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Research Paper

The geography of emergency department-based HIV testing in South Africa: Can patients link to care?

Bhakti Hansoti[a,*], Anant Mishra[a,┼], Aditi Rao[a,┼], Lucy Chimoyi[b], Andrew D. Redd[a,c], Steven J. Reynolds[a,c,d], David F. Stead[e,f], John Black[e,g], Roshen Maharaj[e,h], Elizabeth Hahn[a], Pamela Mda[i], Nomzamo Mvandaba[e], Yandisa Nyanisa[e], Victoria Chen[a], Katie Clark[a], Sofia Ryan[a], Thomas C. Quinn[a,c]

[a] The Johns Hopkins University, 1800 Orleans St, Baltimore, MD 21287, USAs
[b] Implementation Research Division, The Aurum Institute, 29 Queens Rd, Parktown, Johannesburg, 2194, South Africa
[c] Division of Intramural Research, National Institute of Allergy and Infectious Diseases, 31 Center Dr #7A03, Bethesda, MD 20892, USA
[d] Department of Family Medicine and Health Sciences, Faculty of Medicine, University of Cape Town, Anzio Rd, Cape Town 7925, South Africa
[e] Department of Medicine, Faculty of Health Sciences, Walter Sisulu University, Umtata Part 1, Mthatha, South Africa
[f] Department of Medicine, Frere and Cecilia Makiwane Hospitals, Amalinda Main Rd, Braelyn, East London 5201, South Africa
[g] Department of Medicine, Livingstone Hospital, Stanford Road, Korsten, Port Elizabeth 6020, South Africa
[h] Department of Emergency Medicine, Livingstone Hospital, Port Elizabeth, South Africa, Stanford Road, Korsten, Port Elizabeth 6020, South Africa
[i] Nelson Mandela Hospital Clinical Research Unit, Sisson St, Fort Gale, Mthatha 5100, South Africa

A R T I C L E I N F O

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A B S T R A C T

Background: Emergency Departments (EDs) can serve as clinical sites for identification of new HIV infections and their entry into care. We examined if HIV-positive patients who present to EDs in South Africa are able to successfully link to care.

Methods: We conducted a one-year longitudinal prospective cohort study in four hospitals across the Eastern Cape, South Africa, with participants followed between July 2016 and July 2018. All adult, non-critical patients presenting to the ED were systematically approached, asked about their HIV status, and, if unknown, offered a point-of-care (POC) HIV test. All HIV-positive patients were further consented to participate in a follow-up study to assess subsequent linkage to care and distance from "home" to ED. Linkage to care was defined as self-reported linkage (telephonic) or evidence of repeated CD4/viral load testing in the National Health Laboratory System (NHLS) at either the 6- or 12-months post index ED visit.

Findings: A total of 983 HIV-positive patients consented to participate in the study. In the 12 months following their ED visit, 34·1% of patients demonstrated linkage to care (335/983), 23·8% did not link to care (234/983), and 42·1% (414/983) were lost to follow-up. Though not statistically significant, a high percentage of young men (27/50, 54%) and those presenting with a trauma-related complaints (100/205, 48.8%) did not link to care. A considerable proportion of patients (105/454, 23·2%,) resided 50 or more kilometers from their index ED sites, though there was not a significant difference in linkage to care rate between those who lived closer or further from the ED.

Interpretation: We have shown that strategies to improve linkage to care from the ED should consider the high rates of poor linkage among young men and those presenting to the ED with trauma. Furthermore, innovative linkage to care solutions will need to account for the unique geographical consideration of this population, given that many ED patients will need to continue care at a site distant from the diagnosis site.

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* Corresponding author.
E-mail addresses: bhansot1@jhmi.edu (B. Hansoti), anant.s.mishra.19@dartmouth.edu (A. Mishra), aditi.rao@jhmi.edu (A. Rao), lchimoyi@auruminstitute.org (L. Chimoyi), aredd2@jhmi.edu (A.D. Redd), sjr@jhmi.edu (S.J. Reynolds), ehahn6@jhmi.edu (E. Hahn), kclark54@jhmi.edu (K. Clark), sryan24@jhu.edu (S. Ryan), tquinn2@jhmi.edu (T.C. Quinn).
┼ Indicates equal contribution.

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Research in Context

Evidence before this study

Achieving the UNAIDS 95–95–95 targets for HIV testing, ART utilization, and viral suppression by 2030 remain a key metric to achieve epidemic control of HIV. However, In South Africa, while 92% of people living with HIV know their status, only 70% of HIV-positive patients are accessing ART and only 64% are virally suppressed. Emergency Departments (EDs) are key clinical venues where patients missed by current HIV testing and treatment programs can be accessed. ED populations tend to have a higher prevalence of HIV infection than in the local community and other clinic-based facilities, and particularly in South Africa, EDs provide care to large volumes of young male trauma victims. Compared to US- or European-based health systems, South African EDs are fewer and serve larger catchment areas. As a result of this health system design, little is known about if and where HIV-positive ED patients engage in care.

