%)	28 (7.8%)	12 (5.4%)	0.27
Mechanism of Injury				0.16
Blunt Injury (BI)	479 (82.7%)	289 (80.7%)	190 (86.0%)	
Penetrating Injury (PI)	50 (8.6%)	37 (10.3%)	13 (5.9%)	
Other Non-BI and Non-PI	50 (8.6%)	32 (8.9%)	18 (8.1%)	
Emergent EC Treatment During within 6 h				<0.001
Yes	443 (76.5%)	252 (70.4%)	191 (86.4%)	
No	136 (23.5%)	106 (29.6%)	30 (13.6%)	
Surgical Consultation During within 6 h				<0.001
Yes	315 (54.4%)	140 (39.1%)	175 (79.2%)	
No	264 (45.6%)	218 (60.9%)	46 (20.8%)	
Disposition				<0.001
Discharged from EC	316 (54.4%)	253 (70.7%)	62 (28.1%)	
Admitted to Hospital	236 (40.6%)	84 (23.5%)	151 (68.3%)	
Transferred to Another Health Facility	7 (1.2%)	5 (1.4%)	2 (0.9%)	
Died	11 (0.9%)	5 (1.4%)	6 (2.7%)	
Eloped or Withdrew	3 (0.5%)	3 (0.8%)	0 (0.0%)	
Missing	8 (1.4%)	8 (2.2%)	0 (0.0%)	
COVID-19 Restrictions				<0.001
Before COVID-19	399 (68.9%)	266 (74.3%)	133 (60.2%)	
During COVID-19	180 (31.1%)	92 (25.7%)	88 (39.8%)	
HIV Testing				NA
Received testing	221 (38.2%)	0	221 (100%)	
Not Tested	358 (61.8%)	358 (100%)	0 (100%)	
HIV Testing Outcome				NA
Negative			173 (78.3%)	
Positive			13 (5.9%)	
Indeterminate or No Result			35 (15.8%)	

[a] Injury requiring hosptial admission for asmission for definitive management [37].

[b] The percentages for these variables do not add up to 100% because the categories within the variable are not mutually exclusive.

Table 2
Factors associated with HIV testing*.

Variable	Odds ratio [95% CI]	P-Value
Sex		
Female	Reference	Reference
Male	1.69 [1.02-2.78]	0.04
Hours Between Injury and Presentation (+10 h)	1.02 [0.99-1.06]	0.16
Kampala Trauma Score (+1 Score)	0.70 [0.55-0.90]	0.004
Patient Transported by Prehospital Services	Reference	Reference
No	2.07 [1.28-3.35]	0.003
Yes		
Surgical Consultation During First 6 h	Reference	Reference
No	3.13 [1.99-4.94]	<0.001
Yes		
Disposition		
Admitted to Hospital	Reference	Reference
Discharged from emergency centre	0.28 [0.18-0.43]	<0.001

*, Patients with a disposition other than "Discharged from emergency centre" or "Admitted to Hospital" (n=21) or with missing disposition data (n=8) were excluded from analysis.

during EC care is scaled up [24,29]. Studies evaluating EC-based HIV testing in lower-resourced settings have shown high testing acceptability and feasibility in emergency centres; there may be the ability to do so in the Rwandan context [11,24]. Furthermore, providing HIV testing to more patients seeking care for injuries in the EC may target a disproportionately high-risk patient population of younger adults and other high-risk individuals, which could server to help progress Rwanda's national strategic plan for HIV control [30].

During the COVID-19 pandemic, the proportion of patients who underwent HIV testing increased. In this study, severity of illness was higher and there was a greater number of hospital admissions during the intra-COVID-19 study period, which was associated with increased HIV testing. Another study at the same EC site found that during the intra-COVID-19 pandemic, injury care had higher disease burdens and increased inpatient admission with more significant resource requirements than the pre-COVID-19 period [19]. It is unclear if COVID-19 may have influenced clinician decision making related to HIV testing. While other studies have reported challenges to HIV screening and testing programs during the pandemic due to limited in-person interactions, community-based testing, and outreach, the EC is a unique venue that has maintained healthcare access and continued testing efforts [25,31]. Although the increase in HIV testing observed during the pandemic suggests a system benefit, it is essential to note that the sampling frame in the present data limits conclusions on the pandemic's total impact on HIV testing in Rwanda. Further longitudinal studies are needed.

There are limitations to this study. This research was nested in a cohort study designed to evaluate acute injury care at the study site. Although the assessment of HIV testing was an *a priori* outcome of interest data to investigate individual provider practice patterns or decision making that may have influence attainment of HIV testing was not available beyond the patient specific data. To address this future qualitative research should be conducted to assess physician perceptions and decision-making process for HIV testing within the emergency care setting. Furthermore, the current analysis only focused on patient population presenting with injuries. Patients presenting with injuries may differ from those presenting with medical complaints as they are often younger and predominantly male, which represent key groups for HIV testing initiatives in Africa. Additionally, due to the COVID-19 pandemic, there was an interruption in data collection and the results must be interpreted in the context of this event.

The methods did not allow for the assessment of patients who declined to test for HIV, as such, testing acceptability was not evaluated and could be of importance in designing enhanced EC testing approaches. In addition, this study did not assess linkage to HIV care after the identification of a PLHIV in the EC. Linking patients to care after identification is key in impacting HIV programming across the cascade of care and should be evaluated in future studies. Finally, this data represents patients at a single centre tertiary care facility with access to relatively well-resourced emergency care and HIV testing resources and as such extrapolation to other health facilities is uncertain.

Conclusion

In the studied EC injury population in Kigali, Rwanda, there was a modest level of HIV testing completed. EC-based physician directed HIV testing was more likely among males and those requiring greater treatment resources. Patients who were discharged, and those with less severe injuries were less likely to have received HIV testing. Given the persistent need for improved HIV case identification and access to high-risk target groups, the current data may be used to inform the development of EC-based HIV testing approaches in Rwanda and other similar settings.

Dissemination of results

The results of this study were shared with the ED at the study site through a departmental presentation. Preliminary results from this work were presented at the Society for Academic Emergency Medicine.

Authors' contribution

Authors contributed as follow to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: AB contributed 25 %; CGM, OT, CU and ARA 15%; and SJ, ZM, VN, DU, MN and AS, 2.5%. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

Declaration of Competing Interest

The authors have no conflicts of interest. The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the views of or any academic organisations. The funders played no role in the collection, analysis or reporting of the data.

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