Added value of this study

This study is the first to show the low rates of linkage to care for HIV-positive patients who receive care in the ED. Given the low rates of linkage to care for both known HIV-positive patients and those newly diagnosed with HIV, current standard of care practices are ineffective for this clinical venue and patient population. In particular, a significant number of HIV-positive ED patients, including those with new HIV diagnoses, reported receiving follow-up care at distances greater than 50 km from their index ED site.

Implication of all the available evidence

These observations highlight the fundamental challenges and opportunities for improving the HIV care cascade in ED-based HIV-positive patients in South Africa. In order to meet the UNAIDS 95–95–95 targets, policymakers will need to adopt innovative and differentiated implementation strategies to overcome the patient-level factors and structural barriers within the health system to improve HIV care linkage from EDs.

Introduction

In recent years, significant strides have been made to develop and implement innovative strategies to decrease attrition along the HIV care cascade [1]. Global increases in Anti-Retroviral Therapy (ART) use have been shown to prevent viral transmission via the reduction in viral loads, with associated decreases in HIV incidence [2,3]. Today, South Africa remains the epicenter of the HIV pandemic as the largest AIDS epidemic in the world – 20% of all people living with HIV globally reside in South Africa, and 20% of new HIV infections occur there [4]. Despite having implemented universal prevention, testing, and treatment policies to help curb the epidemic, critical coverage gaps remain. In 2019, while 92% of people living with HIV knew their status, only 70% were accessing ART and only 64% were virally suppressed in South Africa [5]. In particular, the epidemic is exacerbated by an alarmingly high rate of new infections in young men and women (nearly 87% of the total) [4]. A key approach to interrupting HIV transmission in young adults is to reach young men who play a central role in propagating the cycle of transmission among their partners [6]. However, despite the obvious need, engaging young men into HIV services has been challenging. Compared to young women who are captured by antenatal care services, young men often do not interact with the health system unless they have suffered a major injury [4,7].

Emergency Departments (EDs) are key clinical venues where patients missed by current HIV testing and treatment programs can be accessed [8]. Globally, it is well established that ED populations have a higher prevalence of HIV infection than in the local community and other clinic-based facilities. Particularly in South Africa, EDs provide care to large volumes of young male trauma victims and other vulnerable patients who do not otherwise interact with the health system. Visits to the ED are unplanned, and patients present with various complaints from bone fracture to strokes, wherein a positive diagnosis for HIV is an incidental finding. The unanticipated diagnosed and competing health priorities result in a lower likely hood of patients engaging in HIV services post-index visit[9–11]. The South African health structure has a tiered service delivery system with 90% of interactions occurring at the primary care-level and 10% at the hospital-level [12]. Thus, compared to US- or European-based health systems, South African EDs are fewer and serve larger catchment areas (one emergency department can serve a radius of more than 200 km). As a result of this diffuse health system design and limited patient tracking capabilities, what remains unclear are the longitudinal outcomes of HIV-positive patients who present for care in the ED and the role that the health system geography plays in their ability to access care.

The Eastern Cape province has the third-highest burden of HIV (25.2% prevalence rate) in South Africa [13]. HIV service delivery in the Eastern Cape, in particular, is hindered by limited resources, lack of standardized training, and competing clinical care priorities [14,15]. Our previous work has identified a high burden of HIV in ED patients in the Eastern Cape (over 28%), with more than a quarter of those patients (29%) having a previously undiagnosed infection [16]. Little is known about their outcomes. The primary objective of this study was to quantify the proportion of HIV-positive patients presenting to the ED that were successfully linked to care (LTC) within 12-months of their index visit in the ED. Our secondary objective was to identify where patients linked to care and their distance from the index site.

Methods

Study design and setting

This prospective cohort is a follow-up study to a prospective cross-sectional observational study in the EDs of four hospitals in the Eastern Cape province of South Africa conducted between July 2016 and July 2018 [16,17]. In contrast to other South African provinces, the Eastern Cape province is characterized by a significant rural population, with few trauma capable health facilities scattered throughout the region. This study was based in three major hospitals and one district hospital. Frere Hospital (located in East London), Nelson Mandela Academic Hospital (NMAH) [located in Mthatha], and Livingstone Hospital (LH) [located in Port Elizabeth] are tertiary care centers that provide 24 h emergency medical and trauma care and accept referrals from district hospitals up to 200 km away. Mthatha Regional Hospital (MRH) [located in Mthatha] is a district hospital with 24 h services that receives ambulances and walk-in patients, though transfers all trauma patients to NMAH, which is adjacent to the hospital complex.

Each hospital was sampled for a period of six weeks during which HIV testing was implemented and conducted in accordance with the 2015 National HCT Guidelines by trained study staff [18]. Study staff approached patients as soon as the triage process was completed. All fully conscious, clinically stable adult patients (≥18 years old) presenting for care in the ED during the study were eligible for HIV testing and enrollment into the study. Further details of the testing procedures are provided else where [16,17]. Staff informed patients

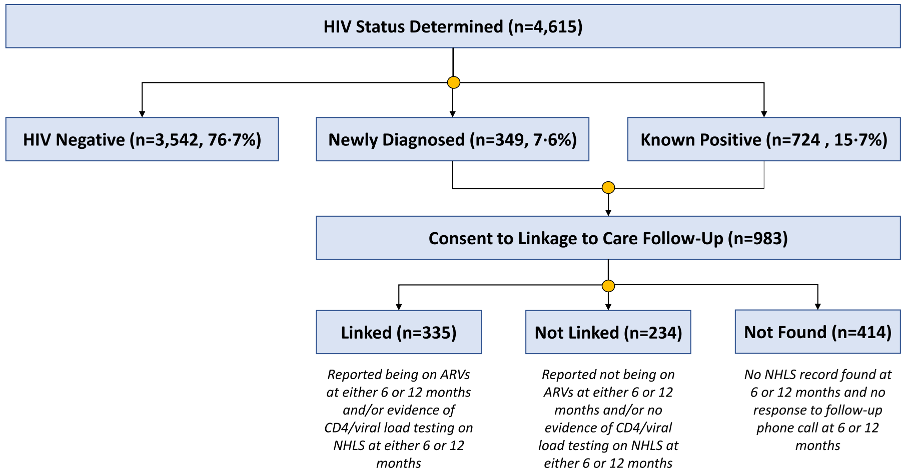

Fig. 1. Study design, enrollment, and linkage to care status overview.

of their HIV results immediately after testing. HIV-negative patients were provided with standard post-test counseling on HIV prevention strategies, the window period, and the importance of re-testing. All HIV-positive patients, identified with either a self-reported HIV-positive diagnosis or through point-of-care (POC) testing were provided with post-test counseling on linkage to care and a referral letter stating their results with directions to HIV clinic within the vicinity of the ED (current standard of care). All HIV-positive patients, (both those with a new diagnosis and known-HIV diagnosis, were further consented to participate in a LTC follow-up arm. Because we lacked complete data on prior engagement in care for all of the known-positive patients, all known-positive patients, in addition to new diagnoses, were consented to participate in the follow-up arm. Patients were requested to provide contact details for telephonic follow-up at 6-months and 12-months to determine self-reported linkage to care and were examined through the NHLS database using their date of birth, hospital number, and legal name, also at 6-months and 12-months (Fig. 1).

Data collection

HIV status, demographic data, presenting complaint, and contact details were recorded on case report forms (CRF) by study staff. Patients were defined as “HIV-positive” if they self-reported a previous diagnosis of HIV infection (i.e., “Known-positive”) or were “Newly Diagnosed” with HIV if they did not know their HIV status and had two positive POC rapid HIV tests. Patients were defined as “HIV-negative” if they had a single negative POC rapid HIV test. Patients were defined as “Unknown Status” if they were unaware of their status and refused a POC rapid HIV test. Of note patients who self-reported a prior negative test were encouraged by study staff to test again, regardless of timeframe. Only a negative POC test in the ED was recorded as HIV-negative for study purposes. In the follow-up phase, for telephonic responses, we recorded if and where patients sought care post-diagnosis, if patients self-reported taking antiretroviral drugs (ARVs), whether thought they were suffering from AIDS and/or were virally suppressed. From the NHLS database, we recorded location of the testing site, date, and results of CD4 and viral load (VL) testing if available. The National Health Laboratory Service (NHLS) is a South African national government institution established in 2001 and brought together the South African Institute for Medical Research (SAIMR), the National centre for Occupational Health and the National Institute for Virology, as well as various provincial health department and university-run pathology laboratories. A network of 265 laboratories service all public hospitals and clinics in the country, and host all the data in a centralized database. All CRFs were scanned and entered using intelligent character recognition in to DataFax© (DataFax, Clinical DataFax Systems Inc., Hamilton, Ontario, Canada) and centrally double-verified by independent data technicians.

Outcome measures and data analysis

For those that consented to participate in the LTC follow-up arm, their linkage to care status was subsequently categorized into 3 categories: (1) linked to care, (2) not linked to care, and (3) lost to follow-up (LTFU) [Fig. 1]. Those classified as linked to care were patients whose NHLS data showed evidence of CD4/VL testing at either 6 or 12 months and/or they affirmed they were on ARVs during telephonic follow-up at 6 or 12 months. Those classified as not linked to care consisted of patients either whose NHLS record indicated no subsequent HIV-related care during the 12 months following their ED visit and/or they stated they were not on ARVs during either of their 6- or 12-month follow-up calls. Those classified as LTFU were those patients whose records could not be identified on the NHLS database at 6 or 12 months after their ED visit and who did not respond to both their 6- and 12-month follow-up phone calls. Patients were called repeatedly on multiple days on all provided numbers (patients provided primary and secondary phone numbers) at both time points and searched extensively for (including with common misspellings of their name) on the NHLS database at both time points before being categorized as LTFU.

The descriptive analysis explored overall LTC levels by site as well as the characteristics of those who linked to care. Results were provided using summary statistics and chi-square testing across sex, age, time, and reason for ED visit to assess for any heterogeneous effects. For those patients with available CD4 and VL results, the proportion of those linked to care with advanced disease (CD4 $<$ 200 cells/ml^3) and suppressed VL (VL $<$ 1000 copies/ml) was also assessed using the patient’s latest lab results. Geographical information systems (GIS) were used to calculate and visualize the distances from a patient’s reported “home” LTC site to the index ED site to capture the approximate geospatial spread of HIV-positive patients presenting to the ED (“home” LTC site was used as a proxy for patients physical home address). Distances were summarized using medians and interquartile ranges (IQR). Finally, a log-binomial model, both unadjusted and site adjusted, was used to examine the association between patient characteristics and linkage to care. Data were analyzed using Stata v.16 (StataCorp, LLC, College Station, TX, USA) and ArcGIS v.10.7.1 (ESRI, Redlands, CA, USA) for geospatial mapping.

Ethical considerations

The study was approved by the Johns Hopkins University School of Medicine Institutional Review Board (IRB00105801), the Human Research Ethics Committees (HREC) of University of Cape Town (Ref 856/2015), and the Walter Sisulu University HREC (Ref 069/15). Written consent was obtained from all participants for the collection of demographic data and POC HIV testing.

Role of funding sources

The funding bodies had no role in the design of the study, data collection, analysis, and interpretation and in writing the manuscript.

Results

Overall study characteristics

HIV status was determined for a total of 4615 individuals presenting to the ED across the four sites during the time period of the study through testing or previously determined positive status. Of those 4615, patients, 3542 (76·7%) tested negative and 1073 (23·3%) were HIV-positive (724 had a known self-reported diagnosis of HIV and 349 were newly diagnosed with POC testing). Of the HIV-positive individuals, 983 (91·6%) consented to participate in a follow-up study (Fig. 1).

The demographic breakdown of patients in the follow-up arm across the four hospital sites was relatively similar (Table 1). The majority of patients were 31 years and older (649, 66·0% overall) and female (604, 61·4% overall). Slightly more patients arrived outside of normal business hours (525, 53·4% overall) and, with the exception of Frere Hospital, presented for medical-related reasons (655, 66·6% overall). Most patients already knew their HIV-positive status prior to their visit to the ED (671, 68·3% overall) and this was consistent across sites. A greater proportion of patients from NMAH (25·5%) and MRH (49·2%) travelled from distances of greater than 50 km.

LTC analysis

Of the 983 patients in the follow up study in the 12-month follow-up period, a total of 156 patients were ultimately reached only by phone (15·9%) and 351 were found only via the NHLS database but not by phone (35·7%), and 62 patients were able to be reached both by phone and tracked via the NHLS database (6·2%) [Table 2]. Thus, we had followed up date on 569 patients and 414 (42·1%) were LTFU [Table 2]. Those LTFU were more likely to present with a medical-related complaint (44·4% of medical patients vs. 37·5% of trauma patients LTFU; $p = 0{\cdot}038$), but did not differ significantly by age, sex, time of ED visit, and by HIV status compared to those patients who were able to be traced (Supplemental Table 1). Overall, of the 569 patients which we were able to track only 335 patients (34·1%) demonstrated linkage to care in the 12-month follow-up period *(*see definition in methods*)*, with 234 (23·8%) showing no evidence of LTC.

A higher proportion of young male patients (18–30 years) [46·0%] did not link to care compared to males aged 30 and above, although this trend was not statistically significant ($p = 0{\cdot}053$) [Table 3]. Patients with trauma-related complaints were significantly less likely to link to care compared to patients who presented for medical-related reasons (51·2% vs. 63·2% respectively; $p = 0{\cdot}005$). Of the 413 participants who were successfully tracked on the NHLS database, only 126 CD4 results and 102 viral load results were readily available, of which 58/126 (46·0%) had advanced disease (CD4 < 200 cells/ml^3) and 63/102 (61·8%) achieved viral load suppression (VL < 1000 copies/ml).

Geographic Information System (GIS) analysis of LTC

Of the 983 patients enrolled in the study, 454 (48·4%) provided a geographical location of their "home" clinic and were subsequently included in the GIS analysis. Of these, 326 linked to care (71·2%) and 128 did not link to care (28·2%). We found no relationship between home-to-hospital distance and a patient's age, sex, presenting complaint, time of visit, and HIV status (Supplemental Table 2). Overall, the median distance from home and index ED sites across all patients was 3·6 km (IQR: 0·3 km–31·0 km) [Table 4]. Mthatha Regional

Table 1
Patient demographic characteristics and linkage to care status across all 4 hospital sites (*n* = 983).

	Frere Hospital *n* = 256 (%)	Nelson Mandela Academic Hospital *n* = 133 (%)	Mthatha Regional Hospital *n* = 377 (%)	Livingstone Hospital *n* = 217 (%)	Total *n* = 983 (%)
Age					
18–30	93 (36·3)	36 (27·1)	147 (39·0)	58 (26·7)	334 (34·0)
31+	163 (63·7)	97 (72·9)	230 (61·0)	159 (73·3)	649 (66·0)
Sex					
Male	109 (42·6)	58 (43·6)	122 (32·4)	90 (41·5)	379 (38·6)
Female	147 (57·4)	75 (56·4)	255 (67·6)	127 (58·5)	604 (61·4)
Presenting Complaint					
Medical	116 (45·3)	94 (70·7)	317 (84·1)	128 (59·0)	655 (66·6)
Trauma	140 (54·7)	39 (29·3)	60 (15·9)	89 (41·0)	328 (33·4)
Visit time					
9am–5pm	120 (46·9)	58 (43·6)	180 (47·7)	100 (46·1)	458 (46·6)
Out of hours	136 (53·1)	75 (56·4)	197 (52·3)	117 (53·9)	525 (53·4)
HIV status					
Known-positive	155 (60·6)	99 (74·4)	261 (69·2)	156 (71·9)	671 (68·3)
Newly diagnosed	101 (39·4)	34 (25·6)	116 (30·8)	61 (28·1)	312 (31·7)
Distance*					
Less than 5 km	107 (69·0)	21 (52·5)	52 (42·6)	78 (56·9)	258 (56·8)
5–25 km	28 (18·1)	2 (5.0)	4 (3.3)	41 (30.0)	75 (16·5)
25–50 km	3 (1·9)	6 (15·0)	6 (4·9)	1 (0·7)	16 (3·5)
More than 50 km	17 (11·0)	11 (27·5)	60 (49·2)	17 (12·4)	105 (23·2)

* Distance data was only available for the 454 patients whose home clinic location could be found and mapped.

Table 2
Patient tracing and linkage to care status across all 4 hospital sites (n = 983).

	Frere Hospital	Nelson Mandela Academic Hospital	Mthatha Regional Hospital	Livingstone Hospital	Total
Phone-call follow up*					
Call at 6 and/or 12 months	40 (15·6)	25 (18·8)	103 (27·3)	50 (23·0)	218
*Reported LTC***	34 (85·0)	14 (56·0)	95 (92·2)	48 (96·0)	191 (87·6)
NHLS tracking*					
Found at 6 and/or 12 months	169 (66·0)	59 (44·4)	46 (12·2)	139 (64·1)	413
*Evidence of LTC***	83 (49·1)	7 (11·9)	30 (65·2)	74 (53·2)	194 (47·0)
LTC status					
Linked	99 (38·7)	18 (13·5)	118 (31·3)	100 (46·1)	335 (34·1)
Not Linked	88 (34·4)	57 (42·8)	24 (6·4)	65 (30·0)	234 (23·8)
LTFU	69 (27·0)	58 (43·6)	235 (62·3)	52 (24·0)	414 (42·1)
Total	n = 256 (%)	n = 133 (%)	n = 377 (%)	n = 217 (%)	N = 983 (%)

NHLS, National Health Laboratory Service. LTC, linkage to care. LTFU, loss to follow-up.
* 62 individuals were able to be traced both by phone and via the NHLS. These individuals are included in both categories.
** Percentages reported here are of those contacted by the respective method, not the overall sample from the site.

Table 3
Demographic and clinical characteristics of patients by linkage to care status (n = 569*).

	Linked$n$ = 335 (%)	Not Linked$n$ = 234 (%)	Total n = 569	Chi-square p-value
Age-Sex				
Young males (18–30)	23 (46·0)	27 (54·0)	50	0·053
Older males (31+)	95 (57·2)	71 (42·8)	166	0·609
Young females (18–30)	87 (62·1)	53 (37·9)	140	0·366
Older females (31+)	130 (61·0)	83 (39·0)	213	0·418
Presenting Complaint				
Medical	230 (63·2)	134 (36·8)	364	0·005
Trauma	105 (51·2)	100 (48·8)	205	
Visit time				
9am-5pm	164 (61·4)	103 (38·6)	267	0·245
Out of hours	171 (56·6)	131 (43·4)	302	
HIV status				
Known-positive	233 (59·9)	156 (40·1)	389	0·466
New diagnosis	102 (56·7)	78 (43·3)	180	
Distance*				
Less than 5 km	191 (74·0)	67 (26·0)	258	0·103
5–25 km	45 (60·0)	30 (40·0)	75	
25–50 km	12 (75·0)	4 (25·0)	16	
More than 50 km	78 (74·3)	27 (25·7)	105	

* Distance data was only available for the 454 patients whose home clinic location could be found and mapped.

Hospital served the broadest catchment area (IQR: 1·8 km, 178·7 km), while both Frere (IQR: 0·1 km, 6·6 km) and Livingstone (IQR: 0·1 km, 9·8 km), which are located in urban centers, served patients that received follow-up services more locally (Table 4). For those linked to care the median home-to-hospital distance was 2·9 km (IQR: 0·3 km–32·4 km), while those not linked to care was 4·5 km (IQR: 1·2 km–18·9 km), although the difference was not found to be statistically significant. This is further illustrated in Fig. 2, where no clustering was observed among those who linked or did not link to care. It is also possible to see that the majority of patients across all sites followed up within close proximity to the index ED site (<5 km, yellow). However, a large number of patients were observed to link further away from index ED sites (>50 km, purple line) with more than 20% crossing district municipality boundaries, including 23·6% of new HIV diagnoses (35/148).

Association between LTC and distance from index ED site

In an unadjusted model, we found that trauma patients were significant less likely to LTC (OR: 0·60; p = 0·018), as were those whose home-to-hospital distance was between 5 and 25 km (OR: 0·53; p = 0·020) (although this trend did not hold true for longer distances)

Table 4
Median home-to-ED distance (km) of patients by linkage to care status (n = 454).

	Frere Hospital n = 155	Nelson Mandela Academic Hospital n = 40	Mthatha Regional Hospital n = 122	Livingstone Hospital n = 137	Total n = 454
Not linked (median distance [IQR])	3·0 [0·1, 11·9]	4·3 [1·1, 73·7]	5·2 [1·1, 128·3]	7·1 [2·0, 16·9]	4·5 [1·2, 18·9]
Linked (median distance [IQR])	2·6 [0·1, 5·4]	4·1 [2·1, 29·8]	58·1 [2·3, 178·7]	1·4 [0·1, 6·7]	2·9 [0·3, 32·4]
Combined (median distance [IQR])	2·7 [0·1, 6·6]	4·2 [1·3, 62·3]	34·4 [1·8, 178·7]	4·6 [0·1, 9·8]	3·6 [0·1, 31·0]

ED, Emergency Department. IQR, Interquartile Range.

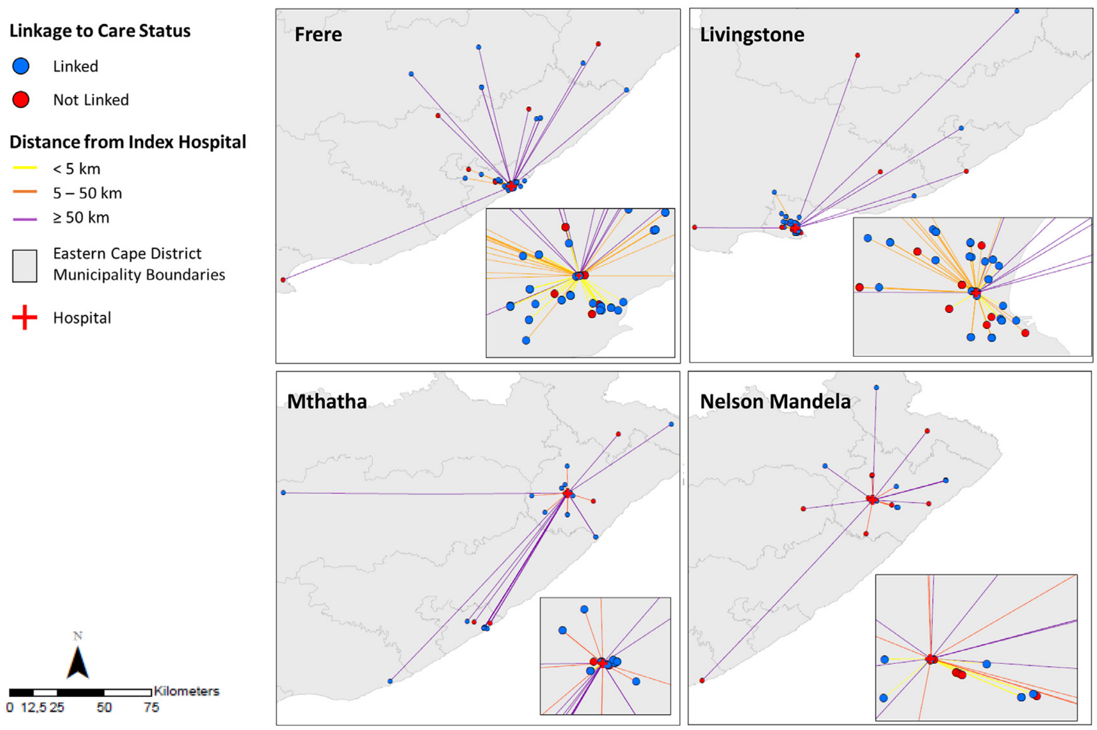

Fig. 2. GIS Mapping analysis of each hospital district by linkage to care status ($n = 454$).

Table 5
Demographic and clinical characteristics of patients affecting linking to care in an unadjusted ($n = 569$*) and fully adjusted ($n = 454$*) model.

	Unadjusted			Adjusted*		
	OR	95% CI	*p*-value	OR	95% CI	*p*-value
Age (years)-Sex						
Young males (18–30)	1·00	–	–	1·00	–	–
Older males (31+)	1·57	0·83–2·97	0·164	1·26	0·54–2·95	0·590
Young females (18–30)	1·92	1·00–3·70	0·049	1·05	0·44–2·54	0·899
Older females (31+)	1·84	0·99–3·42	0·054	1·16	0·50–2·69	0·728
Presenting Complaint						
Medical	1·00	–	–	1·00	–	–
Trauma	0·61	0·43–0·87	0·005	0·66	0·42–1·06	0·085
Visit time						
9am-5pm	1·00	–	–	1·00	–	–
Out of hours	0·82	0·59–1·15	0·246	0·90	0·58–1·39	0·624
HIV status						
Known-positive	1·00	–	–	1·00	–	–
New diagnosis	0·87	0·61–1·25	0·467	0·70	0·43–1·14	0·154
Distance*						
Less than 5 km	1·00	–	–	1·00	–	–
5–25 km	0·53	0·31–0·90	0·020	0·52	0·29–0·92	0·026
25–50 km	1·05	0·33–3·37	0·932	1·51	0·39–5·80	0·549
More than 50 km	1·01	0·60–1·70	0·960	0·62	0·34–1·15	0·131
Site						
Frere	1·00	–	–	1·00	–	–
Nelson Mandela	0·28	0·15–0·51	<0·001	0·33	0·15–0·73	0·006
Mthatha	4·37	2·59–7·38	<0·001	5·03	2·35–10·77	<0·001
Livingstone	1·37	0·89–2·09	0·148	1·53	0·91–2·59	0·111

* Distance data was only available for the 454 patients whose home clinic location could be found and mapped.

[Table 5]. In the site adjusted model, these trends became non-significant. Presenting at NMAH reduced the likelihood of linking to care (OR: 0·42; $p = 0·016$), whereas in Mthatha Hospital the likelihood increased (OR: 5·19; $p < 0·001$).

Discussion

Our study demonstrates that of the patients with whom were able to follow up more than 20% of HIV-positive ED patients do not link to care (234/983), this is true for both patients who have a known diagnosis of HIV when presenting for care in the ED and those with a new diagnosis of HIV in the ED. Though not statistically significant, this trend is further amplified in young male patients and trauma victims. Furthermore, ED patients presented from a wide catchment area with almost a quarter of patients receiving follow-up care at a distance greater than 50 km from the index ED site. These observations present the fundamental challenges and opportunities for improving the HIV care cascade in ED-based HIV-positive patients in the Eastern Cape and similar South African settings.

The ED not only has high prevalence of HIV but also poor linkage to care, providing both a challenge and opportunity to fill gaps in current HIV service programs. In particular, we provide further proof that young men are particularly vulnerable to attrition along the care cascade. A recent South African study shows that it takes an average of 4·9 years for 50% of all HIV sero converters to be linked to care but more than twice that for men [19]. Meeting men where and when they engage in health care may significantly reduce this time. Promisingly, we found that, of those linked to care, 62% were virally suppressed at one year. These results are in line with other US-based longitudinal ED estimates (where only 22% of ED-patients are virally suppressed and 39% in care) and the 2016 South African surveillance estimates where 41.7% were suppressed and 67.2% were on ART giving us promise of opportunity if successful [20,21]. The challenge however remains how to successfully link patients to care. As highlighted above, there are two distinct obstacles to overcome – the distance from the index testing site and the patient-level characteristics of ED patients. Our patients presented to the ED from a board geographical catchment, and this distance varied by study local and also impacted their likelihood to link to care. Also as is known ED patients have higher likelihoods of vulnerabilities as demonstrated by the high-volume of trauma victims and a disproportionate burden of sexually transmitted infections (STI), and tuberculosis (TB) [22,23].

More broadly, HIV-positive patients presenting to the ED exhibit significant heterogeneity, both geospatially and demographically, and thus differentiated approaches will likely be needed to improve LTC. For example, escort services improve linkage to care by supporting the client to proceed with the next step of their care in real-time without being distracted. While escort services have been used successfully as part of a multicomponent strategy to increase LTC in South Africa and can potentially be implemented in the ED, an alternative LTC strategy must be sought for the 50% of patients who live more than 5 km from their index ED site [23]. Theoretically, leveraging an electronic patient management system such a TIER.net© or LinkCARE© care to move past disease surveillance to active patient management by facilitating LTC on a national scale may represent another approach [24]. In the US, time-limited active case-management as demonstrated by the Antiretroviral Treatment Access Study (ARTAS) trial has shown encouraging success [25]. Same-day ART initiation is another strategy that has been shown to improve LTC for HIV-positive individuals, with the CASCADE trial in Lesotho demonstrating a nearly 20 percentage point increase in 90-day linkage to care rates, and sustained improvements in viral suppression rates (50% vs. 34% for standard of care) [26]. However, contradictory studies show that while same-day ART initiation is feasible it may contribute to increased loss-to-follow-up [27]. Implementing same-day ART initiation in the ED will require significant investments both at the health facility and health system levels. For example, while potentially challenging in a busy ED, establishment of dedicated infectious disease/HIV clinics within hospitals may work. However, a significant number of ED patients present for care out of hours when these clinics are likely to be closed and to date there is a paucity of demonstrating successful implementation of such an approach [28].

Lastly, it is important to note that a significant proportion of our HIV-positive patients that did not link to care presented with trauma-associated complaints. While this may in part be due to receiving less holistic care than medical patients, our previous studies have demonstrated that many of these patients were also under the influence of alcohol at the time of presentation and were victims of violent crimes, making them more vulnerable to attrition [10]. It is well documented that alcohol use is associated with suboptimal HIV treatment across the HIV care continuum [29]. Integrated strategies bundling interventions such as peer-navigation for substance abuse with LTC have not only successfully demonstrated gains in HIV service delivery but also risk modification [30,31]. Ultimately, it is clear that a differentiated approach is likely needed for different patient groups (i.e., men vs women, trauma vs medical patients, living near vs far). The ED provides unique opportunities for screening novel groups, but as such must find novel ways to link them to care.

This study has several strengths including the fact that it is one of the first studies to use GIS techniques to show the geospatial heterogeneity for LTC from an ED as an index testing center and highlights new opportunities for improving LTC from the ED, particularly for young males and trauma patients. However, this study has some important limitations and findings that should be interpreted with caution. Despite multiple attempts, more than 40% of the patients in the study were LTFU. While demographically these patients did not appear to differ significantly from those that we were able to track, we cannot rule out a selection bias in terms of those who were ultimately traced. Furthermore, a proportion of our known-positive patients (potentially at least 20%) may have already been engaged in care. Including these patients in our analysis may have biased upwards our linkage to care rate. In addition, there may be potential bias for those patients contacted telephonically, who may have better access to resources and thus more likely to link to care, compared to those that we were unable to contact. The proportion of patients reporting linkage to care who were contacted over the phone was significantly higher than those tracked over the NHLS database. Thus, our estimate of those patients linked to care may be inflated. However, of the 11% of patients who were reached both by phone and tracked via the NHLS, their phone responses were in accordance with their NHLS data which potentially adds some additional validity to the phone response data. Finally, with respect to the GIS analysis, the fact that the clinic location of more than 17% of patients in our final sample could not be located may have biased our results (the directionality of any bias stemming from this is harder to ascertain).

Significant effort and investment are required to overcome both patient-level factors and structural barriers within the health system to improve linkage to HIV care from EDs in the South African context. Given the heterogeneity of ED-patients, a differentiated approach will be needed to increase uptake of ART in this varied population. More broadly, we need to cultivate a deeper understanding of how down-referral from the ED to community-based HIV treatment centers can be better facilitated.

Declaration of Competing Interest

The authors have nothing to disclose.

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Author Contributions

BH, TQ, S Reynolds, A Redd, DS made substantial contributions to the conceptualization and design of the work; BH, A Rao, EH, S Ryan, DS, RM, PM, JB, NM, YN made substantial contributions to the acquisition of data; BH, AM, A Rao, LC, EH made substantial contributions to the analysis and interpretation of data for the work. All authors had full access to the data; contributed to the drafting of the work and/or revising it critically for important intellectual content; AND approved the final version to be published. All authors agree to be accountable for all aspects of the work and in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Study site leads are responsible for the consent data and PHI associated with the study, raw de-identified data was collected electronically and is kept centrally by BH.

Data Sharing Statement

Individual participant data that underlie the results reported in this article, after de-identification, will be made available with investigator support. Contact the corresponding author for access.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eclinm.2021.101091.

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